From Primary Commodity Dependence to Diversification and Growth: Absorptive Capacity and Technological Catch Up in Botswana and Mauritius

DOI:
10.26481/dis.20091015ah

From Primary Commodity Dependence to Diversification and Growth

Absorptive Capacity and Technological Catch Up in Botswana and Mauritius

ISBN 978-2-636-16930-0
Printed in The Netherlands
Cover design: Zuiderlicht b.v.
Prepared with SWP

From Primary Commodity Dependence to Diversification and Growth

Absorptive Capacity and Technological Catch Up in Botswana and Mauritius

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Universiteit Maastricht,
op gezag van de Rector Magnificus, Prof. Mr. G.P.M.F. Mols,
volgens het besluit van het College van Decanen,
in het openbaar te verdedigen op
donderdag 15 oktober 2009 om 12.00 uur

door

Alexis Habiyaremye
geboren te Kanombe

Promotor:

Prof. Dr. L.L.G. Soete

Co-promotors:

Prof. Dr. Louk de la Rive Box, Rector ISS

Dr. T.H.W. Ziesemer

Beoordelingscommissie:

Prof. Dr. B. Verspagen, voorzitter

Prof. Dr. C. Juma FRS, Harvard University, USA

Prof. Dr. P. Mohnen

This research was conducted with the financial support of UNU-MERIT

Labore atque iustitiā res publica crevit...

C. Sallustius Crispus, *De Coniuratione Catilinae*

This study and the effort deployed for its inception,pursuit and completion are dedicated to the late Rev.Fr.Pascal Nkurunziza of the Marist Brothers, former director of Musanze Science College,who,by the power of his example, inspired all those who attended his classes to work resulutely and to be pertinacious in their efforts.

Ongera uvuge y'uko Muzehe wacu ari mwizaaa, araboneyeee, araboneyeee!!!

Acknowledgement

Completing a PhD dissertation is in many cases like arriving at destination after a lengthy journey. Like in any other journey, what makes the road to the completion of a PhD dissertation interesting is not only the final destination but also the people one come across on his way; people who share some portions of this journey in whatever manner or capacity. Obviously, for diverse reasons, some people share longer chunks of the traject with the PhD candidate than others. In that respect I was fortunate from the moment I started this process, until this very moment as I am writing these lines, to walk and work in the shadow of a "dream team" of supervisors and promotors, consisting of Associate Professor Thomas Ziesemer, Professor Louk de la Rive Box and Professor Luc Soete,who have played a crucial role in making my research project come to fruition. Thanks to their prodigious generosity and unwavering support, my wish to engage in scientific research became an achievable goal, and thanks to their sagacious guidance, the undertaken research project resulted in this dissertation. They stayed on message and stuck with me by thick and thin, continuously providing me with all necessary tools for success. In addition to diligently bearing the academic responsibility of the research, they have been egregious guides on whom I could always rely, not only for all matters of the academic realm, but also for all kinds of matters of broader reaches of life. Their trust and benevolence towards me are a compelling reminder of the human dimension of academic research .They will remain an inexhaustible source of inspiration for me. I am honoured to have been their disciple.

I would also like to thank the assessment committee: Professor Bart Verspagen, chair of the committee, Professor Calestous Juma (Harvard University) and Professor Pierre Mohnen for committing their precious time to minutely reading the thesis and providing me with valuable comments and useful suggestions for improvement.

A large number of other people directly or indirectly contributed to the success of the undertaken project in their various capacities: the academic staff and the administrative staff of the institute, and people I met in conferences and seminars as well as during my field research. Among the current and former members of the administrative staff, without being exhaustive I would like to express my gratitude to Yvonne De Groot, the receptionist who always opened the door of the institute for me before I had a permanent security access card; our librarian Ad Notten, a wandering library cum catalogo,who has always been helpful, from the first day when I entered the then UNU-INTECH; Silvana de Sanctis for her gracious support on all kinds of administrative matters; Herman Pijpers for the many times he helped me solve any computer-related problems and inquiries; Eveline in de Braek for expediting the administrative procedure regarding the completion;Wilma Coenegrachts, the administrator of the institute, has been extremely helpful in diligently handling all matters related to funding the research. Marc Vleugels, the other administrator must be thanked among other things for organising together with Wilma a rescue operation to deliver me out of the claws of the Koninklijke Marechaussee. I also wish to thank Eric Engelen and Walter Jansen for their helpfulness on various occasions.

Although I spent most of my time commuting on my bicycles (I wore out more than one) between Oupeye and Maastricht,and had therefore less time to commit to socialising activities in town, the various interactions with my colleagues and fellow Ph.D researchers at MERIT has come to mean that they became more than just colleagues. They provided an atmosphere of positive exchange, impacting hereby positively on the research in such diverse aspects ranging from sharing their experiences to providing feedback on my research drafts, from technicalities such as econometric software commands or text formatting advices to discussions of matters of daily life: it would be next to impossible to separately acknowledge the precious help, encouragements, friendship and advice I received from each one of them in a few lines. I therefore express my gratitude by collectively adressing words of thank to Zakaria Babutsidze and Evans Mupela, with whom I successively shared office, to Semih Akcomak, Saurabh Arora, Theophile Azomahou, Ibrahim Bolat, Flavia Carvalho, Asel Doranova, Keskin Ekin, Nora Engel, Sabine Fuss, Karsten Gerlof, Yoseph Getachew, Kirsten Haaland, Tobias Kronenberg, Nantawan Noi Kwanjai, Kaushalesh Lal, Rodolfo Lauterbach, Bilal Mirza, Baseer Qasi, Iman Rajabzadeh, Fernando Rodriguez, Rossitza Rousseeva, Shuan SadreGhazi, Branka Urem, Daniel Vertesy and Ying Zhang.

My field research in Botswana was hugely facilitated by the gracious help I received from various local people on the sites I visited and in different departments where I gathered secondary data. In particular, I would like to thank Daniel Chitsulo, Leah Ogtakazi and Seema Boitumile for their precious help in the access and compilation of the data used in my research. My special thanks are also owed to Mrs Mien Vink of the Dutch General Consulate in Gaborone for her excellent consular assistance during my stay in Botswana (July-September 2006).

My personal friends, whose support of various kinds would be too long to list here, lest this part becomes an ode to friendship. I would however like to mention nominatim a few of them in a random order: Javan Ufitumukiza, Stefan Weishaar, Stefan Straetmans, Swayan Chaudhuri, Octavien Sebazungu, Geoffrey Gachino,Wladimir Raymond, Andreas Chai, Julia Sophie Woersdorfer, Jean Marie Muramutsa, Epaphrodite Rudodo, Alexander Bielowski, Judith Ihloff, Vincent Feltkamp, Anastase Shyirambere, Daniel Dalohoun, Ignace Rukeribuga, Rose Nyirambabazi and her sons Robert and Yvan Mugemanyi, as well as many others who supported my efforts and encouraged me to persevere on this path. Stefan Weishaar is particularly commendable for having graciously offered to proof-read the entire manuscript and provided me with suggestions to improve its legibility. Likewise I particularly thank Wladimir Raymond, without whose help this thesis would heave a completely different form and lay out. Thanks to his numerous econometric advices, tips and demonstrations of the Scientific Workplace software, the thesis layout was strongly enhanced. Special thanks also go to André Terlingen for his generous help on the cover design and to Faryda Hussein for her gracious help on the Dutch summary of this thesis. It goes without saying that I remain solely responsible for the views and ideas expressed in the dissertation, as well as for any remaining errors, omissions or misstatements.

Finally, there is of course my family, whose unconditional support has been the main driving force for the pursuit of this PhD research: my wife Marlou, who afforded me the freedom and resources necessary to engage on and pursue the path of research, and my sons, Romain and Victor, the pride of my life, whose cheerful faces constantly remind me the words of the poet who asserted that of all possible reasons for Ceasar's apotheosis, his most important merit was that of being the father of a heir greater than himself.

Alexis Habiyaremye

Maastricht, June 2009

Contents

List of Tables

List of Figures

Chapter 1

INTRODUCTION

Background

The evolution of human societies from the primitive civilisations to modern complex economies has always exerted an irresistible fascination on me since my junior college years when I came into touch with the study of the Egyptian, the Greek and the Roman civilisations. The years spent in high school have only reinforced my interest for science and technology and for the social transformations they can bring about. This admiration of the genius of the human spirit and the magnificent things it can achieve when it is set to research and creativity has been translated in a continued interest for research in the various dimensions of technical change after I graduated from Maastricht University.

My stay in South-East Asia between 1999 and 2000 as an exchange student at the National University of Singapore opened for me the welcome opportunity to visit some of the "Asian Miracle" countries while they were slowly recovering from the 1997 Asian financial crisis. The fulgurant transformation of these countries from agrarian economies to the status of industrialised nations left a lasting impression on my thinking over economic development. I used the opportunity offered by one of our class projects to take the economic development of the South Korea, Singapore and Taiwan under scrutiny, and I came to the realisation that, while starting from conditions similar to those of most African countries in the early 1960, Asian countries had been able to considerably reduce the technology gap separating them from advanced countries in only a few decades.

The remarkable economic and technological achievements of the "East Asian Miracle" countries have kept my attention ever since. The resilience with which they coped with the crisis induced me to wonder what other countries could learn from the East Asian experience in their way to development and bridging the technology gap. Was the tremendous economic and technological transformation an example that can be replicated in an African context? Was Africa's poor economic performance not the result of failing to adopt foreign technologies in the way Asian countries had done? What could African countries do to get out of the economic and social marsh in which entire communities live, since the remedies applied so far to the different crises had failed to bring any improvement in living standards of the population?

These interrogations and similar ones have been bouncing in my mind as I attempted to understand what made East Asia different and which lessons from the Asian experience could benefit Africa in its development efforts. On my journey to searching answers to these questions, fortune had brought me in contact with Dr. Thomas Ziesemer at Maastricht University, a "terribly good economist"[1] who was later to become my academic supervisor. This occurred when I took an economics elective related to technology in the theory of international trade offered by him. Although my study background was more in accounting and auditing, my keen interest for technical change and development enticed me to devote due attention to this course, in which I learned much about technology, technical progress and its role in trade flows and human development.

Thomas's ingenuity and incredible dedication to the field of technology, trade and development economics inspired me to undertake the current research project. In the course of this research, I came to be confronted with many complexities of the issue of technology adoption for technological and economic development, of which I present three examples here.

First, while the positive role foreign technology adoption plays in the process of economic development can hardly be contested, the realisation of benefits form the adoption of foreign technologies in backward countries depends on many factors including the interplay between their human skills and the nature of technologies that become available from advanced countries. This means that the supply of human skills influences the amount and degree of sophistication of technologies that can be

[1] As described by one of his colleagues at Maastricht University, Adriaan van Zon, who is also a tremendously good economist.

adopted and efficiently used, while the amount and sophistication of newly introduced technologies has in turn an impact on the demand for technical skills (Mayer, 2000).

Secondly, while the shortage of modern technologies in backward countries is widely blamed for holding down the level of productivity and per capita income, improved access to modern technology imports as a result of globalisation does not appear to have led to labour productivity increase or more demand for skilled labour in many low-income countries. As Mayer (2000) notes, this could imply that a greater supply of human capital with conventional inputs may have no effect on productivity, unless newer technologies are introduced. Therefore, improved access to modern technologies alone does not guaranty that low-income countries will reap the benefits in terms of productivity increase.

Moreover, the introduction of new technologies in backward countries is constrained by many barriers to technology adoption, including economic and trade policies, global intellectual property rights (IPR) regimes and natural trade barriers such as geographical distances that can considerably reduce technology acquisition when the transportation costs of capital goods which embody new technologies become prohibitively high. Countries' ability to import new technologies is usually also limited by the balance of payment constraints, so that export earnings become key to the acquisition of imported technologies.

For all these reasons, I chose to modestly approach the technology adoption issue from Amartya Sen's (1983) wise point of view who acknowledged the limits of traditional development economics in providing adequate answers to the technological development issue and proposed a new line of thinking in this discipline based on what people "*can or cannot do*". After admitting that traditional development economics insufficiently recognised that economic growth was no more than a means to some other objective, Sen proposed to tackle the development issue in terms of how *"the domination of circumstances and chance over individuals can be replaced by the domination of individuals over chances and circumstances"*(Sen, 1983: p. 754)[2]. This is a beautiful expression for the transition from Rostow's traditional stage of economic development characterised by fatalistic attitude, to the second, in which individuals and their societies learn to become master and actors of their destiny. This line of thinking pervades my approach and this dissertation can thus be seen as a plea for Africans to pro-actively engage in replacing the dependence on natural resources (or

[2] Amartya Sen, as quoted by Pakdaman, N. (1994). "The Story of Development Thinking", in: Salomon, J.J., F. Sagasti and C. Sachs-Jeantet (eds).The Uncertain Quest: Science, Technology and Development. UNU Press: p. 49.

what Simon Kuznets calls "selling the fortuitous gifts of nature to others") by mastering modern production techniques that enable them to take their destiny in their own hands. This often requires that complex things be explained with simple words, and has partly motivated the deliberate choice to use of relatively simple empirical techniques and the avoidance of "academic complexity" in this dissertation.

1.1 SSA Primary Commodity Dependence

1.1.1 Commodiry Dependence and Failure to Catch Up

The continuous capital and technological accumulation process in East Asia between the 1960s and 1990s has gone hand in hand with a spectacular, sustained economic growth, a reduction of the technology gap and an even impressive poverty reduction (Petri, 1993). Over the same period, Sub-Saharan Africa has been further falling behind the rest of the world, both in terms of technology acquisition and income. This widening of the technological gap has further exacerbated the technological challenge of the most impoverished continent, which powerlessly sees its population inextricably caught in poverty traps (Sachs et al., 2004). Africa's extreme poverty and its failure to catch up technologically with the advanced world have been a subject of continuous debates, especially among aid donors in developed countries and international financial institutions. Various reasons have been advanced to explain the causes of SSA's failure to catch-up with the rest of the world. They range from bad governance, civil wars, corruption and inadequate economic structures inherited from the colonial era. From the 1960s, when most SSA countries regained independence, the donor community has attempted to address these issues through its aid policies, but notwithstanding some laudable results, the success of the approaches taken so far has yet to materialise.More in particular, the decades of structural adjustment programs (SAP) have proved to be an outright failure and the 1980s have come to be known as the "lost decade" in SSA and Latin America (see Nyang'oro, 1992 or Stein, 1999). They saw the submersion of Africa in a marsh of exorbitant debts, whose servicing has become the most important cause of resource drain of the continent. Instead of helping to strengthen the fragile economies, the waves of privatisation and deregulation have increased income disparities and left many African economies more vulnerable to the risk of falling further behind. In his influential book, "The Bottom Billion", Paul Collier (2007) explains how the problems of the bottom billion people, most of which live in Africa, have been worsening and getting disquieting proportions.

But parallel to the difference between Asia's economic take off and Africa's stagnation, we also observe an astounding difference between the dramatic change in the export composition of Asian countries and the continued reliance on the export of raw materials and other primary commodities for most African countries.While developing countries in other regions of the world have gradually reduced their dependence on primary commodities during the last decades, SSA countries have hardly seen any change in their export composition. According to UNCTAD data, the proportion of export accounted for by primary commodities was falling only slightly from 95 to 90% in middle income countries between 1965 and 1987 (Wangwe, 1995), and is still above 90% in low income SSA countries (UNCTAD, 2004; 2005). In 1980, three quarters of developing countries' exports were primary commodities. By 2001, around 80% were manufactures (Collier and Dollar, 2001). Developing countries as a group are thus no longer dependent upon primary commodities. Africa has missed this transformation and did not seize the opportunity to expand its economy into the global market for manufactures. As a result, most African countries remain highly dependent upon exports of a few primary commodities. According to UNCTAD (2008), while the stereotyping of developing countries as exports of primary commodities and importers of manufactured products is no longer valid, this pattern remains typical for SSA: even the strong growth rates recorded in that year were largely due to higher income from primary commodities, mainly as a result of higher oil prices. Dependence on primary commodities like the failure to catch up can thus be widely seen as idiosyncratic to tropical Africa.

1.1.2 Primary Commodity Dependence and Resource Curse

An influential World Bank study (Collier, 2002) has highlighted the serious problems generated by such primary commodity dependence. It presents empirical evidence that links primary commodity dependence to three major problems. The most common problem is that of dealing with the volatility of world prices and avoiding the so-called "resource curse" when primary commodities are essentially natural resources. Uncertainty about the export price of key primary commodities has generally a negative impact on investment and production planning in developing countries and renders macroeconomic, fiscal and financial management more difficult. Partly as a result of the high volatility in commodity prices, commodity-dependent countries have generally lower long-term average growth rates than economies with diversified production structures and experience greater difficulties in reducing poverty (UNCTAD, 2008).

As for the resource curse (or paradox of plenty), it refers to a seemingly paradoxical phenomenon that countries abundantly endowed with natural resources tend to grow at a slower rate than countries without these resources. Explanations for this phenomenon include the “Dutch disease” (income volatility and the weakening of the economy’s competitiveness as a result of currency overvaluation generated by resource booms, that squeeze resources out of the manufacturing sector, depriving the economy of the benefits of learning effects), the crowding out of capital and human skills, underinvestment in human capital accumulation, government mismanagement of easy windfalls from the resources, and unproductive rent seeking. The resource curse and its various aspects are further elaborated in chapter 3 (section 3.2.4). Another negative effect directly related to the dependence on primary commodities is their low income elasticity of export demand, resulting in chronic deterioration of terms of trade of commodity-dependent countries (see e.g. Kaplinsky, 2005).

The second serious problem is the association of primary commodity dependence with various dimensions of poor governance as shown by growing empirical evidence. Some of the studies that analysed this phenomenon have even suggested that this association may be causal (Sachs and Warner, 1995; 1997; Auty, 1990; 2001; Hoff and Stiglitz, 2002; Isham et al., 2003)[3]. The third major problem is its association with the risk of civil wars. The gravity of this problem is illustrated by Collier and Hoeffler (2001), who found the risk of civil wars arising from dependence on primary commodity exports to be substantial.

This last relationship is particularly disquieting as civil wars have persistently been raging in many African countries during the last decades. Africa’s continued dependence upon primary commodities, in contrast to diversification observed in other developing regions, is thus central to its problem of civil wars, both directly, and indirectly through its connection to poor governance and poor growth performance. The recent eruption of violence in Eastern Congo, a region rich in coltan (=Colombo-Tantalite, a metallic ore from which tantalum is extrcted and used in the capacitors of laptop computer, digital cameras, video game consoles and mobile phones) is one of the most speaking examples of how resource abundance can indeed be a curse. The serious damages brought to the economy by civil wars have been recognised since

[3] Others, like Brunnschweiler and Bulte (2008) suggest that the causality goes in the reverse direction as the bad governance and political instabilitycan hamper the entrepreneurial effort and force those with the best human and financial resources to leave the country and seek better opportunities abroad, therebyweakening the economy and leaving it to depend on the exploitation of underground resources.

ancient times as testified by the following arguments developed by M. Tullius Cicero, when the insurrection of the eastern provinces instigated by King Mithridates of Pontus in 88 BC, was threatening to choke the Roman economy:

> "*Indeed, in most other things, the damage is incurred when the calamity comes; however, when it comes to (tax-) revenue, the loss is incurred not only at the advent of the evil itself, but the very fear of war brings calamity. Indeed, as the troops of the enemy are approaching, even if they do not make any irruption, the cattle in villages are abandoned in the pastures, the ploughs are deserted on the fields, and the merchant ships remain idle in the harbours. [...]. As a result, what has been gathered in so many years of efforts is lost because of one rumour of danger and one fear of war*" (Jonkers, 1951: p. 130).[4]

Indeed, as stressed by Kuznets (1966) or Lewis (1978), political stability, internal pacification and security are a prerequisite for economic development because they provide entrepreneurs with a stable relationship between their effort and the corresponding rewards. Without reasonable assurance of security and stability, no individuals will be willing to invest in future production and capital accumulation will be hampered. At the same time, as the best qualified members of the labour force will tend to seek better opportunities elsewhere, political instability generated by civil wars will lead to economic stagnation (Szirmai, 2005).

Finally, it is important to recall that the abundance of natural resources impedes economic diversification as it tends to concentrate investment in the resource-exploiting sector. This has also indirect effects on growth performance through the relationship between export diversification and economic performance. Indeed, empirical evidence linking export diversification to better growth performance has accumulated over the last decade, like in the above-mentioned examples: Al Marhubi (2000), Amin Gutierres de Piñeres and Ferrantino(2000), De Ferranti et al. (2002) and Herzer (2005).

1.1.3 Deteriorating Terms of Trade

In spite of these familiar problems associated with natural resources, last year's African Development Report 2007 has been given as theme "Managing Natural Re-

[4] From M.Tullii Ciceronis "De Imperio Cnaei Pompei sive pro Lege Manilia: Oratio ad Quirites, VI", in: Jonkers, E. (1951). Keur uit de werken van Cicero, tweede druk. E.J Brill, Leiden (author's own free translation of the original text).

sources for Sustainable Development". In his preface to the report, African Development Bank's president is convinced that African future prosperity rests on an adequate management of natural resources. Such considerations are mainly induced by China's growing need for African raw materials to fuel its own relentless growth and the economic prospects that such an increased demand represents for resource-rich SSA countries. However, even though the current resource boom and the expectations of further price increase may kindle the appetite for Chinese money, those who design trade and growth policies should keep in mind the hard lessons from the trade history. Indeed, the world trading system has often proved to be disadvantageous to countries whose main participation in the global trade has essentially been the export of raw materials and primary commodities, while importing finished products.

This disadvantage has been particularly visible since mid-1980s, when a substantial fall in the world prices of principal primary commodities and industrial raw materials led to a serious deterioration of the terms of trade of most SSA countries. For example, the simultaneous rise of manufactured imports and the decline in coffee prices has resulted in a fall of the purchasing power of coffee receipts (barter terms of trade) by 54% over the period 1964-2000, with some sub period of peak declines by 83% between 1977 and 2000 and a 25% decline between 1995 and 2000 for the coffee exporting countries (Kaplinsky, 2005: ch.6). The income loss from falling terms of trade of SSA countries constitutes undoubtedly the largest single mechanism through which real economic resources are transferred from poor to developed countries (Cummings, 1992; Khor, 2000).

In the 1990s, the general level of commodities price fell even more, leaving SSA and other commodity dependent countries with a permanent deterioration of terms of trade (Khor, 2000). Although primary commodity prices recovered somewhat in the early 2000s, the price of commodities important to SSA countries continued to fall. As an example, prices of copper, cotton, and sugar halved between 1995 and 2002 while coffee collapsed to a third of its 1995 price. A report of the secretariat of the United Nation Conference on Environment and Development (UNCED) in 1991 showed that for SSA, a 28% fall in terms of trade between 1980 and 1989 led to an income loss of USD 16 billion in 1989 alone. In the four years 1986-1989, Sub-Saharan Africa suffered USD 56 billion income loss or 15-16% of GDP in 1987-1989. Data from the UNCTAD reveal that this deterioration had still not been reversed in 2003.

Even in spite of the current boom in the demand for natural resources and industrial raw materials, as well as the soaring prices of crude oil and foodstuff driven by rapid growth in large Asian late developers, UNCTAD's data show that in real terms, the

2007 prices of all commodity groups with the exception of metals and minerals, as well as the average price of all internationally traded primary commodities remained below their levels of 1970s (UNCTAD, 2008: p. 22). Moreover, for most African countries in the current situation with soaring oil and food prices, rising commodity prices often mean higher income for one commodity type but also higher import cost for another type, because these countries are not only exporters of primary commodities but also importers (UNCTAD, 2008). This has results in a net 20% deterioration of terms of trade between 2001 and 2007 for countries which do not export oil and minerals (UNCTAD, 2008).

Furthermore, even for many mineral-rich African countries, the extensive privatisation and the subsequent foreign ownership of African mining have come to mean that most of the mining profits generated by the current boom in metal ores are remitted abroad. An illustrative example of that is Zambia, where the extremely lenient fiscal regime meant to attract foreign investment has given most of the copper mines ownership to foreign mining corporations (Breisinger and Thurlow, 2008). As a consequence, the inherent difficulties in taxing foreign mining companies resulted in more than 60% of the profits being remitted abroad , according to UNCTAD's estimates, and prevented many resource-rich governments from turning natural resources revenues into public investments as they have lost control of them (UNCTAD, 2008: p.29).

Despite the current positive trend in commodity prices that started in 2002, the terms of trade losses have thus not been reversed to their pre-deterioration levels. In their decline period since the 1970, their worsening has exacerbated the marginalisation of SSA, leading to a sharp decline of the already small SSA participation in world trade. Africa's marginalisation from the global economy is thus directly linked to the disquieting dependence on primary commodity exports of the SSA's economies in their trade relations. As an illustration of this lack of diversification, the Hirschman concentration index, which measures the relative importance of individual products in a country's export, was around 0.49 for SSA countries. This is relatively high compared to 0.15 for Asian middle-income countries and 0.11 for OECD countries during the 1990s and was still as high in 2001 (Ng and Yeats, 1996; African Development Bank, 2005). This primary commodity dependence exposes those economies to recurrent fluctuations of their export earnings and renders them more vulnerable to poverty traps. If we do not want to have history repeat itself, those who have the responsibility of crafting development policies in African countries have to take these lessons from trade history very seriously when considering the role of natural resources for long-term development.

Dependence on primary commodities is therefore highly problematic as it reinforces the trap-like characteristics of African poverty. The need to break out of this self reinforcing mechanism associated with it in many developing countries calls for imminent measures to initiate and expand economic diversification, especially in SSA countries where poverty traps seem to have most devastating consequences. One of the biggest development challenges facing SSA is thus to address this dependence by gradually engaging in economic diversification away from primary commodities, in contrast to the belief that Africa's future prosperity lies in ignoring what others do with its raw materials[5]. That ignorance is precisely what Friedrich List(1841) was denouncing as a source of weakness that in the long run leads to the relinquishment of all powers of production, freedom and independence into the hands of those who possess more production knowledge. The failure to recognise the depth of this message is suicidal because this production knowledge is the primary source of power to reach prosperity. In the words of List (1841: ch.4):

> *"Power is more important than wealth. And why? Simply because national power is a dynamic force by which new production resources are opened up, and because the forces of production are the tree on which wealth grows, and because the tree which bears the fruit is of greater value than the fruit itself* ".

1.1.4 Commodity Dependence and Weak Participation in World Economy

As a result of its continued dependence on the export of primary commodities and raw materials instead of finished products, Africa has remained mired in poverty while a handful of countries in East Asia have managed to close the income gap and converge towards industrialised countries' productivity levels. African countries have thus not benefited from the tremendous expansion of world economy and increased productivity of the post-WWII period in various parts of the world because these productivity

[5] The problem of primary commodity dependence is also sometimes referred to as the "cocoa-chocolate problem" to reflect its simplifying illustration by the example of cocoa farmers who produce and sell the cocoa beans for export instead of using them to produce chocolate, but must subsequently pay a high price to consume imported chocolate, because they do not know how to produce it themselves

gains occurred primarily in the manufacturing sector, while African exports have remained heavily dominated by natural resources and other primary products. During this period, many SSA economies have been performing poorly for many decades without significantly affecting the good performance of other world regions. SSA seems therefore to be almost disconnected from the global economy when it comes to growth (see for example Collier, 1995). Even its insignificant share in world trade has been declining since the mid-1960s. While African trade constituted between 4.1 and 4.9 of world trade in the period 1960-1965, its value had declined to 2.3% of world trade in 1987 (UNCTAD, 1993). Africa's exports went similarly from 4.7% to 2.0% of world exports between 1975 and 1990. All of this happened while the world exports were growing at 2.5 percent per annum (UNCTAD, 1993, 2005).

The decline was even worse for the least developed countries in SSA with their share of 0.6% declining to 0.2% over the same period (Wangwe, 1995). This drastic decrease of the SSA's presence in world trade was not only a result of the deterioration of the terms of trades (due to low income elasticity of demand) in primary commodities, on which Africa is mainly dependant, but also of the loss of competitiveness in manufactures (Kaplinsky, 2005, ch.6). SSA's manufactured exports, which are a tiny fraction even when compared only to other developing countries, showed an equally steep decrease. Their share went from 5.2% of developing countries exports in 1975 to 2.5% in 1990 and has not improved much since then. The share of Africa as a whole in world exports has declined from 7.3% in 1948 to a low 1.5% in 2001 (African Development Bank, 2005). This is another illustration of how SSA has increasingly been marginalised in the world economy., they developed in their own particular circumstances and a majority of other developing countries continue to live on income levels 40 times lower than those of advanced nations because development experience is context dependent rather than a fixed recipe that can be easily replicated. In that respect, Sub-Saharan Africa (SSA) remains the region most lagging behind by any measure of development and economic performance.

Despite the increasing trend of global trade and cross-border capital flows (believed by many to spread the benefits of world economic integration and facilitate technology transfer), Sub-Saharan Africa seems to have remained marginalised from the world economy, or at least from the benefits suggested by globalisation. Its share of world trade and cross-border investment has remained extremely low and displays no increasing dynamics. Attempts to restructure African economies through liberalisation policies during the so-called Structural Adjustment Programs (SAP) have left many of the continent's economies worse off, while the declining terms of trade of their export products have not shown significant signs of recovery (Stein, 1999; UNCTAD, 2004). In addition, most of Sub-Saharan African economies depend only on the export of a handful of primary commodities in their trade relationships and the continued low productivity in the corresponding sectors has been at the basis of a general failure to catch up technologically with other developing countries, let alone with advanced countries. Instead of narrowing, the income and productivity gap separating SSA from advanced countries continues to show a widening trend.

1.1.5 Commodity Dependence and Prevalence of Poverty in SSA

By whatever measure of poverty one can think of, Sub-Saharan Africa remains thus the most impoverished region in the world and runs the risk of falling further behind. Table 1.1 compares the prevalence of poverty in SSA to those of the rest of the developing world. As it clearly resorts from the numbers, while the proportion of people living in absolute poverty was decreasing in the rest of the developing world, it remained not only the highest, but also still on the rise in SSA between 1990 and 2001, where almost half of the population lives on less than $1 a day and a third of the population suffers undernourishment.

In addition to the direct and afflicting effects that it exerts on the SSA population, poverty in Africa goes often hand in hand with unequal income distribution and has therefore adverse effects on the growth potential of these economies. Indeed, some of the scholars who analysed the impact of income inequality on growth performance such as Persson and Tabellini (1994) found a strong evidence of a negative correlation between inequality and growth and suggested that inequality is harmful to growth. Although far from conclusive[6], economic debates related to the issue of reverse causality between growth and poverty tend to point thus to negative effects of income inequality on economic growth[7]. Through its adverse effects of unequal income distribution, poverty is thus likely to impede growth and therefore attract more poverty in a vicious circle.

While poverty reduction is difficult to imagine in a country where no economic growth is taking place, breaking the vicious circle requires measures that lead to less inequality and can thus have positive effects on economic growth. These mea-

[6] See for example James K. Galbraith's (2007) discussion in his paper "Global Inequality and Global Macroeconomics".

[7] The "Kuznets curve" displays an inverted U-shaped relationship between growth and inequality, in which inequality first increases with growth and then flattens before becoming negatively correlated with growth.

TABLE 1.1. Prevalence of poverty in developing countries by region

	People living on less than $1 a day			
Region	Millions		Percentage	
	1990	2001	1990	2001
East Asia and the Pacific	472	248	29.6	15.6
China	377	212	33.0	16.6
Europe and Central Asia	2	18	0.5	3.7
Latin America and the Caribbean	49	50	11.3	9.5
Middle East and North Africa	6	7	1.6	2.4
South Asia	462	428	40.1	31.1
Sub Saharan Africa	227	314	44.6	46.5
Total	1291	1101	27.9	21.3

Source: World Bank data

sures include empowering the poor to produce and market more output from their scarce resources through the application of knowledge and creating conditions that allow them to sustain and improve their livelihoods: in other words, empowering the poor to help themselves. The challenge of poverty reduction in Sub-Saharan Africa through conventional means has thus only increased in dimensions. Initiatives by the United Nations to address these challenges worldwide through the so-called Millennium Development Goals (MDG) have received much publicity, but various specialists continue to question the effectiveness of MDG implementation and to wonder whether their targets will be achieved more successfully than the stated objectives of previous bilateral and multilateral development aid initiatives.

For instance, Addison, Mavrotas and McGillivray (2003) estimate that the principal MDG target - reducing the proportion of people living in extreme poverty to half the 1990 level by 2015 - on current trends, will not be achieved in sub-Saharan Africa. According to them, even seemingly optimistic forecasts suggest the MDG income poverty target will not be achieved in sub-Saharan Africa until 2147, some 132 years later than the targeted 2015. They see prospects for the achievement of other MDG targets in sub-Saharan Africa by 2015 as being just as dismal. Cutting child mortality by two-thirds and achieving universal primary education, for example, will not be achieved until 2165 and 2129, respectively, according to recent forecasts (UNDP, 2003). Disentangling the SSA poverty trap will therefore remain a challenge for many years to come, as illustrated by Enos' estimations (Enos, 1995).

1.2 Research Questions

One of the most recurrent issues in economic debates is explaining growth and income differences between economies. Dani Rodrik (2003) considers the spectacular gap in income that separates the world's and poor nations to be the central economic fact of our time. Income and wealth distribution around the world has shown large and persistent disparities that are still only partially explained by existing economic theories.The idea that SSA can achieve long-term development through an appropriate and sustainable management of its natural resources is undoubtedly rooted in the theories of (static) comparative advantage that have shaped our thinking over trade for many decades. According to these theories based on the initial ideas of classical economists, the source of comparative advantage is the relative factor endowment. The introduction of free trade trade will thus lead to a specialisation process in which each country eventually specialises in the production of the goods that utilise more intensively its relatively abundant factor (Heckscher-Ohlin Theorem). This explains why many economists and some African policymakers see SSA as bound to a comparative advantage in the export of primary commodities, since natural resources form its most abundant endowment (beside unskilled labour).

However, as illustrated above, the perennial dependence on primary commodities in the export structure of developing countries poses serious developmental challenges, as it often tends to be self- reinforcing. List (1842) had already discussed at length and illustrated with historical examples how the countries that lost productive power and were reduced to mere exploitation and export of primary produce and rwa materials quickly witnessed the decline of their economic prosperity. Kuznets (1971) notes that even though some countries can provide increasingly large income rents to their populations because they happen to possess a resource exploitable by more developed nations, what is more important for long-run growth is deriving abundance by using advanced contemporary technology, "*not by selling fortuitous gifts of nature to others*"[8]. According to Kuznets (1971), the capacity to advance technology and the institutional and ideological adjustments that it demands is the permissive source of economic growth, though only a potential, a necessary condition, in itself not sufficient.

Indeed, advancing technology enables countries to provide an increasingly large and diverse number of goods and services to their citizens, which is the essence of economic growth according to Kuznets (1971). Even though diversification can't be expected

[8] Simon Kuznets, 1971 Nobel Prize Lecture

to become a panacea for SSA poverty, the accumulated empirical evidence linking export diversification to better growth performance puts it in a prime position in the search for structural solutions. For example, Al Marhubi (2000) found a significantly positive correlation between the number of export sectors and the rate of growth in per capita income in a cross sectional regression. Similarly, Amin Gutierres de Piñeres and Ferrantino (2000) and De Ferranti et al. (2002) also found a positive association between the degree of export diversification and the subsequent growth across countries.

Herzer (2005) tested this diversification-led growth hypothesis on the case of Chile and found increasing horizontal export diversification to have positive effects on domestic production. He attributes this better growth performance to learning-by-exporting effects. In addition to learning-by-exporting effects and learning-by-doing externalities, he explains that the better growth performance observed as a result of export diversification can partly be attributed to the reduction of growth impeding instability of export revenue in the primary sector.

A corollary of this association between export diversification and better growth performance is that solving the problem of primary commodity dependence by laying the structural foundations for diversification is desirable on multiple grounds. The Verdoorn effects due to export specialisation mean that for a given country, an expansion of the manufacturing export sector may cause specialisation in the production of export products, which may increase the productivity and skills level in that sector. This may then lead to a reallocation of resources from the relatively less efficient traditional sector to the more productive export sector. This productivity change may in turn lead to output growth.

Considering the multitude of problems linked to primary commodities dependence in many SSA countries and the potential growth benefits of export diversification, it is pertinent to ask **to what extent primary commodity dependence in SSA countries explains their failure to catch up technologicallywith advanced economies,** to investigate **whether economic diversification is possible in SSA countries**, to examine the mechanisms **through which the diversification could take place** and to analyse **factors that are critical to its success**. Further, it is appropriate to explore whether the diversification and technological catch-up experience of other developing countries, namely the East Asian fast growing economies, **can provide useful lessons to SSA that can help it reduce its primary commodity dependence**. More specifically, this thesis aims to examines to what extent the **economic performance of the two most successful SSA economies,**

Botswana and Mauritius, can be traced to diversification or sectoral shift strategies, and how their experiences can be emulated by other SSA countries.

1.3 Hypotheses

From these considerations above, we can state that for countries dependent on "*selling the fortuitous gifts of nature to the others*"-to use Kuznets' words-, long-run growth depends essentially on their capacity to enlarge their productive base by adopting technologies used in advanced countries and successfully applying them in domestic productive activities. The role of technology in determining the long-run productivity has been a subject of many theoretical and empirical analyses. In the related debates, the various research avenues have increasingly identified technological advance as the principal determinant of long-term growth performance of economic entities, be they firms or nations.

Both standard neoclassical growth theory and the more recent endogenous and evolutionary growth theories pointed to technological differences across nations as being the primary explanation of long-term growth differences as well as of wealth and income inequality around the world (Solow, 1957; Romer, 1990; Aghion and Howitt, 1992). Trade and catch-up theories also see technology as the essential determinant of long-run productivity growth across nations. For these reasons, catch-up theories have aimed to analyse how technology flows from technologically advanced to technological backward countries and determines convergence in income levels and productivity. The recognition of the importance of technological advance as the engine of long-term growth is thus widely shared among various economic schools of thought.

However, various growth and trade theories diverge in their explanations of the generation and diffusion of technology and have not been of much help to developing countries in quest of foreign technology. Neoclassical theory considers technology as both universally available and applicable, and explains technological differences as variations in the endowments of production factors and infrastructure (Stokke, 2004). In contrast, endogenous growth theories consider that technology differences and the limited capability of developing countries to absorb new knowledge are the main reasons for persistent low productivity, and therefore for poverty (Lucas, 1988). But none of these theories gives sufficient guidance as to why a considerable number of least developed countries (LDC) fail to adopt even relatively less advanced technologies, or what they could do in order to access them.

Since technological advance is recognised as the main driving force behind long-term economic growth, technology adoption and utilisation in developing countries is still largely considered as the key to poverty reduction for obvious reasons. Indeed, since the 1950s and 1960s, it was widely believed that rapid economic growth and industrialisation in developing countries would automatically remove poverty through a "trickle down" effect on the poor and the underprivileged (Bhalla, 1994). However, the development of modern production technologies takes place mainly through deliberate research and development (R&D) and is a costly process that often requires large financial outlays. Since most of world R&D activities and technological innovations are highly concentrated in a small number of industrialised countries, most of developing countries are dependent on technological knowledge developed outside their borders (Mazumdar 1999). To understand diversification in SSA countries, we must therefore explore and analyse the adequacy of their capacity to catalyse the adoption of foreign technologies and effect their further diffusion and dissemination throughout their economies.

Consequently, African countries, like other developing nations confronted with slow economic growth, have placed high expectations in the acquisition of technology as a means to increase their productive capabilities and to catch-up with advanced countries. However, the growth maximisation strategies pursued in many developing countries under the influence of this thinking did not lead to any substantial trickle down to make any impact on the unemployment and poverty problem. In some cases, especially in Africa, empirical evidence generated during the 1970s showed that there was even an absolute decline of the standards of living of the lower income groups (see e.g. Bhalla, 1994).

Diversifying the economy to reduce dependence on primary commodities, however desirable it might be, is thus a highly demanding task: it requires active technological learning that enables commodity dependent countries to adopt and successfully apply other production technologies previously unknown to them. For most developing countries, the success of such technological learning depends essentially on the ability of their economic units to acquire, internalise and utilise knowledge developed abroad and potentially made available to them (Narula, 2004). This ability, known as "*absorptive capacity*" is a necessary condition for developing countries to effectively exploit external sources of knowledge and generate own innovations.

This concept of absorptive capacity pioneered by Cohen and Levinthal (1989) finds its origin in the notion of "*social capability*" coined by Abramovitz (1986) to refer to skills and technical competences as well as institutions and markets capable of mobilizing resources on large scale. Narula (2004) related it to the notion of technological capabilities and identified its four main components, each of which is measurable by many indicators of *basic and advanced infrastructure* to provide public amenities, train human skills and produce energy, *firms* to internalise new knowledge, and *institutions* to provide the operating framework and determine the *incentives* for the adoption and creation of new technologies. In order to understand the factors underlying diversification, we must therefore analyse its relation to absorptive capacity, technology transmission and growth.

The growth literature contains many theoretical arguments and ample empirical evidence linking various aspects of absorptive capacity to growth performance. For example, De Long and Summers (1991; 1992), Temple and Voth (1998), Eaton and Kortum (2001) and similar studies have underscored the role of physical investment and the importation of capital goods in fostering economic performance. Likewise, Aschauer (1989), Easterly and Rebelo (1993) and Fedderke and Bogetic (2006), among others, analysed the role of public infrastructure on growth and found infrastructure to foster economic performance by acting as an additional production factor or facilitating investments by lowering transaction costs. As for human capital, Psachalopoulos (1985), Azariadis and Drazen (1990), Hanushek (1995), Borensztein et al. (1998), Benhabib and Spiegel (2002) and Grier (2004) provide arguments and evidence stressing the importance of sufficient levels of human capital for better growth through the adoption and utilisation of more productive technologies.

Next to that, there are studies conducted by some of the leading contemporary economists such as Sachs and Warner (1997) and Collier (2002), shedding light on the negative role played by the reliance on natural resources in the bad economic performance of some developing countries. A structured representation of these various arguments and findings as on figure 1.1 allows the visualisation of the building blocs for the formulation of the main argument of this thesis.

On the other side, there is also considerable empirical evidence linking export diversification to economic growth through learning-by-exporting-effects (e.g. Al Marhoubi, 2000; De Ferranti, 2002; Herzer, 2005). Moreover, in his acceptance lecture of the 1971 Nobel Prize, Kuznets explains that countries' economic growth is essentially about the rise in their capacity to provide an increasing number of diverse economic goods and services to their citizens through the application of modern technologies. This view is also apparent in Romer's (1990) model of endogenous technical change based on the "love of variety" idea.

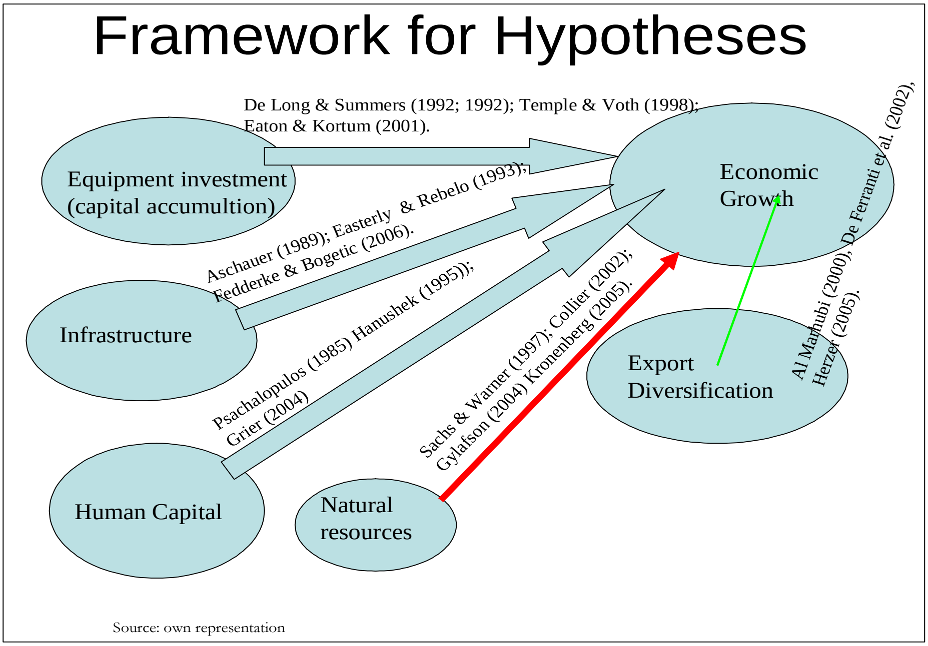


FIGURE 1.1. *Factors affecting growth in various theoretical and empirical studies*

For developing countries, the classical development economics literature posits a strong relationship between changes in the sectoral composition of an economy and its rate of growth. The intersectoral reallocation of labour from low- to high-productivity activities is seen as central to increases in overall productivity in developing countries. Specifically, industrialisation and the growth of manufacturing is the engine of technical change and economic growth[9]. This differs from developed countries setting, where technological innovation, rather than changes in the sectoral composition of the economy, is most important for raising aggregate productivity. Further, as argued by Tregenna (2007), in the absence of sufficient dynamism, neither technological progress nor productivity-enhancing structural changes in the economy are likely to reduce unemployment.

[9]We acknowledge, however, that a mere reallocation of resources from the agriculture to the industry cannot work without technical change in the agricultural sector itself.Indeed technical change in agriculture is needed to generate and free the necessary labour, food and financial resources for the industry as expressed in the viability condition of the industrial sector in the theories of dualism, such as the Jorgenson(1961) model. An excellent discussion of the dualism modelsand the viability conditions is provided by Ziesemer (1987).

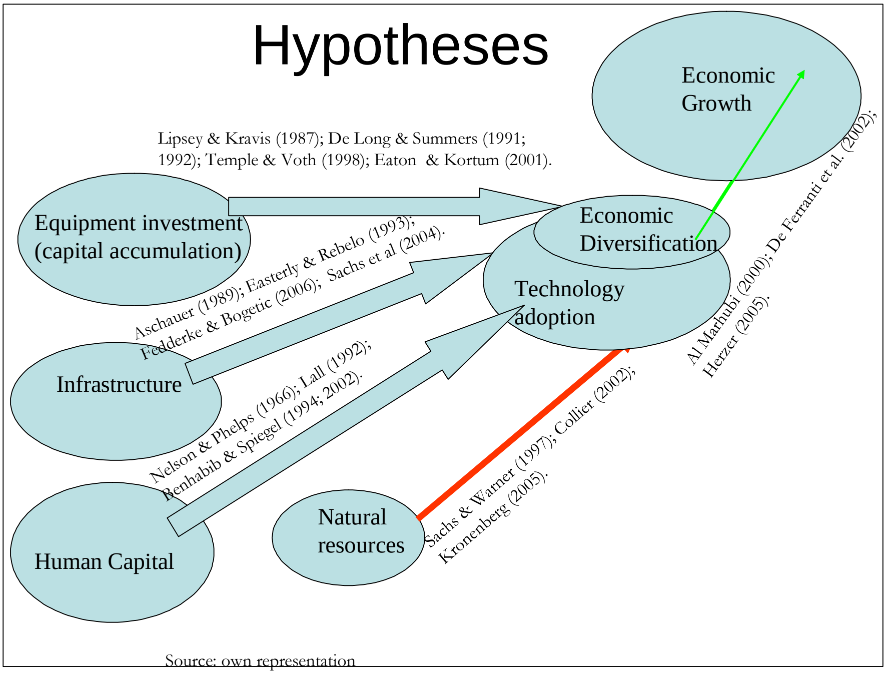


FIGURE 1.2. *Growth channels of Diversification*

In our view, the results of Al Marhoubi (2000), De Ferranti (2002) and Herzer (2005) are an extension of Kuznets' (1971) and Romer's (1990) argument that growth is essentially about the capacity to diversify production through the application of various technologies. This thesis combines these results of the two sides, as presented above, with Kuznets' definition of growth and argues that the role of the various components of absorptive capacity in explaining growth is essentially to catalyse technology adoption and economic diversification by fostering technological learning and industrialisation, which in turn affects growth performance (Figure 1.2).

In line with Kuznets (1971) and Romer (1990), we also argue that the primary mechanism through which the acquisition of foreign technologies contributes to productivity growth in developing countries is by widening the range of productive activities, especially by spurring new activities that can increase the diversity of production and export. Indeed, since different individuals in an economy are usually endowed with different talents, diversification of economic activities creates opportunities for various talents to fully express their creative and productive potential. Even for individuals with multiple, universally recognised talents, it would be very difficult to perform well in a society if for example farming, herding or lion hunting were the only benchmarks for achievement: diversification therefore enables the economy to optimize the utilisation of most of its available human and physical resources. For primary commodity-dependent countries, diversification means in the first place acquiring *sufficient levels of human and physical capital as well as adequate technological knowledge and industrial infrastructure* to support the processing of primary commodities or the initiation and expansion of other manufacturing activities (Lall,1992a; Benhabib and Spiegel, 2002; Collier, 2002).

The processing of primary commodities enables countries to add value to their abundant resources. The value added to primary commodities by processing can be considerable and even exceed the original intrinsic value of the resources themselves (see e.g. P. Ovidius Naso's Metamorphoseon[10] or John Dryden's translation of the Aeneid[11]). Moreover, manufacturing is typically considered to have more externalities than the primary sector. By his repeated arguments in his famous "Das Nationale System der Politischen Ökonomie", and its many illustrative examples, Friedrich List (1941) is incontestably one of the strongest advocates of manufacturing as a source of productive power and long-run prosperity. According to him, in manufacturing economy, science, technology and arts are better applied but also generated, the various mental and bodily talents of the individual can better express themselves so that even the work of the cripple and the weak can be more valuable than the labour of the strongest man in purely phyical activities like in agriculture and exploitation of natural resources. The heterodox literature like that of the broad Kaldorian tradition has also seen the manufacturing sector as being imbued with 'special characteristics' that are not shared by the other sectors. As set out in Tregenna (2007), the special characteristics typically attributed to the manufacturing sector include:

- The idea that manufacturing growth 'pulls along' economic growth in ways that growth in other sectors of the economy does not.
- The learning curve effects and dynamic economies of scale in manufacturing imply that the higher the growth in manufacturing output, the higher will be the growth of productivity in manufacturing and in the overall economy. This is also related to the notion that 'learning-by- doing' is more important in industry than in agriculture or services. Learning-by-doing, innovation, and intersectoral linkages thus render overall productivity growth endogenous to growth in dynamic manufacturing

[10] P.Ovidii Nasonis Metamorphoseon, Book II, 5-6: "Materiam superabat opus: nam Mulciber illic aequora caelarat... "

[11] Virgil, The Aeneid, Book I, 905: (The gold itself inferior to the cost of curious work). Wordsworth Editions Ltd. 1997: Wordsworth Classics of World Literature

sectors. This typically means that expanding the manufacturing sector would raise manufacturing and non-manufacturing productivity.

- The argument that most technological change occurs in the manufacturing sector. Furthermore, technological change that takes place in the rest of the economy tends to be diffused out from the manufacturing sector by cumulative causation, in part through the use of higher productivity inputs from manufacturing in the production process of the rest of the economy.

This has led to a special place being accorded to the manufacturing sector in the growth process, and policy suggestions of the need to put particular focus on this sector in the development process (Tregenna, 2007).

Expanding production into manufacturing is thus an effective first step, if successful, to build technological capabilities needed for diversification. Expanding into large scale manufacturing activities is essential for the acquisition of skills necessary to manage technology and complex businesses. Indeed, as Meier and Rauch (2000) express it, achievement of high per capita income without accumulation of modern infrastructure and investment in plant and equipment seems virtually impossible, save for a few countries endowed with enormous mineral wealth or oil.

Developing countries seeking to diversify their export structure must thus possess the ability to make effective use of technological knowledge in production, engineering, and innovation in order to create and sustain some level of competitiveness in the global economy. In the absence of such capabilities and the necessary investment resources, developing countries may remain confined in low growth equilibrium, if they fail to pay the set up costs needed to bring a more productive technology into use (Barro and Sala-i-Martin, 2003).

1.4 Study Objectives

On the basis of the results of these various studies relating some components of absorptive capacity to growth, we have argued that their positive effects on growth performance go essentially through the acquisition of technology and competences that enable the expansion and diversification of productive activities. For primary commodity dependent SSA countries, this means *in concreto* harnessing foreign technologies to generate growth from other sectors of production, namely by engaging in manufacturing. Recognising the central role played by technology adoption and dissemination in any development process, we therefore endeavour to analyse how absorptive capacity as a subset of technological capabilities catalyses technology adoption, innovation and economic diversification to reduce primary commodity dependence.

The pivotal role played by absorptive capacity in bridging the technology divide that separates commodity dependent from advanced countries forms the leitmotiv of our inquiry into the factors and conditions affecting the adoption, application and adaptation of foreign technologies. This thesis proposes an empirical model to test the simultaneous effects of selected indicators of absorptive capacity on technology adoption and economic diversification in a general context and in a SSA setting. The insights from the growth theories and the trade literature and their implications for trade and industrial strategies in the acquisition and diffusion of new technologies will form the analytical background in our study.

In order to get more detailed insights in the diversification-led growth effects, we also aim to map absorptive capacity and relate the diversification and growth experiences of two African countries to their capacity indicators: diamond dependent Botswana and textile newcomer Mauritius. These two countries are particularly suited to this analysis because of their unique economic position in SSA. They also enjoy the additional advantage of relatively efficient statistics services, so that secondary data could be gathered without much difficulty. In Africa's disappointing economic performance, Botswana and Mauritius have evolved as poles of stable growth that allowed them to become two success stories in building adequate absorptive capacity and laying the foundations of diversification-led growth strategy. Both countries have exceptional experiences of macro-economic and institutional stability, and constitute thus a suitable field to analyse the practical transferability of East Asian capability building lessons to Africa.

Botswana, whose growth rate compared favourably to that of the "East Asian Miracle" countries praised in the World Bank Report (1993), remains nonetheless dominated by diamond exports, while the East Asian countries have built more diversified economies that are less vulnerable to adverse shocks in the primary sector. For Botswana, the sectoral analysis will examine the role played by the embodied technology import in the acquisition and expansion of the manufacturing industrial sector. It will also cover the recent initiatives to expand the diamond sector into high value-added activities as well as the move towards stimulating technological upgrading and expansion in other sectors.

Mauritius' exports are also still largely dominated by sugar and textiles, but Mauritius' resilience to the phasing out of the Multi Fibre Arrangement (MFA) shows that the country has the potential to generate growth in other sectors. For Mauritius, the study will analyse the transition from sugar cane dependence to the rise of a competitive edge in the textile and apparel industry. It will also take a close look on the sectoral development impact of the MFA expiry and its sectoral shift effects, namely the emergence of Information and Communication Technology (ICT) and offshore financial services. From the experience of these two countries, we will examine the critical mass effects of absorptive capacity components and draw lessons and policy implications for the transferability of technology adoption experience to other Sub-Saharan African countries.

1.5 Approach

In order to analyse the problem of primary commodity dependence, we will make use of insights from three main strands of literature: growth, trade and catch-up theories, which are reviewed in chapter 2. First, the growth literature is scrutinised in an attempt to find explanations for the persistent bad growth performance of many of SSA countries and the role technology plays in it. Growth theories are indeed useful for understanding the role of innovation and technology generation in sustaining competitiveness and log-run productivity. Second, trade theories, especially in their technology related aspects, are used to diagnose and find the roots of the primary commodity dependence in the SSA countries. Indeed, trade theories of comparative advantage contain some useful explanations for the reasons why some countries specialise in given products. This literature has thus the potency to help us understand why SSA exports are dominated by natural resources and other primary commodities. Trade theories also explain how technological knowledge needed for reducing primary commodity dependence is transmitted between trading countries.

Lastly, the catch-up literature provides interesting insights in the dynamics of technology gap between advanced and backward countries and sheds light on the mechanisms through which technologies are transmitted across countries and on the factors fostering or impeding such a transmission. This literature is thus crucial for understanding the factors that have impeded SSA countries from tapping the immense reserves of available technologies in order to converge to higher productivity levels. Through its notions of "social capabilities"(Abramovitz, 1986) and "optimal gap"(Baumol, 1989), this last strand of literature calls as an extension the national innovation systems (NIS) literature to the fore with its various linkages, knowledge and skills deployed in interacting institutions. The NIS approach (Freeman, 1987; Lundvall 1992; Nelson 1993, Edquist 1997) is a systemic perspective on technology adoption and innovation, based on the notion of non-linear and multidisciplinary innovation processes, where interactions and learning are at the centre of interest. The most crucial new insight brought in by the use of NIS as a framework is the realisation that linear approaches to technology will not be sufficient to bring a developing nation to a technological track (Lall, 1992a; Feinson, 2003). In this thesis, we will focus on the developing country variant of NIS, namely the Systems of Innovation for Development (SID) as an approach to catch-up and diversification strategies. Premised on the more limited innovation capabilities in developing countries, the SID approach emphasise learning and capability building as a precondition for catch up by acquiring and adopting technologies in developing countries before being able to develop own innovations.

After diagnosing SSA dependence on primary commodities, the next step is to examine the quantitative and qualitative aspects of the relationship between components of absorptive capacity and the corresponding level of diversification. To that end, we develop an econometric framework to quantitatively estimate and analyse the effects of the different indicators of absorptive capacity on the evolution of diversification and the reduction of primary commodity dependence. This framework links the findings of Azariadis and Drazen (1990), Borensztein et al.(1998), and Benhabib and Spiegel (2002), whose results confirm a positive relationship between human capital stocks above threshold levels (critical mass) and technological learning and diffusion, to those of Herzer (2005) who found an empirical association between export diversification and growth performance through learning. Using this framework, this study to proposes an econometric model structured on the basis of a production function to reflect the simultaneity and interactive nature of various absorptive capacity indicators.

This model will empirically test the effects of selected indicators of absorptive capacity on technology adoption and economic diversification in a general context, in a developing country context and finally in a SSA context, using export diversification data from Comtrade and UNCTAD's datafiles, from World Development Indicators (WDI), World Factbook and Barro and Lee (2001) data on the major indicators of absorptive capacity, namely human capital stocks, basic and technological infrastructure and physical capital investment (see also Lall, 1992a). This study models the threshold effects and enables to estimate them for each of the components of absorptive capacity separately.

After sketching the general framework for understanding the relationship between absorptive capacity and export diversification in chapter 3, this econometric framework is subsequently used as a general contextual reference to empirically analyse the evolution of absorptive capacity and the corresponding technology adoption paths in two historical case studies of the chapters 4 and 5: the diamond-dependent Botswana and the once sugar-cane dependent, now relatively diversified Mauritius. This study analyses in more details these two most successful SSA countries in terms of economic performance, starting with Botswana to examine how its acquisition of foreign capital goods affect manufacturing skills accumulation (chapter 4) and then analysing the role played by foreign demand for Mauritius export products in its ability to upgrade its productive technologies (chapter 5).

Within this framework, we will again make use of insights from growth trade and technology diffusion literature to examine the role of trade policy in facilitating the acquisition and use of foreign techniques for long term growth objectives. The case studies will also focus on mapping absorptive capacity in the two countries and will cover the period from the independence (respectively 1966 and 1968 for Botswana and Mauritius) down to the present. Using company and sectoral data on technology adoption, productivity and export performance, the diversification effort will be looked into in detail. From the company survey carried out during the field research, and from data obtained from the chambers of commerce and the central statistical offices and other institutions of the two countries and from other sources, we will examine the evolution of technology adoption and the corresponding effects on the reduction of primary commodities dependence. Companies that have adopted or introduced foreign technologies throughout this period will be analysed on labour productivity increase and the contribution of their combined output in the domestic production and export.

1.6 Relevance and Contribution of the Study

The role of technology adoption in the process of economic development has been a recurring theme in the economic literature. Various researchers have addressed this issue and brought to light important findings that have greatly enriched our understanding of the role technological change plays in shaping economic development and how new technologies diffuse throughout the economy (Griliches, 1957; Soete &Turner, 1984; Silverbeg, 1984; etc). The field of technology transfer across nations and its developmental effects has also been extensively covered by the work of extant academic researcher, such as Caves (1974), Mansfield et al. (1983), Fransman (1986) and others. However, while important new insights have been generated in the way technologies diffuse in advanced industrialised nations, the problems inherent in technology adoption by technological laggards continue to challenge our systematic understanding of technological catch-up.These challenge result from the lack of similarity between developed and developing countries as pointed out by Edquist (1997; 2001) or Viotti (2002), who refute the adequacy of using the NIS concept in analysing the processes of technical change in typical settings of industrializing economies, which are completely different from those of industrialised countries. Some prominent scholars in the innovation systems field have therefore argued that developing countries need their own specific approach to NIS (Edquist, 2001; Juma et al., 2001).

For this reason, while most studies have been devoted to analysing the (indirect) growth effects of absorptive capacity inputs (Psacharopoulos, 1985; Aschauer, 1989; Temple and Voth, 1998; De Long and Summers, 1991; 1992; etc.), we seek to deepen the existing insights by estimating the absorptive capacity's direct effects on technology adoption and economic diversification, instead of the indirect effects on growth. Moreover, a majority of studies in this field have generally adopted a unidimensional or additive approach to the role of components of absorptive capacity, in which the latter has usually been proxied by its most salient component, namely human capital. Our research breaks with this tradition and takes a multidimensional approach to reflect the simultaneity and interactivon of the various components in shaping technological learning and supporting diversification. This will allow to analyse the relative importance of each of these components and to better assess their critical mass effects on breaking the dependence on traditional primary commodities.

The policy relevance of this research rests on the wide recognition of continuous innovation and technological advance as an essential condition for sustained competitiveness and long run growth performance (see e.g. Ruttan, 2000). As we have already emphasised above, both standard neoclassical growth theory and the *new growth theories* explain the persistent poverty in developing countries as being at least partly due to differences in technology between rich and poor countries (Mayer, 2000). In advanced industrial countries, science, technology and innovation have been the principle source of long-run economic growth and increasing social well-being (OECD, 2005). In the future, the innovation performance of a country is likely to be even more crucial to its future economic and social development. A thorough understanding of the factors and processes underlying technological innovation and its adoption in developing countries is therefore essential in the analysis of economic development.

By mapping absorptive capacity and examining the role of industrial policies in fostering innovation, knowledge diffusion and competition in the two SSA countries, this study will enable us to gain more insights in the process of knowledge accumulation and active technological learning that enables economic entities to exploit new sources of knowledge in order to create new products and services or increase the quality and the efficiency with which existing ones can be produced. This study will contribute to broadening insights in the ability SSA countries to acquire and harness modern technologies and will serve to identify effective policy measures for promoting technology adoption. By shedding more light on the process of technological learning and technology adoption in the context of SSA countries, this research also contributes to the deepening of our understanding of the catch-up mechanisms in countries dependent on a limited number of primary commodities in their trade relationships. It also permits to derive practical and policy relevant lessons in technological learning that can be applied to other commodity-dependent SSA countries. In an increasingly globalised world economy, where access to foreign technologies is facilitated by ever-growing economic interdependence but also complicated by stringent global intellectual property rights (IPR) regimes, the results of this research will permit a deeper appraisal of the conditions for, and benefits from export diversification based on foreign technology adoption.

1.7 Thesis Outline

In the first chapter, we have provided the background for the persistent problem of extreme poverty in SSA and its association with trade and international investment marginalisation, primary commodity dependence and technological backwardness. We outline the problem of primary commodity dependence and ask the main research questions as to how this problem can be overcome. Then we formulate hypotheses linking absorptive capacity to technology adoption, diversification and productivity growth. Finally, we present the objective and relevance of the study as well as the approach used to find answers to the research questions.

Chapter 2 reviews the main economic theories that help understand the reliance on primary commodity dependence and evaluates why catch-up did not work for SSA. It covers the theory of dualism, the classical, the neoclassical and the new growth theories as well as various trade models with the view to enquire how can be applied to analyse and explain primary commodity dependence. For trade theories the underling idea is the role played by technology and relative factor endowment in explaining trade patterns, and thus in understanding why African countries continue to depend on primary commodities in their trade. Subsequently, catch-up theories are reviewed to gain insights in the factors affecting productivity differences and to understand the obstacles to technology transmission across countries that could help close the productivity gap and change the trade pattern between advanced and backward countries. In this chapter, we then apply the OECD taxonomy of technological capabilities for development to gain insights in the creation and expansion of favourable conditions for fostering the acquisition and use of foreign technologies. To that end, it examines the Systems of Innovation for Development (SID) approach as alternative for diagnosing the primary commodity dependence problem in order to achieve economic diversification and reduce primary commodity dependence.

Chapter 3 analyses the components of absorptive capacity and links them to the adoption of foreign technologies and economic diversification to reduce commodity dependence. It also explores the role of agriculture and financial markets in supporting the expansion of other sectors within the SID framework and proposes an analytical model that allows to empirically test the link between various indicators of absorptive capacity and the level of diversification.

Chapter 4 builds on the results and insights obtained from the analysis of chapter three and examines in more detail how the obtained relationships hold true in diamond-rich Botswana. It analyses Botswana's capabilities incentives and institutions for fostering technology acquisition and examines the corresponding evolution with respect to natural resource dependence. It also analyses to what extent embodied technology acquisition through capital goods import has contributed to increasing productivity and expanding the manufacturing sector, thereby reducing the dominance of diamonds.

Chapter 5 similarly looks at the absorptive capacity and diversification experience of Mauritius from sugar cane dependence to competitiveness in the textile and ICT sectors. It maps Mauritian capabilities and incentive systems to relate them to the rise of textile industry with an impressive export performance. It finally examines how Mauritius export partners' income growth and demand change for Mauritian export products can be used to explain capital accumulation and growth performance through income and price elasticity.

Then, chapter 6 compares the two countries that are often cited in one and the same breath as Africa's success stories, but whose growth experiences are far from being similar. It reviews the major factors explaining their institutional differences and assesses the role these factors play in the resulting differences of outcomes in capability building and diversification. It concludes by drawing some useful policy implications. The final chapter discusses and summarises the major findings, derives implications for technology acquisition and industrialisation strategies in other SSA countries and concludes by commenting the limitations of this study and sketching directions for further research.

Chapter 2

THEORETICAL FOUNDATIONS OF PRIMARY COMMODITY DEPENDENCE

2.1 Introduction

Over several generations of economists, various economic theories have been put forward to explain income and growth differences across countries and their variation over time. While classical economists explained income differences mainly through factor endowment and labour productivity, later theories have gradually given a central role to innovation and technological progress in determining long-term competitiveness and income growth. In addition to directly affecting productivity growth, technological knowledge is the main factor that determines the range and mix of goods and services that can be produced within a given economy. The lack of technological knowledge can thus be seen as a major explanation of primary commodity dependence.

In that light, narrowing the technology divide between advanced and backward countries has thus come to be seen as the key to reducing primary commodity dependence of the latter, as well as productivity and income inequality problems resulting from this dependence. Closing this technology gap implies that technologically less developed and commodity-dependent countries take advantage of their backward position and find means to adopt, absorb and utilise existing technologies developed in the advanced countries at a faster pace than the rate at which technological innovation takes place in the technological leaders (Gerschenkron, 1962; Nelson and Phelps, 1966; Benhabib and Spiegel, 2002; Narula, 2004). Indeed, this so-called Veblen-Gerschenkron catch–up hypothesis based on the “advantage of backwardness” appears to be validated by subsequent empirical investigations, provided that the technological lagging countries have sufficient stocks of human capital to sustain technology adoption and utilisation (Abramovitz, 1986; Benhabib and Spiegel, 2002; Stokke, 2004). Various technology gap and catch-up models such as Gomulka (1971), Fagerberg (1988) or Verspagen (1991) have since been developed to explain how technologically backward countries can converge to the productivity levels of developed countries or fall further behind if they fail to meet some critical mass of absorptive capacity. On the other hand, models of trade in capital and intermediate goods between developed and developing countries constitute the main theoretical illustration of how technological knowledge is transmitted across borders and how it contributes to improving productivity in the industrial activities of developing countries.

Within these developing economies, reliance on primary commodities can primarily be viewed through the concept of technological dualism as set out by Ranis (1988), which explains the initial dominance of the primary (mainly agricultural) products in a developing country’s economy by differences in technologies between two sectors, one traditional with variable technical coefficients, and the other, modern, with fixed coefficients. The dynamics of the development effort in this setting, which is essentially asymmetric, will be characterised by a flow of resources from the traditional to the modern sector, the viability of which will depend on the existence of a surplus product generated by positive growth in the traditional sector. As elaborated by Ziesemer (1987), the existence of such a surplus that can be saved, thus the emergence and viability of an industrial sector that reduces the dependence on primary commodities, depends upon whether the rate of technological progress exceeds the rate of exogenous population growth and the effects of (diminishing) returns to scale.

Premised on the view that the lack of technological knowledge is the main factor explaining primary commodity dependence, this chapter reviews the various theories of dualism, growth, trade, and catch-up literature that help explain technological differences between advanced and backward countries and provide thus insights in the causes of the failure to diversify in the latter. Whereas the dependency theory has tended to attribute the continued dependence on primary commodities to a malign and rigid international division of labour enforced by the capitalist system of developed countries, we think its arguments are incomplete and provide only a truncated image of the failure of developing countries to liberate themselves from their vulnerable export structure. Indeed, according to the dependency theory, as a result of an economic system and labour division imposed by the former colonial powers, the dependent states supply cheap minerals, agricultural commodities, and cheap labor, and also serve as the repositories of surplus capital, obsolescent technologies, and manufactured goods (Frank, 1972). Such a labour division and trade structure orient the economies of the dependent states toward the outside: money, goods, and services do flow into dependent states, but the allocation of these resources are determined by the economic interests of the dominant states, and not by the economic interests of the dependent state. In the dependency theory, this division of labor is ultimately the explanation for poverty and there is little question that capitalism regards the division of labor as a necessary condition for the efficient allocation of resources (Ferraro, 1996).

In our opinion, this explanation of dependence and poverty of developing countries by a coercive integration into the Western economic system only as producers of raw materials or to serve as repositories of cheap labor, in which they were denied the opportunity to market their resources in any way that competed with dominant states, seems too simplistic, and is fatalistic in its essence. In contrast to this fatalistic view, while not entirely ignoring the burden of the past, we abide by our stated approach that puts diversification effort and development outcomes in developing countries own hands. In effect, despite the pertinence of some of the argument of dependency theory the successful catch-up by East-Asian Economies, some of which are former colonies, provides an irrefutable illustration that developing countries can assimilate technological knowledge from advanced countries and successfully take their development destiny in own hands.

In order to gain insights in the mechanism through which technological knowledge generated in developed countries can be translated into labour productivity improvement in developing countries, we also review some of the theories involving growth models that combine the import of capital and intermediate goods with export of primary commodities and link them to the productivity growth of developing countries through the income and price elasticities of export demand, such as Ziesemer (1995a). These types of models will also serve as the basis of our empirical analysis of the diversification efforts of the two SSA countries of our case studies in chapters IV and V. We believe that the analysis of these theories forms an important step in understanding how the problems of low technological learning in the primary sector of commodity-dependent countries can be overcome through the adoption of foreign technologies for industrial diversification.

2.2 Technological Dualism and Primary Commodity Dependence

2.2.1 Dualism and the Dominance of the Traditional Sector

Throughout this book, dependence on primary commodities will be used to mean the reliance on the export of agricultural products and natural resources as the main source of foreign exchange in the international trade relationships of a country. From that perspective, both the agriculture and the exploitation of natural resources can be viewed as belonging to the traditional sector in the theory of dualism. Dependence on primary commodities can be conceptualised here as the failure of the economy to establish a viable, modern sector, strong and competitive enough to contribute to the country's export revenues. The classical concept of dualism such as in Ricardo's (1815) view focused on the coexistence of a predominant agricultural sector with no benefit of technological progress and whose activities are subject to diminishing returns to labour on the fixed land, and a non-traditional sector recognised as growing in importance as a result of capital accumulation (Ranis, 1988). Agrarian dualism has thus emphasised the predominance of agriculture and the importance of an agricultural surplus in the emergence and growth of the modern sector.

Such a surplus, coming from the profits of the agricultural entrepreneurs after payment of input factors was seen as the main fuel of the reallocation of labour and the accumulation of industrial capital necessary for establishing an industrial sector. In the classical view, the failure of an economy to generate this surplus as a result of the absence of significant technological change within the agricultural sector or new technologies in the modern sector, may lead to an underdevelopment trap. For a closed economy, Ziesemer (1987) points to the diminishing returns in the agricultural sector as the major factor leading to underdevelopment equilibrium when population growth is exogenous and slow technical change fails to compensate for these diminishing returns, while for an open economy exporting agricultural products and importing manufactured goods from advanced countries with unlimited export possibilities, the growing terms of trade may become the main source of negative effects on capital accumulation in the industrial sector by causing nominal wages to rise.

2.2.2 Resource Reallocation in a Dualistic Closed Economy

Ranis (1988) provides an interesting analytical framework for the various aspects of the modern concept of dualism in both closed and open economy settings. This framework comprises the intersectoral commodity market, the dualistic financial market and the labour market. In the closed economy setting, a part of the total agricultural output is used for own consumption by agricultural households while another part, which corresponds to the agricultural surplus, flows to the non agricultural sector. Part of this surplus is consumed by the non agricultural households while another part of it is used as an intermediate input in the modern non-agricultural sector. At the same time the agricultural production sector receives modern input from the other sector, so that the net real resource transfer from the agricultural sector is the difference between the foodstuff plus raw materials delivered to the industrial sector and the total amount of industrial goods received. The financial counterpart of this real resource contribution is analysed through the dualistic financial market in which total funds available for capital accumulation are equal to agricultural surplus plus the possible profits or savings from the industrial sector. In the dualistic type of developing countries, where the agricultural sector is initially predominant, the savings from the agricultural surplus serve as the primary source of investment funds for growth of the dualistic economy.

The labour market is also modelled on the intersectoral commodity market since the participant in this latter are, on the one side, the workers newly reallocated to the industrial sector who use their non-agriculture wage income to buy food and on the other side, the owners of the agricultural surplus, who sell this surplus to the industrial sector. The intersectoral commodity market allows workers to find goods they need for consumption and is thus indispensable for transforming the agricultural surplus into wage income for industrial workers, while allowing the owners of agricultural surplus to acquire a portion of the industrial output in exchange. Here, the availability of the financial market in the form of financial intermediation will permit an increasing separation of ownership and control of the industrial output so that claims against this output can be maintained in the form of savings, bank deposits, bonds and direct ownership of industrial company shares. For the dual economy to have a strong modern industrial sector, this financial intermediation network must be sufficient in reach and diversity to provide financial asset acceptable to various owners of the agricultural surplus and enable the dualistic economy to convert the savings from the agricultural sector into productive non-agriculture investments, as stressed by Ranis (1988).

The exchange in the intersectoral labour market, through which some of the low marginal product labour is reallocated from the traditional agriculture to the modern industrial sector can thus only take place as a result of a productivity increase to generate a surplus in the agriculture and the existence of successful commodity and financial markets to reallocate the resources. In typical developing countries more than 80% of the labour force is initially in the agricultural sector while less than 20% is active in the modern sector and only a successful structural transformation can trigger a level of development strong enough to reverse these proportions over a few decades. During such a transformation, the organisational dualism becomes important in the labour market where the agricultural sector with traditional technology and low capital labour ratio and production entities based on households sees the gradual rise and predominance of modern, specialised production techniques organised on the basis of urban, large-scale operations. In the context of unlimited supply of labour with limited land in the agriculture, such as the one suggested by Lewis (1954), the unskilled industrial real wage will be tied to, although not equal to, the agricultural wage. The existence of such relatively constant real wages with a relatively stable gap between them will lead to labour intensive technology choice and labour using technological progress in both sectors(Ranis, 1988). The supply of real wages in the agricultural sector has thus important distributional significance as it is the main regulator of the labour allocation and the principal determinant of intersectoral terms of trade and commodity exchange.

2.2.3 Dualism in an Open Economy

In an open economy, dualism is characterised by the coexistence of commercialised activities in the traditional and the non-traditional sectors with non commercial food producing activities in the traditional agricultural sector. The exportation of cash crops enables the economy to generate the foreign exchange needed to import capital goods for a further expansion of the export sector and foreign consumer goods to induce domestic agricultural workers to move out of the low marginal productivity traditional sector into the export-oriented activities. Since the open economy setting opens the possibility to import technologies which were not available in the closed economy case, this additional opportunity should render development easier, other things being equal. However, this optimist picture is often mitigated by the observation that the benefits of this international trade carry built-in tendency for relative neglect of the food production in the agriculture sector at the benefit of export cash crops and natural resources. The primordial role played by the agriculture, as underscored by Nurkse (1953) and Lewis (1954) means that such a neglect may be fatal to industrial development as the existence of growing industrial sector depends on significant improvements in agriculture. Successful transformation of dualistic open economies where a large fraction of the population is initially engaged in traditional agricultural activities depends thus on the ability to mobilise this sector and reallocate resources in the non-traditional export sector.

Without such a mobilisation, the economy will find it very difficult to achieve substantial growth rate and favourable income distribution, even in the presence of ample natural resource endowments. In general, the relatively easy availability of export earnings from natural resource bonanzas can induce a country in an illusory belief that it can avoid the difficult but necessary policy and structural changes required to move the economy from traditional sector dependence to export substitution. Ranis (1988) warns against temptations to skip this mobilisation by importing food and attempting rapid industrialisation, because yielding to such temptation can imply substantial cost in forgone savings, foreign exchange and growth. Reliance on natural resource bonanza to overcome this problem will also prove ineffective in many cases, as the appreciating exchange rate may have perverse effects on other tradables, and therefore result in sluggish growth[1]. A booming market for this natural resource and primary export may lead to an overvalued exchange rate, making it more difficult to mobilise the resources needed to diversify into competitive industrial exports.

In conclusion, the essence of development problem in the dual economy is therefore the ability to mobilise the agricultural sector so that it can yield sufficiently large surpluses and to use an as large possible part of these surpluses for productive investment in the non-agriculture sector. At the same time, this modern sector financed by the agriculture surplus and reinvestment of its own profits must grow fast enough to absorb the labour force being reallocated from the agricultural sector. To be successful, the dualistic economy must therefore mobilise its major potential resource, i.e. its unskilled labour and its entrepreneurial capabilities to efficiently utilise the agriculture surplus and penetrate international markets competitively. The end of dualism and the corresponding dependence on primary commodity will then occur only when the country has succeeded in reallocating enough workers so as to render the unskilled labour a scarce resource as determined by the real wage rate.

[1] This economic paradox in which the boom in revenues from natural resource exports damages a nation's productive economic sectors by causing an appreciation of the real exchange rate and an increase of the wage rate is referred to as the "Dutch disease", and is covered in more details in chapter 3

2.3 Growth Theories

In the following, we proceed by examining how the various growth theories, ranging from the neoclassical to the more recent evolutionary theory, were used to analyse income differences between developed and backward countries and the role attributed to technology by each of them in explaining the backwardness of the least developed countries. We take as starting point the basic principles of the economic growth and trade theory as developed by classical economists such as Adam Smith (1776), Thomas Malthus (1798), David Ricardo (1817), Frank Ramsey (1928) and Joseph Schumpeter (1934). These basic ingredients of the growth and trade theories such as competitive behaviour and equilibrium dynamics, the effects of diminishing returns, the accumulation of physical and human capital, the effects of technological progress resulting from increased labour specialisation or better production methods for old and new goods and the incentives for technological change can be taken as fundamental building blocs for subsequent theories, which we review in the next sections in an attempt to gain more insights in the process of growth and catch up.

2.3.1 The Neoclassical Growth Theory

Ramsey's (1928) classic article, a work widely considered to be several decades ahead of its time is seen as the chronological starting point for modern growth theories (Barro and Sala-i-Martin, 2003). Ramsey's treatment of intertemporal optimisation by infinitely-lived households or "dynasties", allows a good understanding of saving choices made by households, thus of capital accumulation. The determination of capital accumulation path through dynamic optimisation techniques enables in turn to identify the growth behaviour of per capita income. In this model, a higher willingness to save (as a result of increased valuation of future consumption with respect to current one) leads to faster capital accumulation and thus to higher output growth, since per capita output is an increasing function of capital stock per worker.

In contrast to Ramsey's model, the neoclassical growth models like Solow (1956) or Swan (1956) take the saving rates to be constant and exogenously determined, so that differences in productivity growth can only be explained by exogenous factors. In this setting, growth is achieved by the use of more factor inputs with constant returns to scale, better input utilisation (productivity increase as a result of learning effects, scale economies, and more efficient factors allocation) or technological progress. However, even though in the short-run productivity improvements can be achieved through more factor inputs or a more efficient allocation of the available resources, the gains from such improvements are limited in time. After all short-run improvement possibilities have been exhausted, subsequent progress depends to a large extent on a country's ability to achieve technological progress. One of the major insights contributed by the neoclassical growth theory is thus that an increase of the ratio of national saving to output cannot create a permanent increase in the growth rate (see also Gordon, 1998).

In the long-run, growth is therefore driven by technological change, which is also exogenously determined. This exogeneity has increasingly been questioned and the dissatisfaction about its explanations led to the emergence of endogenous growth theories which we will review below. The other main criticism to the neoclassical literature is that it simply takes technology to be freely available to all countries and, within each country, to all firms. As many authors have expressed it, technological advance is assumed to "fall like manna from the heaven" (e.g. Katz, 1994) or "drop from the sky" (see Gordon, 1998). According to this theory, countries productivity is determined by the capital- labour ratio present in their production function and this ratio is simply chosen in accordance with the factor price ratio which is determined by the relative endowment of physical capital and labour. The factor endowment available in the economy is also at least partly exogenously determined: labour is determined by the country's population and its growth rate, while the capital is accumulated through continuously investing a portion of the output that is determined by the constant saving rate.

The assumption of free and readily and universally applicable technology in the traditional approaches has a fallacious feature that carries the potential to impede technological effort in developing countries. One of the consequences of this assumption of the free availability of technology is namely to confine development thinking in terms of static comparative advantage determined by relative factor endowment. It should be noted here that the assumed decreasing marginal return to capital by itself implies that capital would freely flow to capital-poor countries and reduce productivity difference as capital owners constantly look for opportunities of higher capital rents.

For technology transmission between advanced and developing countries, the neoclassical approach to technology also assumes that all innovations and technological advance originate from developed countries: developing countries are assumed to receive all relevant improvements from developed countries at no cost and without any problem in assimilating the transferred technology. Adaptation here is considered irrelevant, since alternatives are available for all factor prices. Following such reasoning, any technological effort to build technological capabilities or to establish a dynamic comparative advantage in a certain technology is a waste of time and resources.

The neoclassical view explains the failure to catch up mainly in terms of poverty traps. Since the neoclassical theorists consider technology to be exogenous and therefore the growth differences to be explained by differences in factor accumulation and utilisation, the failure of countries to catch up is explained as being an equilibrium situation characterised by low level of capital stock and per capita output (Barro and Sala-i-Martin, 2003). Attempts to break away from such equilibria become useless, since the economy will have the tendency to return to the low level steady state, which explains why such a situation is a poverty trap. The dominance of agriculture, a sector where diminishing returns tend to prevail, is often put forward as one of the major causes of poverty traps.

As Lall (1992b) explains it, the general thrust of these conventional approaches to development is to minimise, not only the role of technological activity in developing countries, but also the need of policy to induce, support and protect such activities. Those approaches have tended to confine their policy recommendations to prescriptions like "getting prices right", reduction or elimination of protection, deregulation, privatisation, free international flows of capital and technology, and elimination of government intervention in industrial activity. Only since the publication of World Bank's (1993) report, "The East Asian Miracle", some moderate neoclassical thinkers have started to admit the need for intervention in industry, but even they admit only the so-called *market friendly* or "functional" interventions to support the market working in the presence of market failure.

In conclusion, the neoclassical approaches assert that the long-run productivity of a country's economy depends primarily on that country's ability to generate and apply new or better technologies. However, they have ignored and largely continue to disregard the complex nature and the substantial costs of technological learning in developing countries, as well as its dynamic benefits resulting from the externalities it generates. The failure of the neoclassical approach to take into account the costs of technological learning makes it ill-suited to analysing African primary commodity dependence problems and gives support to the view that as such, macroeconomic theory and policy alone, as conveyed by the neoclassical vision, are simply not sufficient for guiding development (Lall, 1992a).

2.3.2 Endogenous Growth Theories

Ever since the development of Solow's neoclassical growth model in the 1950s, numerous economists have remained unconvinced by its explanations of exogenous technology generation, income inequality, long-run growth and convergence. In the mid 1980s a group of growth economists including Paul Romer (1986) and Robert Lucas Jr. (1988) became increasingly dissatisfied with exogenously driven explanations of long-run growth and developed new growth theories in which the key determinant of growth were endogenous to the model. These theories were termed "endogenous growth theories" because they aimed at explaining technical change as the outcome of entrepreneurial market activities in response to economic incentives rather than just assuming that technological change takes place exogenously (Gordon 1998). In this new theory, **human capital** and **knowledge creation** were given a central place to eliminate the tendency of diminishing returns to production factors as assumed in the neoclassical model. Initially based on the Arrow's (1962) setup, the theory assumes that knowledge creation is a by-product of investment, since firms that increase their stock of physical capital learn simultaneously how to produce more efficiently, thus experience learning-by-doing effects.

But even assuming non-diminishing returns, the initial models (Romer, 1986) could not explain productivity divergence between advanced and poor countries as physical capital could move freely between them. The analysis was supplemented by (Lucas, 1988) in a model combining the ideas of Uzawa (1965) with those of Romer (1986) and using human capital as a third production input: since human capital is more available in advanced countries and not freely mobile, models featuring it as a production factor make it possible to explain the productivity divergence between developed and developing countries. For developing countries to converge to higher productivity, they must thus reduce the gap in human capital. As shown by Ziesemer (1991), it is important to note that the optimal resource allocation for the generation of human capital and knowledge will not be reached by a market system and individual decisions without government intervention if there is no market for intangible knowledge. Ziesemer's (1991) uses the ideas of Schultz (1962) and Uzawa (1965) to explain how human capital and the stock of knowledge necessary for continuous technical progress is generated by allocating the available labour, knowledge and physical capital between the production of goods and services and the production of human capital which produces new knowledge. In a perfectly competitive setting but in the absence of a market for the intangible knowledge, the zero profit condition will require that governments be brought to intervene in the form of subsidy to knowledge generation to induce firms to use higher levels of knowledge, and to offset the subsidy by a lump-sum tax, so that firms that do not choose the knowledge level optimally risk to have negative profits. This incentive scheme combining tax and subsidy allows for an optimal human capital accumulation rate with first best solution for a long-term growth path (Ziesemer, 1991).

The production of human capital can thus be seen as an alternative to technological advance in the generation of long-term growth. This way, the presence of human capital in the production function allows to relax the assumption of diminishing returns to a broad concept of capital and may lead to long-term growth of per capita income even in the absence of exogenous technological change (Barro and Sala-i-Martin, 2003). However, concerns arose that the mere accumulation of human capital cannot indefinitely sustain long-run growth. These concerns were based on the perception that the human capital accumulation must eventually also encounter declines in the rates of returns to its production.

This view led to the development of models with continuous advances in methods of productions and the types and quality of the produced goods and services in order to escape diminishing returns. Expansion in the variety (Stokey, 1988; Romer, 1990; Grossman and Helpman, 1991: ch.3) and improvement in quality (Aghion and Howit, 1992) of products became thus essential drivers of technical change and long term-growth. The development of an ever increasing number of new ideas for new and better goods and production methods became the key to long-term productivity growth. To solve the incentive problem of how these ideas get produced, endogenous growth theorists apply growth models relying on the ex-post rents of monopoly power enforced by patents, trade marks, copyrights and other IPR protection measures. Aghion and Howit (1992) applied Schumpeter's (1934) ideas of entrepreneurship and "creative destruction" to develop a model in which new and better products establish monopolies by rendering obsolete the existing ones.

Endogenous growth theory has thus greatly improved our understanding of the difference between developed and backward countries. However, in spite of all its merits in explaining the development of new goods and production techniques, this theory has been of little guidance to policymakers in developing countries wishing to catch up with technologically more advanced economies. Although the generation of human capital and technologies is endogenised, the factors explaining the obstacles to technology transmission across countries and diffusion within countries (beyond the monopoly protection) are not fully dealt with.

2.3.3 Evolutionary Growth Theory

The evolutionary economic growth theory also emerged from the Schumpeterian tradition putting entrepreneurship and innovation at the cutting edge of competitive advantage. It is thus endogenous in its nature. In contrast to neoclassical and initial endogenous growth theories however, evolutionary theories of economic growth rejects the assumptions of representative agents and perfectly rational choice underlying neoclassical competitive equilibria (steady states, balanced paths) because their assumptions ignore that heterogeneity is omnipresent in human societies. Among many examples, Chakrabarty and Schmalenbach (2003) empirically reject the representative agent hypothesis. The perfectly rational representative agent is further made implausible by the overwhelming evidence of irrational behaviour, such as the many example presented by Conlisk (1996) who, instead, defends the idea of bounded rationality.

Evolutionary modelling is based on multiple agents who are autonomous but are interacting in a selective environment. Through interactions, heterogeneous agents learn and adapt themselves to the system in which they operate, and by so doing, they introduce innovations, some of which will be more successful than others. By analogy to the Darwinian theory, evolutionary economic theory refers to the selection process and survival of the fittest by the use of organisational routines as units of analysis for evaluating evolutionary changes (Nelson and Winter, 1982). In the evolutionary framework, the economy reacts to the introduction of innovation by endogenously choosing the best technologies and setting the wage rates to reinforce this choice and thereby determines which technologies will prevail. The superiority of any given technology and its speed of diffusion depend on its profitability and on its relative capital stock relative to the average (Silverberg 1984; Soete and Turner, 1984; Silverberg and Lehnert, 1993). In Silverberg (1984), the superiority of the technology depends on its selective potential. Technologies that increase labour productivity will be selected and will determine technological progress.

However, the history of innovation is full of examples in which apparently inferior technologies have succeeded at the expense of technologies with perceived superiority. This has been attributed to the so-called lock-in effects and path dependency (see e.g. Liebowitz and Margolis, 1990; Arthur, 1994 or David, 2000). Some of such lock-in effects can be attributed to various evolutionary features including technical interrelatedness (compatibility with other existing technologies), economies of scale and quasi irreversibility of investments as argued by David (1985). Other general conditions that can generate or reinforce lock-in effects include network externalities and the quest for standardisation.

Evolutionary economic modelling teaches us that technologies that are ultimately successful on the market are selected on the basis of their evolutionary selective potential. In simple words, technologies that better increase labour productivity will have primacy on those that do not increase labour productivity, while technologies that tend to increase capital-output-ratio will be progressively eliminated. The prevalence of unique optimal solutions, ergodicity (different sequences leading to same outcomes) and the survival of the fittest arguments have also been used (it was argued that technologies that eventually dominated were intrinsically better since a generally agreed upon measure of technological superiority is not easy to identify).

Therefore, since disequilibrium, rather than equilibrium, is pervasive in evolutionary economic theory, new technological developments can make past successful paths irrelevant and open new opportunities for dynamic growth for low-income countries (Szirmai, 2005). Catch-up by developing countries and even leapfrogging are thus possible outcomes of new technological development and drastic changes in the selective environment. However, one of the problems of this approach is the assumption that no investment going beyond the original R&D is necessary, that the productivity effects of innovation are immediate and no diffusion takes place, even though imitation effects can lead to the diffusion of the routines (see e.g. Silverberg, 2002).

2.3.4 Growth models with imported inputs

Bardhan and Lewis'(1970) imported inputs models are among the earliest growth models involving export of primary commodities and import of intermediate and capital goods to explain growth in developing countries. In those models, the long-run rate of growth in developing countries is influenced by the world demand for primary commodity exports because the export revenue constrain the growth of availability of imported inputs used in domestic production.

The first model analyses the role played by imported intermediate goods in raising the marginal product of domestic factors of production. Assuming that the intermediate products are the only imported inputs and that trade is balanced, the model uses an augmented Cobb-Douglas production function in which the imported intermediate constitutes one of the three production factors alongside capital and labour. Under free trade, profit maximization condition means that the price of the intermediate product must equal its marginal product, and since the intermediate inputs are paid for by export revenue, the balanced trade assumption implies that the growth of domestic output will depend on the exogenous foreign growth of export demand, which is assumed to be price-inelastic. The model notes that in the steady state, if the exogenous rate of growth in foreign demand for the country's export is smaller than its population growth rate, the long-run rate of capital accumulation will be lower than its "natural" rate of growth. Moreover, the long-run growth rate will be also constrained by the price elasticity of export demand and terms of trade for the developing country will decline if the capital-labour ratio is below its steady state level.

The second model assumes that the export revenues are used to import foreign machines instead of intermediate products. These foreign machines are distinct from domestic capital, alongside which they enter in the production function together with labour as the third production factor. These two types of capital are assumed essential for production so that efficient allocation must lead to a solution in which both types will be utilised and their rates of return equalised if there are no difference in risk. As in the first one, this model also assumes a price-inelastic foreign demand for the country's export products, which may mainly consist of primary commodities. This demand grows at an exogenously determined rate. Under free and balanced trade, the value of imported machines will be equal to the total price of exported products. The competitive equilibrium in the allocation of capital investment between foreign machines and domestic capital goods allows to express the terms of trade as a function of the capital labour ratio of the two types of capital. If the demand for each type of capital goods is only dependent on its value and rate of return, the terms of trade will improve over time with the increased capital labour ratio in foreign capital and will decline with the per capita accumulation of domestic capital. In the steady state, the rate of growth of domestic production will be equal to the growth rate of domestic capital and will be an increasing function of the (absolute value of) price elasticity of demand for the country's exports if the exogenous growth rate of demand is smaller than the population growth rate. If the exogenous foreign demand grows faster than the country's population, the terms of trade will improve and domestic growth rate will be a decreasing function of the price elasticity in absolute terms. However, in both cases, an increase in the exogenous growth rate of export demand will always have a positive effect on domestic growth.

Ziesemer (1995a) modified and extended this last model with the relaxation of balanced trade in the short run by the introduction of debt owed by the developing country that imports capital goods while exporting primary commodities (or labour intensive goods). The model takes the extreme case in which no luxury consumption goods are imported from the developed country, so that all the export revenue is invested in imported machinery. The demand for export are assumed to depend on foreign income which is growing at an exogenously determined rate and on endogenous terms of trade so that the growth of total export revenue will depend on both income and price elasticities of demand.

The introduction of debt in the model implies that a country can import more than the value of export revenues in some years, while export can lag behind interest payments when the developing country has some positive wealth. Current investment can thus be covered by future exports. With this model if exports grow slowly due to unfavourable income elasticity of demand, the investments will also grow slowly since invested capital goods must be paid for by export revenue. As a consequence, labour productivity will grow faster if the rate of imported capital accumulation is fast. This is of particular importance for the majority of developing countries that must import most of the capital goods to be invested from developed countries and pay for them by the export of natural resources and other primary products. Unfavourable foreign demand conditions will induce more growth in domestic consumption at the expense of investment growth while favourable world demand characterised by low interest rate and high foreign income will lead to a development path characterised by more export growth compared to consumption growth: such a development path can then be called export-led growth. One of the consequences of the debt in the model however, is the possibility of an optimal long-run equilibrium in which the economy is completely owned by foreign capital.

The effect of high price elasticity of the export demand (in absolute value) in this model is to strengthen the impact of technical progress on the growth of imported capital goods since a technical progress leads to an increase in marginal productivity of labour and a decrease in export prices, which generate more export revenue and more import if the price are elastic. These increased imports of capital goods may also lead to an increased demand for labour and have a positive effect on real wages. This increase in wages, however, leads to an increase in terms of trade, which in turn has a lowering effect on real wages and per capita income. The overall effect of technical progress on the growth rate of real wages and per capita income is however positive in this model.

2.4 Trade Theories

Trade theories, from the initial classical ideas of comparative advantage to the relatively more recent models including technical change explain trade patterns between countries by differences in production technologies. These differences in technologies form the basis of comparative advantage and determine the direction of trade. On the basis of static and dynamic comparative advantage, trade theories enable to identify the reasons why countries specialise in given production techniques. The imitation-gap and product life-cycle theories are especially suited to explaining the trade flows between developed and developing countries. In this section, we pay attention to some of the main trade theories and summarise the explanations they offer for understanding the lack of diversification in backward countries.

2.4.1 Classical Trade Theories

The classical theories of absolute (Adam Smith, 1776) and comparative (Robert Torrens, 1815 and David Ricardo, 1817) advantage form the foundation for the gains from trade and the justification of its benefits for all trading nations. Initially developed as a reaction to the mercantilist spirit of the time, the classical trade theories have emphasised the view that factor endowment and labour productivity were the primary source of comparative advantage. Differences in wealth and income were thus to be mainly traced to differences in capital endowment and labour productivity since trade offers each country the opportunity to reallocate resources and specialise in sectors where it has comparative advantage while importing the products for which it is disadvantaged (Södersten and Reed, 1994: p.7). Relative price convergence and country specialisation is ensured by competitive equilibrium and arbitrage. In the classical trade model, technology difference is explained as mainly due to labour productivity difference because labour was assumed to be the only production factor. Extension of this model to better explain the causes of differences in production technologies include the specific-factors trade model (Jones, 1971) in which production factors specific to some industries, in addition to mobile labour, are assumed to be immobile and available in fixed supply, so that their relative abundance determines the used technology.However Friedrich List (1841) has vigourously criticised the theory underlying the ideas of free trade between economies that do not possess the same level of industrialisation, arguing that unrestricted trade between an economy with manufacruting power and an agrarian economy would ineluctably lead to reinforcing the supremacy of the former and to the perrenial dependence of the latter on the supply of raw materials to the manufacturing industries of the leading economy.

2.4.2 The Heckscher-Ohlin Trade Model

The most dominant trade model of comparative advantage in modern economics is beyond doubt the Heckscher-Ohlin model, in which the two production factors, capital and labour, are mobile across sectors but immobile between countries. With both factors displaying decreasing marginal returns and the production having constant return to scale, the source of comparative advantage will be the relative factors endowment and trade will lead to each country specialising in the production of the good that utilise more intensively its relatively abundant factor (Heckscher-Ohlin theorem)[2] .

In this model, technology difference is explained only as being the difference in the intensity of use of production factor and no attempt is made to elaborate on the causes of technological advance and how they may change trade flows. Extensions of this model to include production technology difference have been limited to assuming scale economies (Södersten and Reed, 1994: p. 76) and provide therefore only limited insights into what determines actual observed technology differences and trade flows. In addition, empirical testing of this model with US data has revealed some contradiction with respect to the predicted trade flows, a contradiction that came to be known as the Leontief Paradox[3] (Leontief, 1956). Moreover, the long-run equilibrium implications of the model lead to gains for the owners of capital and losses for workers in the capital rich country as a result of the move from autarky to trade. Another puzzling feature of this framework is the possibility of *immiserising growth* that may result from a deterioration of the terms of trade if the country experiencing productivity growth is large enough to influence the world prices (Södersten and Reed, 1994: p. 122).

2.4.3 Imitation-Gap Theory of Trade

An important model explicitly considering technological change and transfer as a determinant of trade and growth is Posner (1961). Posner's trade model explains trade flows between countries by technology difference, by *imitation gaps* (time lag between the first introduction of a production technology in one country and its adoption in the foreign country) and by demand lags (time lag between the development of a new good

[2] Note, however, that demand factors such as large taste differences between the consumers of the two countries may offset and even reverse the production possibility advantage in this model

[3] Leontieff's testing of the capital intensity of US exports and imports found that US, a capital abundant country, was exporting labour intensive goods and importing capital intensive goods. However, as shown by Trefler (1995), this paradox vanishes when the used data go beyond 1980.

in one country and the emergence of a demand for that good in the foreign country). In this model, if there is a technological innovation that leads to the production of a new good, producers in the foreign countries will have to decide whether to adopt his technology or not. However, patent protection and/or the time required to learn the new process, to adapt the plant to the new production and acquire the necessary equipment will delay their adoption of the new technology.

Whether technological innovation in one country will generate trade between countries having otherwise identical technologies depends thus on imitation and demand lags. If the imitation lag is longer than the demand lag (which is likely to be the case if the innovation is significant) technological innovation will give rise to a trade flow between the innovator and the country where the production technology has not been adopted but where the demand for the new good has already emerged. A continuous flow of innovations can thus allow a country to penetrate and expand foreign markets while imitation in the foreign countries will reduce the first country's export if it comes timely enough. Imitators may even reverse the direction of trade flow if the adoption of foreign technology stimulates their own innovative behaviour and allows them to generate subsequent innovations more quickly that the first innovator (Akamatsu, 1962).

This model provides very meaningful insights in the innovation and technology differences as determinants of trade flows and growth but gives little explanation as to why innovations tend to be concentrated in richer, more developed countries, and why the production tends to remain initially in the innovating country, even though firms making innovations could relocate production to countries whose factors endowments provide cost advantage for the production of the good in question. While the first of these two questions could be explained away by the abundance of the input to innovation in developed countries (R&D spending, research equipment, human capital and more innovation- responsive markets), the latter question remains intriguing. These puzzling empirical observations have led to the development of product life-cycle theories of trade.

2.4.4 Flying Geese and Product Life-Cycle Models

The product life-cycle trade models are closely related to the flying geese paradigm which we will review in more details when we deal with catch-up theories. According to this paradigm, countries specialise in the export of products for which they enjoy a comparative advantage commensurate with their level of technological development and at the same time seek to upgrade their industrial structure by augmenting their endowment in capital and technology. The product life-cycle theories developed by Vernon (1966) and Hirsch (1967) attempted to explain the tendency for the production of new goods to be concentrated in developed countries early in the life cycle of the products, but to move to other countries later on. They explain this phenomenon by the fact that for a given good, factor requirement will vary over the lifetime of that good so that a cycle in the production of a new good may be observed.

The risks associated with innovation are first borne by rich firms and force them to be close to markets in richer countries in order to recoup their investments. As the product and its production process become more standardised, the risk becomes lower, and producers in other countries may undertake production as the patent protection expires, provided that the pattern of factor price for the production of this good give them a cost advantage over the initial producers. If the production process still requires highly skilled inputs of labour, such a competition in the production is more likely to arise from other developed countries, since the good might still be so costly that its purchase remains limited to high income consumers.

Only when the technology of the good has become completely standardised in a form that can use relatively unskilled labour, the production can be relocated to cheap labour countries by existing firms or established by newly domestic firms in those countries. The initial producer will then experience a decline in their export and might even become an importer of that good in later stages (Södersten and Reed, 1994). A consequence of this, is that advanced countries possessing a competitive advantage in innovation will specialised in the production of new goods, while the less advanced countries will specialise in the production of old goods, in line with their cost advantage as also emphasised by the Krugman (1979) model.

2.5 Convergence Hypothesis and Catch-up Theories

Catch-up or "convergence" theories are based on the catch-up hypothesis originating from Veblen's (1919) and Gerschenkron's (1962) ideas that the technology gap between technologically leading and following countries will narrow gradually as technologies diffuses between them. The possibility of technology to flow between the leader and the followers is the basis of Veblen-Gerschenkron "advantage of backwardness", which implies that the most backward countries have a relative growth advantage which, if exploited, will lead to convergence with technological leaders. Convergence refers to the long-run tendency for countries at lower stages of economic development to catch-up with the productivity levels of the technological leaders at rates which are inversely proportional to their initial level of productivity. The rationale behind this idea stems from the argument that capital formation in the leading country contributes to the productivity growth by embodying recent technological advance, while investment in the lagging countries can draw upon a large pool of technology that include not only these recent advances but also the larger reserves of available but previously unused technologies (Rogers, 2004).

When technology is allowed to flow between advanced and backward countries, the catch-up process is then likely to set in through state intervention to increase capital accumulation in the laggard (Gerschenkron, 1962), through demonstration effects and international division of labour (Akamatsu, 1962) or through cross-border investment spillovers (Findlay, 1978). Verspagen (1991) also notes that as a result of the "public good" nature of technological change, international knowledge spillovers will bring about the tendency for countries with lower technological levels to achieve faster productivity growth. This potential for growth has been hypothesised to depend on the productivity gap and implies therefore that the catch-up rate will decline over time as the productivity gap narrows. In this section, we first examine the mechanism of catch-up as proposed by the "advantage of backwardness" arguments, and subsequently analyse how the various catch-up models explain the convergence process.

2.5.1 Advantage of Backwardness and the Importance of State Intervention

The central tenet of the advantage of backwardness is the positive role of relative economic backwardness in inducing systematic substitution for the prerequisites for industrial growth. Gerschenkron's (1951; 1962) formulation of this hypothesis was based on the observation that relative backwardness creates a tension between the promise of economic development, as achieved elsewhere, and the continuity of stagnation. Such a tension takes political form and motivates institutional innovation, whose product becomes appropriate substitution for the absent preconditions for growth. State intervention can then be used to compensate for the inadequate supplies of capital, skilled labour, entrepreneurship and technological capacity encountered in follower countries seeking to modernise for example by the formation of large banks to provide access to needed financial capital for industrialisation.

For Gerschenkron, the greater the degree of backwardness, the less likely was the agricultural sector to provide a growing market to industry, and the more dependent was industry upon growing productivity and inter-industrial sales, for its expansion. Therefore more state intervention was required in the market economy to channel capital and entrepreneurial leadership to nascent industries through coercive and comprehensive measures required to reduce domestic consumption and provide a boost to national savings. His formulation dominates the Rostovian stages of growth approach, because of its emphasis upon differential development in response to different initial conditions.

The simple convergence hypothesis based on the advantage of backwardness states that since the potential for growth varies with the productivity gap between the technological leader and the backward country, a country's growth rate can be expected to decline over time, as the productivity gap narrows. In the early stages of development, when the reserves of unexploited technologies are large, the early adoption of the simplest technologies can be achieved easily and with quick results. As these relatively easy to implement technologies get exhausted, the catching-up country will increasingly have to borrow technologies that will be relatively more expansive.

This logic seems convincing but there are many other factors that may act to reinforce or oppose this tendency. For example, the gains in productivity resulting from an efficient reallocation of labour from low to high productivity industries and sectors of the economy are likely to be greatest when the economy still has large pools of underutilised labour in agriculture and informal service sector, which will usually be the case in early stage of the catch up process (Lewis, 1978; Abramovitz, 1986; Alam, 1991). However, this pool of underutilised labour may not decline linearly and may even increase at times.

Moreover, in the early stages of the catch-up process, the acquisition of more productive foreign technologies is likely to be facilitated by the fact that they can be easily purchased at affordable costs since the reserves of unexploited technologies are large. But as these accessible technologies get gradually exhausted, the catching-up country will probably have to purchase more expansive, technically complex or proprietary technologies and therefore run into higher costs. As stressed by Alam (1991), the rapid adoption of new technologies in the early stages is also less likely to be opposed by special interest groups which may not have had time to organise and wield influence over the political process.

2.5.2 The Flying Geese Pattern of Economic Development

The Flying Geese Paradigm

One of the earliest catch-up theories is the Flying Geese paradigm or "flying geese pattern of economic development" (*«Gankoo keitai hattenron»*) as developed in the

1930s by the Japanese economist Akamatsu Kaname. This paradigm intends to explain the catching-up process of industrialisation of latecomer economies. It was introduced to world academia only after the World War II in 1961 and 1962 through Akamatsu's articles in English. Initially, it had a focus on specific industries in specific countries, but has subsequently been extended to analyse the change dynamics of industrial structures and further to analyse the shift of industries from one country to the other (Kwan, 2002). In this model, the life cycle of a specific industry is traced by following the time path of an indicator of its competitiveness (such as the growth of market share), which takes usually the shape of an inverted v-shaped curve, showing that the industry's competitiveness first improves progressively, reaches a summit and then start to deteriorate. In this process, the industry in question goes through the phases in the developing country: import, production, and export.Evolution takes place within industrial production as well as from low- to high value-added activities and better quality.

Capital accumulation (including foreign investment) and forward and backward linkages with other industries has the effect of changing the comparative advantage of the country in question and can lead to industrial upgrading: this is represented by a series of inverted u-shaped curves, which have given the name of "flying geese" to the model. In its inter-industry aspect, this paradigm describes thus sequential appearance and development of industries in a given developing country, with industries being diversified and upgraded from consumer goods to capital goods and/or from simple to more sophisticated products.

When applied to an open economy context, this model is used to analyse the shift of industries from advanced countries to countries that are technologically catching up. The main driver in the model is the *"lead goose's imperative for internal restructuring"* due to increasing labour costs (Kasahara, 2004: p.87). As the comparative advantages (on a global scale) of the 'lead goose' causes it to shift further and further away from labour-intensive production to more capital-intensive activities, it sheds its low-productivity production to nations further down in the hierarchy in a pattern that then reproduces itself between the countries in the lower tiers. A typical example of this is the shift of the textile industry from Japan, first to the Asia's NIEs and later to the ASEAN countries and China in the quest for cheap labour locations.

According to this paradigm, countries advance in an orderly manner towards the goals of reaching technological sophistication, the technological leaders in front, followed by other industrializing nations in the order of their level of industrialisation, while the backward countries move at the back of the flock (Korhonen, 1994). This model assumes a simple hierarchy, but one in which the relative position of countries change over time just as the position of geese flying in formation. The leader may tire and drop back, while strong followers get at the front of the formation.

Catch-up Stages in the Flying Geese Model

Akamatsu (1962) distinguished three main stages in which the catch-up process of the flying geese paradigm takes place, the fourth stage being the one in which the former follower competes at the head of the formation. The first stage of development, which transforms a previously unconnected traditional economy into a "follower country"(*kooshinkoku*) opens by importing curious, interesting or just useful goods from industrialised countries. The exposure to these foreign goods induces a process of *"seduction"*, or *"demonstration effects"* and can begin either by a forced opening of trade, as was the case of Japan, or by the temptation of economic profit. It heralds the beginning of international communication in which imports gradually grow larger as consumer demand expands and the limit of available international exchange is reached. This process brings about many social and economic disruptions in the less advanced country, especially when the amount of imported foreign goods grows rapidly. The import of cheap goods produced in rationalised factories in developed countries destroys existing handicraft industries in the importing country, pricing craftsmen out of their markets and driving them into poverty and even starvation.

However, the less advanced countries have some important economic advantage: low wages, cheap raw materials and a consumer market to be serviced within a short distance. Wages may have already been lower before communication with the advanced countries began; after the harmful effects of trade and political measures have destroyed the traditional economic structure of the country, they are certainly lower. Raw materials are often in abundance, because that has been the direction in which the stronger industrial countries have developed the local economy, by intensifying agriculture, opening mines, etc. (Korhonen, 1994). The follower has also a market for cheap industrial goods, as the population has become accustomed to them, and demand may even be growing as the goods diffuse to even larger consumer segments. Akamatsu (1962) predicts that the workings of capitalism itself in continuous maximisation of profits eventually destroy the structure of trade and little by little, industrial production begins in the importing country as producers may relocate in search of cheap labour or to be close to the market.

Industrial production may start with local capital, but it may also start with foreign capital. For example, in search for larger profits, Western European capital built up industries in colonies, in North America as well as in Asian countries such as India, even in defiance of the overall colonial policies of the home countries (Akamatsu, 1962). Because the market has already been formed, local production is in the advantageous position of overcoming imports from foreign countries, by offering cheaper prices or better quality, if achievable (Akamatsu, 1956). In the long run, it is thus impossible to maintain permanent structures of domination and the direction of trade flows.

According to Akamatsu (1962), the initial import of foreign goods is a necessary prerequisite for a relatively rapid jump towards development, because its demonstration effects create a market for such goods and because these goods come to the backward country by bringing with them various elements of foreign culture, which change the values and ways of life of people. At this stage, import of foreign goods subsists alongside domestic production in the importing country and this is the crucial phase of the catch-up process because it's where the nascent local industry is involved in a "death struggle" (*shikatsu no toosoo*), and requires the local entrepreneurs to "shed their heart's blood" (*shinketsu wo susugi*) into copying foreign goods and inventing new ones. Here, as pointed out by Korhonen (1994), Akamatsu uses vivid metaphors to describe fierce competition between imports and local produced items, and makes the case for the infant industry protection, but warns against an unnecessarily prolonged protection of inefficient industries.

For development to continue, a shift towards national capital becomes necessary before long and the second stage sets in: domestic capital has to be accumulated and its use has to be determined by native industrial polices. To facilitate expansion of the means of production, technology and capital goods have to be imported. If raw materials cannot be produced locally in sufficient quantity or at the required quality level, they will have to be imported as well. This kind of development tends thus to increase the overall pattern of international trade. Then, at some point in the process of development, there is a qualitative jump: local production becomes dominant and the rate of increase of imports turns downwards. At this stage, this holds true only for finished consumer products; imports of machinery and raw materials still continue to increase.

In general, the normal course of catch up leads first to the production of crude products in the follower; only later more sophisticated ones can be produced and a long time is needed for this. Accordingly, there will usually be a phase when crude products are exported, while more expensive sophisticated products are imported (Akamatsu, 1956). This phase, when local industry is strengthened into an economically viable position in the local market, is the second stage of the flying geese pattern of development (Akamatsu, 1956).

The third stage is reached when national production increases still further, so that exports can be started. Imports diminish in absolute terms until a point is reached where the volume of exports exceeds that of imports for a given category of consumer goods. This situation benefits the overall balance of payments of the developing country. Exports enable more imports, such as capital goods for continued expansion of production. Also new consumer goods can now be afforded, and they introduce new industries into the developing country (Akamatsu, 1956). This three-stage development of import, production and export as sketched out here is the basic structure of the flying geese pattern of development as exposed by Akamatsu (1956).

The picture becomes more complicated when capital goods also enter the flying geese pattern. As the general level of technology in the follower country advances, it becomes possible to produce capital goods there as well. However, in order to build production machines, higher-level machines with which to produce ordinary machines have to be imported. This is an even more important change in the industrial structure of the country, not only because different categories of products are added into the industrial base of the country but above all because it has wider repercussions in society.

The production of the means of production turns the originally imported industry into a local one and transforms the local economy into a competitor of the capital goods producing countries (Korhonen, 1994). When this stage has been reached, development process gradually leads to the fourth stage in which export of industrial goods from the follower to the leading countries takes place. This phase corresponds to the comparative advantage of old goods production predicted by the product life-cycle model. When this process begins, the advanced countries will gradually have to give up the production of ordinary consumer goods and concentrate on the production of capital goods or the design of new, sophisticated products.

The flying geese paradigm is therefore a dynamic and deterministic view of development and catch up. According to this view, no country will be able to achieve a permanent leadership advantage over its rivals because leaders will tire and be overcome by the followers. It is also not possible to create a durable international division of labour; therefore, the economic system is both dynamic and unstable. The ability to develop in this model is influenced by many factors including the productive base a country has, the industrial and trade policies it follows, as well as educational and social policies it has adopted. The relative importance of these factors change over time and the whole process of industrialisation will not be similarly completed in all countries, but as the weak has always the chance of becoming stronger some time, many countries will be successful in catching up sooner or later.

2.5.3 Findlay's Spillovers Model

Findlay's (1978) dynamic model of technology transfer between advanced and backward countries is based on the gap theory and the catch-up hypothesis. His argument was that the rate of technological progress in relatively backward countries is an increasing function of the gap between technology level of the country in question and that of advanced countries and the degree to which the backward country is open to foreign investments. Therefore, the larger the gap between the backward and the developed country, the higher will be the pressure for change in the backward country. Hence, the backward country will grow faster than the developed one, as long as the gap is not too wide to deter the learning and technology adoption process. This model was operationalised by dividing the world into "advanced" and "backward" regions and assigning a technology efficiency index to each region. Taking A(t) as the technological efficiency index of the developed region, Findlay first postulated that this index grows at a constant rate n according to the function:

$$A(t) = A_0 e^{nt} \tag{2.1}$$

If $B(t)$ is the technological efficiency index of the backward country, then the Veblen-Gerschenkron catch-up hypothesis can be expressed as:

$$\dot{B} = \frac{dB}{dt} = \lambda(A_0 e^{nt} - B(t)) \tag{2.2}$$

in which λ is a positive constant whose magnitude depends on such exogenous factors as human capital and other productivity determinants or the *"social capability"* as advanced later by Abramovitz (1986)(see below). This formulation is similar to the contagion-theory based model used by Mansfield (1961), who argues that the adoption of innovation in a given industry occurred at a rate proportional to the number of firms that had already adopted this innovation. Further, Findlay hypothesises that other things remaining equal, the rate of technical change in the backward economy was an increasing function of the relative extent of exposure to foreign technology such as the presence of foreign firms from the advanced countries with their superior technology.

Measuring the exposure to the foreign technology by the ratio γ of capital stock $K_a(t)$ of firms from advanced countries to the capital stock of domestic firms $K_b(t)$,

and taking χ,the relative backwardness and the contagion hypothesis can be combined as follows:

$$\gamma = \frac{K_a(t)}{K_b(t)} \tag{2.3}$$

$$\chi = \frac{B(t)}{A(t)} \tag{2.4}$$

$$\frac{\dot{B}}{B} = f(\chi, \gamma) \tag{2.5}$$

with $\frac{df}{d\chi} > 0 \; and \; \frac{df}{d\gamma} > 0$

In this model, the catching up by backward countries is thus expressed as a positive function of the technology gap and the level of exposure to foreign technologies. For a given exposure to foreign technologies, larger technological gaps imply faster catch-up rates, while for an equal technological gap, the higher the degree of presence of foreign technology, the faster the catch-up process.

2.5.4 Abramovitz' "social capability" and Catch Up

The work of Abramovitz (1986) is one of the main landmarks in the catch-up and convergence literature. According to Abramovitz (1986), backwardness carries the opportunity for modernisation in embodied as well as disembodied technologies. By reallocating the large pools of underutilised labour from low productivity sectors, such as farming and petty trade, to more productive sectors using the imported technology, the backward country can gain in productivity and converge towards technological leaders. However, Abramovitz (1986) sees technological backwardness as not being merely a circumstantial accident but rather a product of the society's institutional history. He relates backwardness to the country's societal characteristics that he calls *"social capability"*, which to a large extent explain the failure to achieve the levels of technological productivity of the advanced countries and could prevent them from achieving the full benefits of the advantage of backwardness. Social capability constraint can also be seen as obstacles to change raised by vested interests, established positions and customary relations between society members, firms and institutions.

Moreover, the pace of realisation of the catch-up potential depends on other factors that govern knowledge diffusion, resource mobilisation and the rate of investment.

Foreign technology comes to the backward country through various interactions including trade and rivalry, population movements, capital flows and flows of applied knowledge. The inflow of foreign technology creates technological opportunities that press for change and catch up results from identifying and exploiting these opportunities. Abramovitz predicts countries to learn to improve their institutional arrangements and adapt them to take advantage of the offered opportunities as they gain experience. The constraints imposed by the social capability on the adoption of new technology then gradually weaken and allow full exploitation of the technological advantages offered by the new technology.

2.5.5 Verspagen's Catching Up and Falling Behind Model

Extension and formalisation of the catch-up hypothesis in dynamic models allow a close examination of the catch-up behaviour and the technology gap dynamics. Among the many models dealing with technology gaps and convergence, the Verspagen (1991) model that we present here, is one of the first attempts to incorporate the effect of absorptive capacity on catching up and falling behind. By including absorptive capacity of the receiving country, Verspagen formally models a crucial factor explaining conditions under which the backlog of existing technologies can be assimilated by lagging countries. His formulation helps understand why some lagging countries may fail to take advantage of technologies existing in the technological leader and thus fall behind instead of catching up.

Verspagen (1991) defines the technology gap G between the advanced country, North and the lagging country, South, as the log difference between the knowledge stocks (K) of the two countries:

$$G = \ln \frac{K_n}{K_s} \tag{2.6}$$

where the subscripts n and s refer to North and South. This logarithmic formulation has the appealing feature of displaying a gap of zero when the levels of technological knowledge stocks of the two countries are equal. The model further assumes that the stocks of knowledge grow over time at exogenous rates, while South also benefits from technology spillovers from the Northern technological leader. The model assumes thus that North remain the technological leader and that its autonomous knowledge growth is higher than the autonomous knowledge creation in South

$$\frac{\dot{K}_n}{K_n} = \beta_n \tag{2.7}$$

while

$$\frac{\dot{K}_s}{K_s} = \beta_s + S \tag{2.8}$$

in which S represents the growth of knowledge in South due to spillovers from North. The assumptions above imply thus that$\beta_n > \beta_s$ but the catch-up hypothesis also imply that $\beta_s + S > \beta_n$ For the spillover specification, Verspagen (1991) distinguishes between *potential spillovers* and *actual* spillovers to account for the learning capability needed to internalise the spillover potential. This learning capability is assumed to depend on the *intrinsic capability* (δ) of the lagging country and the technological distance to the knowledge frontier of the leading North. Here, the larger the technology gap, the more difficult it is for entrepreneurs from the lagging country to adopt technologies that are dissimilar to theirs. The learning capability, for a given technological distance, depends on a mixture of social factors as in Abramovitz (1986), education of the workforce as in Baumol et al. (1989), the level of the infrastructure, the level of mechanisation of the economy, and the correspondence of the sectoral mix of production in the leading and following country (congruence) as explained by Pasinetti, (1981).

$$S = aGe^{-G/\delta} \tag{2.9}$$

The potential spillover rate aG in this equation is proportional to the size of the technology gap (with $0 < a < 1$) while the learning capability ($e^{-G/\delta}$ *with* $\delta > 0$) is a function of the intrinsic learning capability δ, and the technological distance measured by the gap. The size of intrinsic capability with respect to the technology gap determines the extent to which spillovers will take place. Increasing the intrinsic learning capability causes $e^{-G/\delta}$ to approach 1, implying that actual spillovers come closer to all potential spillovers. A low δ means that $e^{-G/\delta}$ approach zero and little of the potential spillovers are actually internalised. This functional specification also satisfies some basic restrictions regarding the nature of the spillover term: the actual technology spillovers cannot be bigger than the potential spillovers, the actual spillovers are zero for closed technology gaps, and spillovers can grow for larger values of δ.

With these specifications, one can analyse the dynamics of the technology gap by taking the time derivative of the gap equation and substituting equations (2.7), (2.8), and (2.9) into the derivative so that the expression for the dynamic behaviour of the technology gap becomes:

$$\dot{G} = \frac{d}{dt} \ln \frac{K_n}{K_s} = \frac{\dot{K}_n}{K_n} - \frac{\dot{K}_s}{K_s}\beta_n - (\beta_s + aGe^{-G/\delta}) = (\beta n - \beta s) - aGe^{-G/\delta} \quad (2.10)$$

Technology gap has the tendency to increase as a result of the exogenous difference between the rates of growth of the knowledge stock in North and South ($\beta_n - \beta_s$) while it also tends to *decrease* due to knowledge spillovers. This implies that the speed of catch up will come to an end when the difference in exogenous knowledge generation (a measure of technological congruence) is equal to actual spillovers. The state diagram of this differential equation above displays two equilibrium points, a stable and an unstable one, suggesting that under the conditions leading to the unstable equilibrium, countries may fall behind rather than catch up.

Verspagen's catch-up model identifies thus both the value of the intrinsic learning capacity and the initial value of the technological distance as determinants of the dynamic behaviour of the technology gap. Countries with a high intrinsic learning capacity and/or small initial gaps are likely to catch up, while countries with a low intrinsic learning capacity and/or large initial gaps are likely to fall behind. Verspagen cautions that total convergence of technological levels, however, will not be reached by means of catching up alone. In order to close the gap completely, the backward country will have to go through one more phase characterised by the expansion of domestic research efforts, up to a level comparable with the advanced country.

2.5.6 Rogers' Technology Gap Model

According to Rogers (2004), the concepts of "absorptive capability" defined as the ability to access, learn and absorb relevant overseas technologies and the "technology gap" are central to understanding the process of technology diffusion, economic growth and catch-up. Similar to the concept of "social capability" used by Abramovitz (1986), the concept of absorptive capability expresses the ability to access and learn overseas technologies in order to apply them in domestic production processes. The three main components of absorptive capability advanced by Rogers (2004) are access to overseas technologies, learning ability and incentives or barrier to implement new technologies. Accessibility to foreign technologies depends on such factors as international business links, education and social links level of international trade in goods and services and the presence of foreign domestic investment. Countries having higher linkages are likely to have more *"familiarity"* with foreign economies and are more likely to absorb foreign technologies, which enables them to catch-up (Goodfriend and McDermot, 1998).

The ability to learn and understand foreign technologies depends on a wide range of factors including education and foreign language skills, as well as knowledge of more specialised "language skills", such as those used in engineering to communicate technical information. The incentives to implement new technologies are vital in catch-up and depend on various economic, social and political factors such as property rights, rule of law macroeconomic and political stability, availability of banking and credit system and health and life expectancy indicators to induce people to invest.

The Rogers' model is based on Nelson and Phelps (1966) and highlights the importance of absorptive capability and the technology gap for catch up. By expressing the economy's level of technology (A) and its absorptive capacity [$\varphi(.)$] with scalars, he describes the growth of technology by the following equation based on Nelson and Phelps (1966) human capital model:

$$\frac{\dot{A}}{A} = \frac{dA/dt}{A} = \varphi(.)[\frac{T-A}{A}] \tag{2.11}$$

where T represent the world technology frontier. Assuming that T grows at an exogenous rate g (determined by the foreign country's R&D input and other factors), the dynamics of the catch up are defined by the system of differential equations formed by (2.11) and $dT/dt = gT$. By solving this system for the steady state, it can be shown that in the long run, the growth of A will be equal to g. This is rather intuitive because unless the growth rate of A equals the growth rate of T, the right hand side of (2.11) must be changing. This means that a country which starts at time t_0 with an initial technology gap $T_0 - A_0$ which is larger than the long run equilibrium level defined by $A/T = \varphi/(\varphi + g)$ will experience a rapid growth relative to g. Conversely, countries which start with a technology ratio above $\varphi/(\varphi+g)$ will experience growth rates lower than g. In this setting the functional form of equation (2.11) is somehow arbitrary because any functional form that satisfies the condition that knowledge growth is zero when in the catching up country when the technology gap is zero could be eligible. An alternative functional form that is more easily used for empirical analysis is[4] :

$$\frac{dA/dt}{A} = \ln[\frac{T}{A}\varphi(.)] \tag{2.12}$$

[4] See also Verspagen's (1991) specification.

Note, however, that the model only describes the rate of absorption of technologies from abroad and does not allow for domestic technology generation. In addition the implied growth rates are the technology growth rate and not the GDP growth rate. In the neoclassical and the endogenous growth models, these two rates will converge in the steady state.

2.6 Building Capabilities for Technology Adoption: The SID Approach

2.6.1 Introduction

From what we gathered above in the trade and catch-up theories, especially in the Verspagen (1991) and Rogers (2004) models, it appears that the amount and degree of sophistication of technology developing countries can adopt and efficiently utilise depend, among other factors, on their supply of technical and managerial skills and their interactions with technologically more advanced countries. For many, if not most developing countries, catching up technologically depends on the extent to which they are able to learn and position their technological policies to best take advantage of knowledge flows from developed as well as from other developing countries. In this respect, Juma et al. (2001) notes that many developing countries will have to move from natural resources extraction economies to knowledge-based ventures that add value to these natural resources. These authors observe moreover that all these changes require a shift in public policy at the national and global level because domestic innovation will not be possible without access to international markets and likewise, access to international markets cannot be achieved without domestic technological innovation.

Various theoretical arguments and empirical evidence show that the realisation of technological improvements in developing countries is closely related to their level of human capital (Nelson and Phelps, 1966; Abramovitz, 1986; Benhabib and Spiegel, 1994; 2002; Xu, 2000). This implies that development policy targeting technology acquisition and the reduction of the technology gap must be aimed at facilitating the interaction between technology flows and human skills. Indeed some developing countries in East Asia and Latin America have been successful in narrowing the technology gap in a few decades, and their educational attainment is credited for much of this achievement (Lall, 1992a; Kim et al., 1987; Jomo, K.S., 2000; Rasiah, 1998).

Economically successful countries are those that have been able to transform scientific knowledge and technical innovation into profitable economic productivity. Such economies succeeded technologically because they possess a complex, integrated system of human capital, infrastructures and institutions for translating new knowledge and innovation into economically viable new products and processes (Feinson, 2003). Such systems, now known as “National Innovation Systems (NIS) have increasingly been recognised both as a supplement and as an alternative analytical framework to standard macroeconomic perspective on development.

However as a result of institutional and contextual difference between developed and developing countries, a specific perspective on NIS, which has become to be known in the literature as Systems of Innovation for Development (SID) has been advanced by Edquist, 2001) as more appropriate for analysing capability building and technological catch up in developing countries. This section presents the SID approach to capability building and lays out the SID framework for devising strategies aimed at tapping from technology flows between advanced and lagging countries to affect innovation and productivity growth in the latter.

2.6.2 NIS as Analytical Framework for Knowledge Flows

It is increasingly accepted that innovation is one of the most important source of competitive advantage and long-term economic growth in all countries. In essence, successful economic development is intimately linked to a nation’s capacity to acquire, absorb, apply and disseminate modern technology within its economy. Such a capacity is anchored in the country’s NIS. According to Lundvall (1992), the concept of national systems of innovation can be traced back to Friedrich List (1841), who advocated a wide set of national institutions (such as those related to liberties and public justice as well as those engaged in education and training) as well as infrastructures (like networks of transportation of people and commodities) as crucial to the process of the development of productive forces. Indeed, List’s "National System of Political Economy", with its extensive plea for the primacy of manufacturing power over dependence onraw material production, lays out the major concepts of the modern theory of National Systems of Innovation and contains all of its main pilars. A national innovation system can thus be seen as a historically grown subsystem of the national economy in which various organisations and institutions interact and influence each other in the carrying out of innovative activities. For developing countries, challenges and the resource requirements associated with setting up an adequate innovation system are thus similar to those of making it function properly and meet its objectives of stimulating innovation.

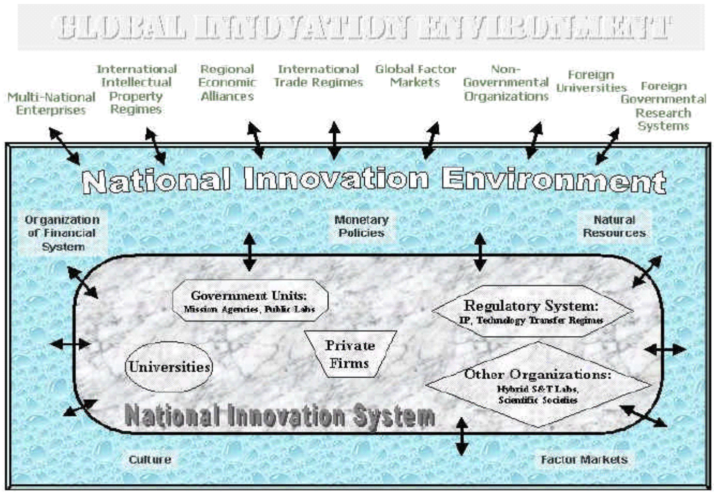
In other words, national innovation systems are complexes of regulations, institutions, human capital and government programs involved in the process of linking science and technology to economy (Feinson, 2003). The modern revival of this concept has emerged some 20 years ago, under various approaches including the Aalborg University approach (Lundvall, 1985) and the US- approach (Nelson, 1988). This notion of NIS was introduced into contemporary debate by Freeman (1987: p.1) who defined it as "the network of institutions in the public and private sectors whose activities and interaction initiate, import modify and diffuse new technologies".

2.6.3 Actors, Institutions and Linkages in a National System of Innovation

Various attempts have been made to schematise the flow of information and resources between environment and national systems of innovation and to map the actors and linkages that make them function. An analytical distinction has been made between a narrow innovation system concept, which includes the institutions and policies directly involved in scientific and technological innovation and a broad NIS perspective which takes into account the cultural, social and political environment of the country being examined. The narrow version is an integrated system of economic and institutional agents directly linked to the promotion of the generation and use of innovation in the national economy (Adeoti, 2002), whereas the broad version includes, in addition to the components of the narrow system, all economic, political and social institutions affecting learning, research and innovation activities.

Schematically, NIS can thus be represented as a systemic structure of people, organisations and institutions interacting to fulfil various interconnected functions that are essential to effecting technological change (Figure2.1). Alternatively, it can be represented as a set of actors, institutions and linkages that together implement the innovation strategy. To understand the functioning of innovation systems, it is indispensable to conceptualise the knowledge flows and linkages among its actors.

The broad definitions of NIS includes, in addition to the above components, all institutions affecting learning and research in a country, e.g. a nation's financial system, its monetary policy, the internal organisation of private firms, the pre-university educational system, labour markets regulatory policies and institutions. Conceptually, the narrow is embedded within the broad system as depicted in the OECD schematic representation of figure 2.2.



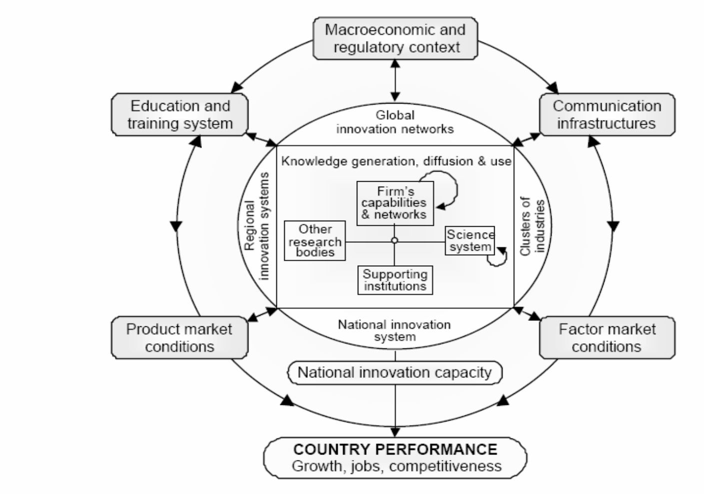
Source: Sarewitz (2003: p. 6)

FIGURE 2.1. *National System of Innovation and its environment*

The NIS linkages which reflect the absorptive capacity of the entire system are determined by the flow of knowledge and resources between the narrow and the broad levels and amongst the institutions and organisations through the formal and the informal channels. The individual institutions that make up both the broad and the narrow innovation system are important, but the intensity and variability of knowledge flows among constituents of a national system are the critical determinant of its functioning (Feinson, 2003). For this reason, it has been suggested that policy makers should shift their interest from steady structures and absolute measures of innovative activities to the different types of interaction among actors within and beyond the boundaries of a national system of innovation.

While a great variety can be found in national economies and tremendous complexities exist within the systems themselves, it is possible to identify the key actors and the main functions of innovation systems. According to the OECD (1999), innovation systems institutions and actors, defined in the narrow context, can be divided into five main categories:

- Governments (local, regional, national and international with different weights by countries) that play a key role in setting broad policy direction;
- Bridging institutions such as research councils and research associations which act as intermediaries between government and the performers of the research;
- Private enterprises and research institutes they finance;
- Universities and related institutions that provide key knowledge and skills;



Source: OECD (1999): Managing National Innovation Systems

FIGURE 2.2. *Actors and linkages in the innovation system*

- Other public and private organisations that play a role in the national innovation systems (public laboratories, technology transfer organisations, joint research institutes patent offices training organisations, etc.)

The production of technological knowledge is not sufficient to generate technological innovation. The critical role of NIS is the circulation of knowledge and resources between enterprises and other actors involved in the implementation technological progress. For innovation systems to be a catalyst of sustainable technical change, they must fulfil the following functions, as stressed by Johnson (2001):[5]

- Supply of incentives for firms to engage in innovative activities;
- Supply resources (capital and competences);
- Guide the direction in which actors deploy resources;
- Recognise the potential for growth;
- Facilitate the exchange of information and knowledge;
- Stimulate or create markets;
- Reduce social uncertainty about how others will act and react;
- Provide legitimacy for the innovation.

[5] Alternative lists of NIS functions have been suggested by Rickne (2001), Johnson and Jacobson (2001), Liu and White (2001), Jacobson et al. (2004) and Hekkert et al. (2005), but all share the same core functions and attributes.

Hekkert et al. (2005) propose a set of indicators that may be used to assess the fulfilment of these functions in a system of innovation. As a result of interactions among the various functions, they may have reinforcing features, as the fulfilment of a given function might have a positive effect on the other and vice-versa. The overall performance of the system is thus to be assessed on the basis of the overall diffusion of technology over time.

2.6.4 Distinguishing Between Developed and Developing Countries' NIS

The application of NIS as a framework of analysis must be articulated around the various functions that national innovation systems perform. This means that countries, industrial sectors and firms assess their success in effecting technological change by evaluating the overall performance of the functions of their innovation systems. However, as a consequence of contextual and institutional differences between developed and developing countries' innovation systems, it has been argued that developing countries need their own specific approach to NIS (Juma et al., 2001). One of the arguments in favour of specific approach to NIS in developing countries is that NIS are more at odds with neoclassical theories of growth in developing countries as indicated by Lundvall (1997). This has led Edquist (2001) to propose the concept of Systems of Innovation for Development (SID), which has a number of key differences with the NIS approach taken in developed countries:

- Product innovations are more important than process innovations because of effect on the product structure;
- Small, incremental innovation are more important and more attainable than radical ones;
- Absorption (diffusion) of existing technologies is more important than development of innovations that are new to the world;
- Innovations in low and medium technologies are more attainable than those in high technology systems or technology frontier.

Viotti (2002) also refutes the usefulness of the NIS concept in analysing the case of technological laggards when he points out:

"The NIS approach is not appropriate for dealing with the processes of technical change typical of industrializing economies, which are extremely different from those of industrialised countries". (p. 654).

Based on this critique, he develops the notion of *national learning system* (NLS) as an alternative more suited to the developing countries context. Along the same line, Bell and Pavitt (1993) equally noted various contrasts in the mechanisms of technological change between developed and developing countries and observed that efficiency does not follow automatically from the acquisition of foreign machinery embodying new technology and the accumulation of related operating know-how by developing countries.

The difference of context between developed and developing countries explains why development scholars have put emphasis on the building of absorptive capacity by developing nations or their ability to acquire, learn and implement the technologies and associated practices already in use in developed countries (Dahlman and Nelson, 1995). The promotion of learning and national absorptive capacity through various components of the national systems of innovation is indispensable for long-term industrial and economic development. As a consequence, the focus of absorptive capacity shifts the emphasis for developing countries from innovation to learning, both passive and active.

Under this approach, the most important attribute of NIS is to stimulate technological learning. Though not sufficient alone, active learning is a necessary condition to achieve long term, sustainable development. This explains why development scholars have put emphasis on the building of absorptive capacity by developing nations or their ability to acquire, learn and implement the technologies and associated practices already in use in developed countries (Dahlman and Nelson, 1995). The promotion of learning and national absorptive capacity through various components of the national systems of innovation is thus indispensable for long-term industrial and economic development. We now turn to some of the elements of the systems of innovations in both South Africa and Botswana in order to examine how they stimulate interactions and technology flows between the two countries.

Passive learners absorb the technological capabilities for production, using a kind of black-box approach, while active learners master technology and its improvements through a deliberate learning effort (Juma et al., 2001). The choice of passive versus active learning has therefore profound implications on a country's ability to achieve the type of growth that will ultimately improve the living standards and well being of its citizens. Juma et al. (2001) stress that passive learners are doomed to remain underdeveloped in the long run because they depend on spurious competitiveness such as low wages, natural resources depletion or state protection. Though not sufficient alone, active learning is a necessary condition to achieve long term, sustainable development. Analysis of development problems should be understood in this context.

2.6.5 SID Framework: Technological Learning and Capabilities

In order to be able to devise a sustainable and successful development strategy, a set of minimum conditions regarding the SID must be fulfilled. As the famous Chinese strategist Sun Zu once wrote, a general who does not know himself and does not know his enemy is doomed to loose all his battles. Likewise, a country that does not know its capabilities nor the challenges it has to face on its development path, will most probably lose the battle for technological and economic development. Knowing oneself supposes having developed the capabilities to correctly asses what one can achieve and the forces and resources needed to achieve it. This systems approach is based on human capital, learning and absorptive capacity necessary to organise institutions, to build and manage infrastructure, and to create the necessary policy environment in which capital accumulation, trade and technology adoption work together for the purpose of achieving economic growth and poverty reduction.

For the purpose of industrialisation, the OECD framework provides the tools to asses the existence of development conditions. According to the OECD (1987) *"... over the longer term, economic growth arises from the interplay of incentives and capabilities. The capabilities define the best that can be achieved; while the incentives guide the use of capabilities and indeed stimulate their expansion, renewal or disappearance. Institutions set the rules of the game and intervene directly in the play; they act to alter capabilities and change incentives and they can modify behaviour by changing attitudes and expectations" (OECD, 1987: p. 18).*

Lall (1992a) uses this three-pronged approach involving the interplay of *incentives*, *capabilities* and *institutions* to analyse numerous factors that influence the national technological capabilities in developing countries. He groups *technological capabilities* at the national level under three broad headings: **physical investment**, **human capital** and **technological effort**. According to Lall, these three are strongly intertwined in ways that make it difficult to identify their separate contribution to national technological performance, but they do not go automatically together: if physical capital is accumulated without the skills or the technology needed to operate it efficiently, national technologic capability will not develop adequately. Likewise, if formal skills are created but not combined with technological effort and supported by a financial system that provides needed financial resources, efficiency will not increase in a dynamic way.

Human capital here is meant to include, not only the skills generated by the formal education and training, but also those created by the on-the-job training and experience of technological activity and the legacy of inherited skills, attitudes and abilities that aid industrial development. Literacy at primary and secondary education is essential for any efficient form of industrialisation and may be largely sufficient for early industrialisation effort utilising simple technologies. However, as more sophisticated technologies are adopted, the need for more advanced, specialised skills on the part of both the workforce and management emerges and becomes increasingly important.

Moreover, even a trained labour force and *physical capital* are only fully productive when they can be combined with efforts consented by productive enterprises to assimilate and improve upon the relevant technologies. Such *technological efforts* comprise a broad spectrum of production design and research work within firms backed up by a technological infrastructure that provides information standards, basic scientific knowledge and various facilities that are too large to be owned by a private firm (Lall, 1992a). Technological effort is therefore equally crucial to the development of efficient industrial capabilities.

Both physical and human capital are necessary for industrial development, but they will not be effectively utilised in the absence of an appropriate structure of *incentives* for investment and production. Incentives arising from market forces, institutional functioning and government policies affect the pace of accumulation of capital and skills, the types of capital purchased and the types of skills learnt and the extent to which existing endowments are exploited in the production system. They determine the choices made by firms, other NIS actors and all economic entities about where to commit resources and how much of the resources to commit in the pursuit of their strategies.

Lall (1992a) points out that the incentive system comprises both the neoclassical prescription of export orientation as well as internal competition and sufficient selective protection to allow diversification and deepening to take place. In most developing countries, the role of government policies is of great importance because structural and market failure call for remedial actions by state intervention. However, care must be exercised to avoid excessive or misjudged intervention; even justifiable interventions must be judiciously administered. Incentives are classified in three broad categories: macroeconomic stability, competition and factor markets conditions.

Macroeconomic incentives: GNP growth rate and stability price change, interest rates exchange rates, credit and foreign exchange availability as well as political stability and exogenous shocks like sudden deterioration of terms of trade. They shape the climate within which all other incentives interact to optimise resource allocation.

Competition: While acknowledging the benefits of free market competition, most economic theories accept that interventions in the incentive framework of free trade in the form of infant industry protection or promotion , as advocated by List (1841), are sometimes needed to overcome many market failures affecting resource allocation. Such interventions must be selective, requiring that policy identifies specific sectors activities or even firms for promotion over others to exploit their superior growth potential linkages or externalities. Authorities in charge of development policy should be able to identify suitable activities for protection. Protection should not be too widespread, indiscriminate or prolonged, and should be offset by other incentives for increased efficiency. Competent authorities should be able to correct protection mistakes if they occur and they must be given resources and political strength to do that.

Incentives from factor markets: For an efficient resources allocation, properly functioning of capital markets, labour markets and technology markets with relative factor prices reflecting the scarcity of factors are indispensable. Some selective market intervention by the government to optimise social returns, such as guiding education and training towards certain industry needs, may be necessary or even inevitable.

Institutions: The importance of institutions in shaping the framework within which economic development takes place has been underscored since the illustrious work of List(1841), who observed that everywhere and at all times the well-being of nations had been in equal proportion to the intelligence, morality, and industry of their citizens but who recognised that

> *"however industrious, thrifty, inventive, and intelligent, individual citizens might be, they could not make up for the lack of free institutions"*(ch.10).

This view has been further advocated among others by North and Thomas (1973) and Acemoglu, Johnson and Robinson (2003; 2004). In North and Thomas's view, institutions form the fundamental explanation of comparative growth differences, because they structure incentives in human exchanges, whether political, social, or economic. North (1990) has defined institutions as follows: *"Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interactions"* (North, 1990: p. 3).

According to Acemoglu et al. (2004), who emphasise property rights and markets, economic institutions are of primary importance to economic outcomes because they influence the structure of economic incentives in society. Without property rights, individuals will not have the incentive to invest in physical or human capital or adopt more efficient technologies. Economic institutions are also important because they help to allocate resources to their most efficient use: they determine who gets profits, revenues and residual rights of control. As a consequence, the absence of market institutions causes gains from trade to go unexploited and resources to be misallocated. Institutions are therefore the fundamental cause of income differences and long-run growth. Societies with economic institutions that facilitate and encourage factor accumulation, innovation and the efficient allocation of resources will prosper more than those that do not.

Institutions reflect thus the 'rules of the game' that emerge from the functioning of the market and facilitate transactions, interactions and learning. Institutions act to alter capabilities and change incentives and they can modify behaviour by changing expectations and attitudes. According to Lall (1992 a), the development of capabilities and the allocation of incentives express themselves only through specific market and non-market institutions that emerge naturally from the functioning of markets. As a result of market failure or rigidities in the existing system, appropriate institutions may fail to emerge. If they do not emerge by themselves the development of a proper institutional framework must become a priority. As a prominent actor in the innovation system, the government has the ultimate responsibility to contribute to the formation of human and social capital as well as the institutional framework needed to evaluate, choose, implement and modify foreign technologies.

2.7 Summary and Conclusions

The lack of modern production technology has widely been recognised as the main reason why some countries remain at low levels of productivity. The growth models reviewed above have therefore emphasised the central role played by technology generation and utilisation in crafting a long term growth advantage. In the classical and neoclassical growth theories, capital accumulation and labour specialisation were central to generating efficiency-related growth effects. In the long run however, when factor accumulation has reached its limits, technological change is the main engine of economic growth. Under the neoclassical perspective, even though some costs to technology acquisition are recognised, technology is assumed to be freely available and readily applicable by all firms in all countries. Accordingly, the main precept one can draw from this view is that, market working will ensure technology flows across countries provided that backward countries remove all institutional distortions and impediments to the free flow of goods, services and cross-border capital investment. Given the actual huge costs involved in generating or even imitating real world technologies (for instance, the pioneering of the aircraft technology has claimed many human lives and huge financial resources before it could really take-off), the neoclassical view on technology acquisition is of limited guidance for developing countries seeking to escape primary commodity dependence.

In the endogenous growth theories, only continuous innovation through the generation of new ideas for new products provides a competitive and sustainable source of growth advantage. Whether technological innovation comes in the form of expansion of the existing varieties as in Romer (1990), or in the form of creative destruction as in Aghion and Howitt (1992), it demands a costly investment in research and development and the promise of monopoly rent profits is necessary to induce entrepreneurs to invest in innovative activities. However, this monopoly protection by patents, trademarks or trade secrets, while deemed necessary for innovation, retards the diffusion of technologies and partly explains why sophisticated products are produced in developed countries while backward countries may remain confined to the supply of raw materials. The evolutionary perspective on technology development and diffusion highlights the selective potential (Silverberg, 1984; Soete and Turner, 1984; Silverberg and Lehnert, 1993), the lock-in effects resulting from network externalities or scale economies (David, 1985), the path dependency and the importance of selective environment for new technologies to be successful. The most profitable technologies determine the factor costs by setting wages that reinforce their prevalence and those that increase labour productivity the most, dominate the production pattern.

Under this view, one can then characterise the production of primary commodity in SSA countries as either the most profitable or as locked-in by external factors. However, while the evolutionary perspective offers convincing explanations for technology diffusion within relatively advanced countries, in many countries emerging from the Rostovian traditional first stage of development, the basic technologies used in the primary commodity production cannot be said to have competed with others and to have prevailed on the basis of their profitability or selective superiority. Arguably, the most plausible explanation is that this production pattern has been set up in the colonial period to supply the metropolitan industries with the needed raw materials (Korhonen, 1994) and may thus have resulted in a lock-in. Only the realisation that this production pattern has insidious consequences for the long-run development can induce those in charge of technology policy to bear the costs of breaking away from it.

The trade theories underscore the benefits of free trade and the role of technology in determining the comparative advantage in production, thereby in determining the direction of trade flows of goods and services. Classical trade theories were mainly based on labour productivity as a determinant of production efficiency and comparative advantage. However, List (1841) showed that free trade between economies before they reach the same level of technology and industrialisation was bound to weaken the productive capability and inhibit the development of the less advanced countries, making them dependent on the supply of raw materials to the leading economy, which would see its industrial and geostrategic supremacy further increased. Even the influential Heckscher-Ohlin trade model, while it emphasises factors endowment as the main determinant of the direction of trade, it recognises that technological change can shift the comparative advantage and reorient the trade directions. An inflow of new technology may thus help to raise labour productivity and shift comparative advantage in sectors that are not subject to declining terms of trade (see also Mayer, 2000).

Imitation-gap and product life-cycle theories, for their part, explain the emergence of technological imitation that may take place as a result of trade exposure to foreign products when factor cost advantage in the form of cheaper labour in the lagging country comes to be exploited to produce standardised goods with fairly established technology. The risk associated with innovation forces the innovators to keep the production of new goods close to the rich market in the early stages, and relocate production to sites with cheaper input factors only when technology has been fairly standardised. This results in a trade pattern in which the developed countries export new goods and may import old goods from developing countries for which the latter may have acquired a cost advantage, usually after the expiration of patent protection.

Again, these theories provide little guidance as to why many SSA countries have not developed competitive advantage in the manufacture of relatively standardised products using unskilled labour for which they enjoy a labour cost advantage. In sum, trade theories suggest that the gains from trade will lead to countries specialising in the production of some category of goods for which they enjoy a comparative advantage, but nothing is less true: rich trading nations are also those that have the greatest variety of traded goods and services. The more countries become efficient and successful in producing traded goods and services, the better they become at inventing new ones and successfully bringing them on the market. Therefore, from the primary commodity dependence point of view, specialisation does not necessarily coincide with comparative advantage.

The catch-up theories have emphasised the *advantages of backwardness* and the possibility of tapping from a large pool of available technologies to catch up with advanced countries. These advantages result from the fact that imitation costs are usually perceived to be lower than the cost of generating new technologies and imply the potential for benefiting from existing technologies at lower cost than the technology originator. These benefits may be exploited through spillovers from exposure to foreign direct investment (Findlay, 1978; see also Xu, 2000), through technological learning resulting from imports demonstration effects (Akamatsu,1962) or both (Abramovitz, 1986; Verspagen, 1991; Rogers, 2004). While these convergence theories predict faster growth rates for the more backward countries, they stress the necessity of investing in the development of sufficient levels of absorptive capacity or social capability to allow the lagging countries to learn foreign technologies and apply them in their domestic production. By stressing the necessity of threshold levels of human capital for technology adoption, catch-up theories are thus among the firsts to recognise that costs involved in acquiring or imitating foreign technologies can be substantial and even be prohibitively high, sometimes even higher than the costs of innovation when human capital levels are low (Mansfield et al., 1981).In this chapter, we have also presented the NSI in its developing country version (SID) as an alternative systemic approach to analyzing the development of adequate absorptive capacity for the catch-up process. The SID approach highlighted the interplay of human capital, physical infrastructure, technological efforts, appropriate incentives and institution necessary for a country to be able to take advantage of technology flows from abroad and build long-run dynamic comparative advantage.

In conclusion, growth, trade and catch-up theories provide useful insights into the reasons why technologically lagging countries do not produce sophisticated goods and may remain confined to low productivity because they are dependent on exploiting the natural resources for their trade relationships. For countries in traditional economies (corresponding more or less to the Rostovian first stage) to escape the dependence of primary commodities, they must be "seduced" not only by the consumption of interesting foreign goods (Akamatsu,1962), but also and above all by the production thereof. This requires that they develop the necessary capability to marshal human and financial resources needed to start local production of imported good. Such a process often demands active state intervention to raise and channel national savings (Gerschenkron,1962) or design appropriate industrial policies to facilitate the adoption of foreign technology and the survival of domestic firms (Akamatsu,1962).

Chapter 3

MODELING ABSORPTIVE CAPACITY AND DIVERSIFICATION

3.1 Introduction

In chapter 2, we reviewed how the different growth, trade and catch up theories can be used to explain the persistence of primary commodity dependence in backward countries. While the lack of technology for the production of more sophisticated products was identified as the generic reason for commodity dependence, the various theories provide different answers as to how this technology is generated and how it can be acquired and applied in the production processes of lagging countries, such as those in SSA. However, despite divergent views about technology generation and transmission to developing countries, the general conclusion from our analysis of literature in the previous chapter points to the requirement of sufficient levels of *absorptive capacity* as a *conditio sine qua non* for acquiring and effectively utilising foreign technologies needed to expand production beyond the primary commodities sector.

As already highlighted in the previous chapter, when catch-up theories were discussed, *absorptive capacity* is thus central to the process of economic growth in the technologically less advanced countries, because it enables them to exploit the backlog of technological knowledge already existing in developed countries (Verspagen, 1991). Criscuolo and Narula (2002) note that the concept of absorptive capacity as defined by Cohen and Levinthal (1989) can be extended to national level and be related to Abramovitz' (1986) notion of "social capability". Realising that the exploitation of the catch-up potential resulting from technological backwardness was dependent on the country's ability to harness foreign technologies, Abramovitz (1986) used this concept to refer to skills and technical competences as well as institutions and markets capable of mobilizing resources on large scale. The notions of national innovation systems and technological capabilities discussed above are thus closely related to absorptive capacity, defined as the ability to recognise the value of new, external knowledge, assimilate it and apply it to economic ends.

Narula (2004) also relates absorptive capacity to the notion of technological capabilities and identified its four main components, each of which is measurable by many indicators comprising basic and advanced infrastructure, firms and formal as well as informal institutions:

- **Basic infrastructure**
  - Telephones to provide basic telecommunication services and connect businesses with other economic actors
  - Roads, railways, airports and harbours to facilitate transportation and communication
  - Basic skilled human capital (primary and secondary education)
  - Electricity for energy supply to firms and households
  - Primary and secondary schools to provide basic education and skills
  - Hospitals to ensure a healthy labour force
- **Advanced infrastructure**
  - Universities
  - Advanced skilled human capital (tertiary education)
  - Research institutes
  - Banks, insurance firms
- **Firms**
  - Domestic firms with appropriate human and physical capital to internalise technology flows.
  - MNE affiliates (acting both as users and creators of technology flows)
- **Formal and informal institutions**
  - Intellectual property rights regime
  - Technical standards, weights and measures.

A close examination of these components reveals the prominent role played by the human capital in each of them: basic and advanced infrastructure must be managed, operated and maintained by qualified personnel; firms, advanced infrastructure and institutions need competent and skilled human capital to manage them and ensure their efficient functioning. Indeed, as Criscuolo and Narula (2002) indicate, much of the extant work at both the macro-level and micro-level correctly considers it axiomatic that the primary determinant behind technological accumulation and absorptive capacity is human capital. They stress the commonality shared between the definition of human capital and the concept of absorptive capacity and the fact that several empirical studies have in fact used human capital measures as proxies for absorptive capacity. Human capital is thus the core with which physical infrastructure and institutions interact to form absorptive capacity; its preponderant importance in capability building can't be overemphasised. During the catch-up stage, absorptive capacity supports the accumulation of technological knowledge, and technological advances support the further development of absorptive capacity in a cumulative, interactive and virtuous process.

In line with Lall's (1992a) taxonomy of technological capabilities, the above indicators of absorptive capacity can be grouped into three broad categories:

- Human capital required to internalise and utilise knowledge;
- Physical investment and infrastructure for energy, transport, health, and research facilities;
- Technological effort comprising a broad spectrum of production, design and research work by firms supported by a strong technological infrastructure

The problems resulting from dependence on primary commodities in developing countries and the technological learning benefits attributable to diversification form the background of this chapter in which we examine some of the factors that affect the level of export diversification. In this chapter, we take a closer look at absorptive capacity and pay ample attention to its various components in order to analyse how they affect diversification and thus help reduce primary commodity dependence. On the basis of empirical evidence of positive effects of human capital (Psachalopoulos, 1985; Hanushek, 1995; Grier, 2004), capital investments (Delong and Summers, 1991; 1992; Temple and Voth, 1998; Eaton and Kortum, 2001) and infrastructure (Aschauer, 1989; Easterly and Rebelo, 1993; World Bank, 1994) on growth performance and the relationship between growth performance and diversification (Herzer, 2005), this chapter analyses the individual and collective impact of human capital, investment in capital accumulation and the provision of infrastructure on the ability of developing countries to diversify their production and export basis away from the primary commodities into the manufacturing.

The next section reviews the theoretical and empirical literature relating human and physical capital (including public infrastructure) to economic performance and the evidence relating natural resources endowment and economic diversification to growth performance. Section 3.3 presents a multiplicative, log linear model linking elements of absorptive capacity to economic diversification. It specifies a relationship between human capital, physical capital accumulation, and infrastructure on the one hand and export diversification on the other. We test the relationship on a sample of SSA countries and estimate their effects in a cross-sectional regression analysis to check whether these effects may help explain the persistently weak growth performance in this part of the world. The results are subsequently discussed to provide a basis for policy recommendations and conclusions in the final section of the chapter.

3.2 The Role of Absorptive Capacity

This section reviews some of the empirical evidence linking human and physical capital to economic performance. We also lay a specific emphasis on the growth effects of public infrastructure and shed some light on the negative effects that may result form the abundance of natural resources. To better contextualise the components of absorptive capacity, we also examine the role played by agriculture in enabling the expansion of other sectors and analyse the importance of financial markets development in fuelling technology adoption.

3.2.1 Human Capital and Growth Performance

The role of human capital in supporting economic development and technological change has been extensively studied and its importance can now be considered as axiomatic[1]. However, the precise mechanism through which human capital supports economic development is still not fully and unambiguously understood and is still a subject of debate (see e.g. Meier and Rauch 2004). When educational attainment is used as a proxy for human capital, there are three main views that attempt to explain how education affects the production process and contributes to economic performance.

[1] Temple (2001) provides a rich and comprehensive review of the growth effects of education and social capital for the OECD countries, in which the various dimensions of human capital are extensively discussed.

The first view considers education as having the effect of increasing the labour "efficiency units" making an educated worker represent more labour units than an uneducated one in activities where they are perfect substitutes. Keeping the labour force constant, education increases thus the efficiency units of labour available for the production process in an economy and increase output per worker. The second view is that educated workers are able to perform complex tasks and are therefore not substitutable by unskilled workers. Technically skilled workers allow the economy to produce more technologically sophisticated goods and services and help the country to "move up the ladder". The third view associates education and skills of workers with learning and creation of new technologies that generate more output keeping constant the level of inputs. Applied to the case of developing countries, this view suggests that educated workers help the country to absorb, implement and diffuse foreign technology, thereby generate more growth. Benhabib and Spiegel (1994; 2002) used this approach and found evidence that human capital stock indeed facilitates the adoption of foreign technologies and the creation of appropriate domestic technologies.

The evidence linking education to economic performance has been established so well in micro as in macro level analysis. For example, Psacharopoulos (1985) uses the return to education approach to show that investing in education is roughly equivalent to investing in physical capital in developed countries while the return to education seems much higher in developing countries relative to industrial countries. In developing countries, returns to primary education are found to be higher than returns to secondary education, which are in turn higher than returns to university education. In addition, private rate of return is higher than social rate as a result of subsidisation of education. Especially at the university level, the general curriculum has a better return to education than the more costly vocational education. Investing in education has also been found to bring more benefits to female than to their male counterparts and educated people who subsequently work in the private sector are able to capture more returns to their education than those who will work in the public sector (Psacharopoulos, 1991).

The empirical evidence of the economic benefits of education on the macro level has been presented by many studies using the aggregate production function to show that increase in education level resulted in better quality of labour force that explains the technical change. As can be expected, these studies showed that the return to education is higher in less developed countries given their scarce human resource profiles. In a short but now influential paper, Nelson and Phelps (1966) presented a model linking investment in human capital to technological change. According to their findings, the ability of a nation to adopt and implement new technologies from abroad is a function of its stock of human capital. Ziesemer's (1991) human capital based growth model also stresses that technical progress in the production process cannot occur without using the available knowledge stock, because only trained brains produce ideas, while capital stock and labour only contribute to transforming these ideas into new products and services or producing more human capital. The speed of technological catch up and technology diffusion within an economy is thus a positive function of the available human capital.

3.2.2 Capital Investment and Economic Performance

The strong relationship between gross fixed capital formation (as a percentage of GDP) and subsequent growth rates since WWII has led many authors (like De Long and Summers 1991; 1992) to conclude that the rate of (physical) capital formation determines the rate of a country's economic growth. Drawing from the results of De Long and Summers, Temple and Voth (1998) examined the link between human capital, industrialisation and investment. They constructed a model with multiple equilibria, in which the accumulation of human capital triggers investment in equipment and drives industrialisation if the market size is sufficiently big to allow firms to cover large fixed costs. Empirical test of this model in stratified regressions reveals a high correlation between growth and equipment investment. This correlation is strongest in developing countries and falls with the extent of initial industrialisation. Temple and Voth (1998) interpreted this as an indication not only of diminishing returns to equipment investment, but also an indication of industrialisation as the driver of equipment investment, because explaining the regression coefficients by diminishing returns alone would imply unreasonably high rates of return.

Furthermore, some more recent empirical results rejected the existence of a causal effect between physical capital accumulation and economic growth. For example, following Lipsey and Kravis (1987) who found the growth rate to be more closely associated with the rate of capital formation in succeeding rather than in preceding periods, Blomstrom, Lipsey and Zejan (1994) tested the direction of causality between these two measures on a sample of 101 countries and found past growth to have a significant effect on current capital formation, even after controlling for lagged effects. No evidence of capital formation preceding economic growth was found.

However, Howitt and Aghion (1998) challenge the view presented by many neoclassical growth theorists that "*the driving force behind growth is the accumulation of* *knowledge... capital accumulation is not central to growth*"[2]. They develop a model linking technological advance to R&D effort, in which R&D are capital intensive and find knowledge and capital to be two complementary state variables determining the level of output at any point of time. For Howitt and Aghion, technological progress cannot be sustained indefinitely without capital accumulation. A subsidy to capital accumulation, either physical or human, is therefore recommended as it increases the steady state growth rate. The role of gross fixed capital formation in laying the foundation for industrial production is thus essential.

As we mentioned in the previous section, there is a strong association between gross domestic fixed capital formation (GDFCF) rates and economic growth, but the direction of causality is indeterminate. While growth can create investment opportunities that explain the subsequent expansion in investment and fixed capital formation, the accumulation of capital may also be the cause of labour productivity increase as the capital-labour ratio goes up, and therefore be the source of output growth. The relation between capital accumulation and the subsequent diversification may be expected to follow this latter logic and thus display a positive coefficient. A country that invests a bigger proportion of its output in capital formation is likely to accumulate more rapidly the infrastructure and equipment necessary to allow the country to diversify its production basis. Chile and Botswana provide a good example for such reasoning, where the accumulation of capital is mainly related to developing other sectors than the exploitation of primary commodities.

3.2.3 Public Infrastructure and Economic Performance

As Kuznetz (1971) or Meier and Rauch (2004) expressed it, achieving high per capita income without accumulation of modern infrastructure and investment in plant and equipment seems virtually impossible, save for a few countries endowed with enormous mineral wealth or oil. The World Bank's 1994 World Development Report also highlighted the multiple links between infrastructure and development. Infrastructure investments are widely recognised as an influential factor of economic growth. The influence of infrastructure on growth has been hypothesised to come either directly through the capital accumulation effects it represents or indirectly through the increase in total factor productivity (Fedderke and Bogetic, 2006). The provision of infrastructure in the form of public capital can thus be incorporated in a growth model to reflect expectation about its positive pay-offs (e.g. Barro, 1990). Although

[2] Olivier Blanchard, as quoted by Howitt and Aghion (1998), p. 115.

empirical estimates of the growth effects of public infrastructure have shown mixed results owing to methodological difficulties (results ranging from highly positive like Aschauer (1989) to values that are even negative like those of Hulten and Shwab (1991)), positive effects on aggregate TFP growth have been empirically shown by many subsequent studies like Easterly and Rebelo (1993) or Fedderke and Bogetic (2006) after controlling for the raised econometric issues.

One on the most obvious effects of public investment in infrastructure and the provision of infrastructural services is to facilitate private investments by lowering the production costs and opening access to new market or improving the servicing of existing ones. For developing countries, basic, industrial and technological infrastructure is necessary to support the processing of primary commodities or the initiation and expansion of manufacturing activities (Lall, 1992; Collier, 2002). For example, roads, railways and waterways reduce transportation costs while ports and airports increase the exposure to foreign products and force local firms to innovate in response to pressures of international competition. This can result in the creation of new production, trade and profit opportunities. Fedderke and Bogetic (2006) note that on basis of comparative experience from the 1990s, about one-fifth of Latin-American growth underperformance relative to East-Asia has been estimated by Easterly and Serven (2004) to be directly related to underinvestment in infrastructure, while Esfahani and Ramirez (2003) attribute Sub-Saharan Africa's poor growth performance at least partly to the deficient provision of electricity and telecommunication infrastructure. Not only the quantity, but also the quality of infrastructure is essential for facilitating growth and development. According to Estache (2005) Africa's annual growth rate would have been one percentage point higher if it had been able to provide Korea's level and quality of infrastructure. Investing in public infrastructure is thus vital to economic development as it can also be directly linked to better child health and human capital accumulation (Leipziger et al, 2003; Fedderke and Bogetich, 2006) or the achievement of MDG (Bogetic and Fedderke, 2006).

3.2.4 Natural Resources Endowment and the "resource curse"

The Paradox of Plenty

The analysis of the impact of natural resource abundance on economic performance has unveiled a seemingly paradoxical phenomenon called the "resource curse": the fact that high share of natural resource in the economy of a country tends to crowd out foreign capital, social capital, human capital, physical capital, and financial capital, thereby impeding economic growth across countries (Gylfason, 2004). The idea that natural resources might be more an economic curse than a blessing began to emerge in the 1980s. In this light, the term resource curse was first used by Auty in 1993 to describe how countries rich in natural resources were unable to use that wealth to boost their economies and how, counter-intuitively, these countries had lower economic growth than countries without such an abundance of natural resources.

Cross-country empirical evidence suggests that nations that depend heavily on their natural resources tend to have less trade and foreign investment, more corruption, less income equality, less political liberty, less education (in both spending and enrollment), less domestic investment, and less financial depth than other nations that are less well endowed with, or less dependent on natural resources (Gylfason, 2004). All of these factors have significant effects on long-run growth. Over the long term, growth may thus be hampered by the reliance on natural resources through the lack adequate investments, financial depth and human capital resources needed to sustain geconomic performance. The resource curse literature has essentially sought to explain why the economic performance of resource-rich countries has not been better than it has, and why natural resource endowments have actually been a liability rather than an advantage for economic growth in many cases of developing countries. In their seminal paper within this literature, Sachs and Warner (1995; 1997) hypothesise several mechanisms through which a negative relationship between natural resources and economic growth might operate. On the one hand, there are "social" mechanisms, by which they essentially mean that "easy riches" make people lazy and prompts them to neglecting education and productive investments. On the other hand, there are political economy explanations, namely that natural resources can give rise to mismanagement and rent-seeking behaviour, which inefficiently exhausts the public capital.

Numerous studies, ranging from Gelb (1988) to Auty et al. (1991), have equally shown a negative link between natural resource abundance and poor economic growth. Traditional arguments to explain the counterintuitive bad performance are economic in nature and suggest that resource booms limit structural diversification and technology accumulation, and generate rent-seeking and corruption that undermine effective spending of windfall gains (Gelb 1988; Gelb et al, 1991; Auty 1990). Some scholars, like Mehlum, Moene and Torvik (2005) or Robinson et al.(2005) put more emphasis on the institutional aspects of the resource curse as the major explanation for bad economic performance of resource endowed countries, arguing that "the real problem is how you spend [natural resource] rent income relative to other sources" (Gelb, 1986: p. 343). According to Robinson et al. (2005), overwhelming empirical evidence suggests that bad economic policies correlated with the resource rents are the culprits of the bad performance of countries experiencing a boom. Such bad policies include (but are not limited to):

- dysfunctional state behaviour and overspending resulting in unsustainable budgetary deficits;
- overextraction of resources above the socially efficient extraction path by discounting the future too much;
- misallocation of resources in the rest of the economy by increasing inefficient public sector employment to secure loyalty.

As a consequence, countries with institutions that promote accountability and state competence will shift the political behaviour away from patrimonial practices towards the use of rational and meritocratic criteria in allocating public sector resources. Such countries usually tend to benefit from resource booms since these institutions correct the nefarious political incentives that such booms create. Countries without such institutions however may suffer from a resource curse. In addition to the above economic, social and institutional explanations, other economic channels, namely declining terms of trade of primary exports relative to manufactures and declining world demand for primary goods relative to manufactures can add to the above-mentioned factors and reinforce the bad growth prospects of resource endowed countries.

Other channels often discussed in the literature through which resource endowments can actually hinder long-term economic growth also include: exchange rate appreciation, decline in terms of trade, volatility in export revenue, crowding out effects (of capital, human skills, etc), underinvestment in human capital, promotion of corruption, and political mismanagement. A detailed overview of such discussions of the resource curse mechanisms is provided by Gylfason (2004). All of these factors have significant implications for the long-run growth. Over the long term, growth may therefore be hampered by the reliance on natural resources through the lack adequate investments, financial depth and human capital resources needed to sustain economic performance.

Resource Boom and Dutch Disease

When the natural resources are abundant and are experiencing an export boom, capital and labour that would otherwise be used in the manufacturing sector are pulled into the resources sector as well as in the non-tradable sector, whose demand is also increased by the revenues from natural resources. The increased national revenue from the booming sector also often results in higher government spending (health, welfare, military) that increases the real exchange rate and raises wages.The boom in natural resources therefore shifts production factors from other sectors of economic activities, especially from manufacturing and other tradables. Such booms, accompanied by a shift of resources across sectors, tend to shrink the tradable manufacturing sector.The resource reallocation from the tradable sectors, notably agriculture and manufacturing, to the booming resources sector, makes the former less competitive in world markets. The weakening of the sectors exposed to international competition results in an even greater dependence on natural resource revenue and leaves the economy extremely vulnerable to price changes in the natural resource sector.

If the manufacturing sector has externalities such as forward or backward linkages, the shrinkage of the manufacturing of tradable goods results in chronic low growth, named the "Dutch disease" after the phenomenon observed in the Netherlands following the discovery of large gas reserves in the north of the country. The economy then loses the benefits from externalities as well as the advantages of learning effects and increasing return to scale that are usually associated with the manufacturing sector and often inexistent in the capital intensive mining sector. Although empirical evidence of better growth effects of manufacturing is still largely lacking, the view widely held by many scholars tends to reinforce the assumption that manufacturing has larger externalities than resource exploitation and many other forms of economic activities (Matsuyama, 1992; Sachs and Warner, 1995; 1997; Gylfason, 2001a; Tregenna, 2007). Indeed, primary exports usually have minimal forward and backward linkage with the rest of a domestic economy and a less complex division of labour and lower externality learning effects on growth relative to manufacturing.

Through the loss of externalities, the overvaluation of the exchange rate and some of the other channels as mentioned above, the Dutch disease can reduce total exports relative to GNP or at least skew the composition of exports away from manufacturing and service exports that would otherwise contribute more to economic growth (Gylfason and Zoega, 2001). This well-known phenomenon has occurred in countries like Nigeria, DR Congo, Zambia and many other resource-rich SSA countries, which have so far failed to translate resource abundance into equitable and sustainable growth. The "Dutch disease" is thus an economic paradox in which the boom in revenues from natural resource exports damages a nation's productive economic sectors by causing an appreciation of the real exchange rate and an increase of the wage rate. A boom in the revenue accruing from the export of natural resources may thus result in lower growth performance of the economy as a whole as a result of this phenomenon.

3.2.5 The Role of Agriculture

Agriculture, as a sector of economic activity refers not only to the food production, but covers in addition all activities essential to crop, fibres, flowers and phytopharmaceutical production, and all techniques for raising and processing livestock. Agriculture development has been essential for any form of human development and the human history is closely linked to the history of agriculture. Development in agricultural techniques and production has been a crucial factor in shaping social and economic change, including the diversification and specialisation of human activity. Agricultural productive capacity has been identified by List (1841) as one of the three main pillars on material prosperity together with manufacturing power and commerce, with which it must be developed in equal ratio for a country to preosper in the long run. In fact, as argued by Lewis (1954), industrialisation is dependent upon improvement in agriculture and economies in which agriculture is stagnant do not experience industrial development. Nurkse (1953) even asserts that the growth of industry in Britain would not have been possible without key improvements in agriculture (pp. 52-53). To illustrate its historically primordial importance, Appendix A3.1 briefly retraces the role of agriculture in the emergence of some of the earliest human civilisations of the Neolithic (Sumer, Egypt and Ancient China).

Though some African leaders have favoured industrialisation policies that neglected agriculture in their growth strategies, it is well known that agriculture plays a key role in the early stage of economic development, by stimulating growth and production, by fuelling the other sectors and creating linkages between them. For the development of other economic sectors to really take off, substantial masses of labour force need to move from the agriculture, while leaving enough productive capacity to supply the whole economy not only in food but also in raw materials needed for production in those new sectors. Clark (1940) and Kuznets (1955), as recalled by Szirmai (2005), had already pointed out that successful economic development goes through a **structural transformation** that involves the shift of factors and resources from the sector with low productivity, i.e. agriculture, to the industry sector where productivity is much higher and the pace of technical change is more rapid.

For many countries at an early stage of development, the mobilisation of resources needed for capital accumulation requirement in industrial sector depends on the ability to increase agricultural productivity. Transfer from the agriculture also provides resources needed to invest in public infrastructure for transport, communication and energy supply. Since the agricultural sector is the only domestic sector that can provide mobilisable labour and savings in early stages of development, the construction of a modern industrial sector must ineluctably start with an expansion of the agricultural production, but at the same time, with the mobilisation of productive resources from agriculture to industry as stressed by Szirmai (2005).

However, for such a reallocation to take place, countries at a low stage of economic development and labour productivity level must first find means to make a significant increase in food production (Collier, 2007), not only in order to deal with existing food shortages but also to alleviate the pressure caused by the increased prices of the imported foodstuff. This implies building a dynamic agricultural sector, which requires that a part of the agricultural surplus be devoted to building the agricultural sector itself as advocated by Timmer (1988). For the production of surplus food to give an impulse to the economic transformation, the subsistence farming production must gradually shift to large scale production for the market and the countries in question should develop the knowledge and facilities to process agricultural products further, to add value to them and ensure a better conservation. This can range from methods that help limit the losses at the harvesting of fresh agricultural products, to some form of (semi-) industrial processing and transformation into higher value-added food products that can serve not only the local market but also the export markets (Collier, 2007).

This move to processing activities enables a social transformation of citizens from subsistence peasants to agricultural entrepreneurs, if they are given the right incentives and facilities (market). A successful industrialisation process is thus to be preceded by an increase in agricultural productivity, because under Arthur Lewis's (1955) assumption of unlimited input, agricultural productivity increase does not automatically follow from the transfer of labour from agriculture to industry. This increased productivity in agriculture is necessary to supply the needed savings for domestic investments, production of enough food for the industry workers and raw material as industrial inputs. At the same time, agriculture must also generate, through export of cash crops, the foreign exchange necessary for import and foreign capital goods acquisition. Increased agricultural productivity is also necessary for the expansion of the market for industrial output, which makes it a cornerstone of any economic development. As emphasised by Timmer (1988), all of these roles are equally important for the process of economic development. Agriculture plays therefore a primordial role in the structural transformation and the transition from low to high productivity.

3.2.6 The Role of Financial Market Development

Financial Development-Growth Nexus

One of the most important lessons that the current financial crisis has taughtus is the importance of a sound financial system for the good functioning of firms in the real economy in both developed and developing countries. In technologically catching-up countries, the acquisition and mastering of foreign technologies also generally takes place on the firm level. The concept of absorptive capacity on firm level as defined by Cohen and Levinthal (1989) and the notion of firm capabilities encompass the ability to mobilise the financial resources needed to invest in the new production methods and techniques (i.e. investment capability)[3]. Financial development is thus an essential determinant of a country's absorptive capacity since it determines the leverage of the force through which the means for acquiring and absorbing foreign technologies are deployed within firms. Financial development refers to the development of the banking sector (La Porta et al., 2002), stock markets (Atje and Jovanovic, 1993; Levine and Zervos, 1998), and bond markets (Beck et al., 2001). A vast body of empirical literature of which Leeper and Gordon (1992), Roubini and Sala-i-Martin (1992), King and Levine (1993a, 1993b) constitute some of the early attempts, has empirically established a positive association between the degree of financial development and growth performance. These studies concluded in favour of a positive correlation between financial intermediation and productivity growth, as well as between financial development and capital accumulation.

Though the use of cross-section data by some of these studies has been criticised on the basis of not allowing to unambiguously determine the direction of causality, subsequent papers focusing on the issue of causality have also found that developed financial markets induce a strong growth and have thus concluded in favour of bidirectional causality (see, among others, Jung, 1986; Rajan and Zingales, 1998; Beck et al., 2000 and Calderon and Liu, 2003). The possibility that financial intermediation may be beneficial to growth is also evidenced in papers using panel data. Two of the influential papers are Levine et al. (2000) and Beck and Levine (2003), who use the general method of moments (GMM) and dynamic panel estimates and equally conclude in favour of a causal relationship.

---

[3] According to Lall et al. (1994), investment capabilities encompass the skills and information needed to identify feasible investment projects, to locate and purchase suitable (embodied and disembodied) technologies, to design and engineer the plant as well as to commission the plant and start up the operations.

Although some economists continue to disagree whether the state of the financial sector merely reflects a country's stage of economic development or whether it represents one of its key determinants (e.g. Robinson, 1952 or Levine, 2005: p. 867), there has been growing consensus since the 1990s, that services provided by financial markets are essential to economic development (Levine, 1997; King and Levine, 1993a; Greenwood and Jovanovic, 1990). The strong nexus between finance and growth or the level of economic development is thus widely accepted, even though its assumption of a uniform finance-growth nexus across countries has attracted new inquiries into this issue to analyse the difference of this link between developed and developing countries[4] .

Financial Markets and Financial Institutions

There are several channels through which the deepening process of financial development fosters economic growth. In the literature of development economics, the finance-growth nexus is usually thought to be operated through the facilitation of resource mobilisation that reduces the transaction costs of financing investments, and therefore, induces more investments (e.g., Merton and Bodie, 1995). For instance, financial development can help mobilise savings into large scale investment projects, allowing to reap the benefits of scale economies (compare to Abramovitz, 1986). It also helps improve the allocative efficiency of financial resources, and thus increase the returns to financial resources, which in turn raises productivity (e.g., King and Levine, 1993b; Beck et al., 2000).

Moreover, the deepening of financial development helps increase the marginal productivity of capital through the intermediation function of well-informed financial institutions,providing an effect of efficiency enhancement (e.g. King and Levine 1993b; Beck et al. 2000). Indeed, information asymmetry about the investment projects require ex ante evaluation and ex post monitoring by the investor, which in turn requires skills as well as costs. An individual investor usually does not have the necessary skills and the costs might be prohibitively high, while banks can do the job more efficiently by exploiting the law of large numbers to forecast the number of unsuccessful projects

[4] See e.g. Dufrénot, Mignon and Peguin-Feissole (2007), who employ PANIC analysis and cointegration in common factor models to examine the differences of the financial intermediation-growth nexus between the developed and developing countries. Their comparative regression analysis on the 1980-2006 period leads them to conclude that financial intermediation is a positive determinant of growth in developed countries, while it acts negatively on the economic growth of developing countries.

and the expected returns of the loans advanced to financing projects. By the specialisation and cost efficiency of banks in project evaluation and monitoring, savers can be assured of a safe return. In short, the bank is the institution through which savings are channelled into investment in the absence of a perfect insurance market for credit. Likewise, stock markets and bond markets serve to channel savings to companies, and by the principle of separation of ownership and management of corporate enterprises, stock markets play the role of resources mobilisation, while leaving the ownership risk and returns with the investor. This process is conducive to growth in the real economy. For a more comprehensive survey of this literature, Levine (2005) is a good example.

The important role played by financial institutions in mobilising resources for financing the development of absorptive capacity (e.g. large infrastructure projects) has led to the creation of the so-called Development Financial Institutions (DFIs) in many countries. Infrastructure financing is the principal objective of DFIs but they can also act to finance technology development projects. DFI funding for some types of emergent technologies can allow them to influence future commercialisation or success of these technologies. DFIs have thus often been used as technology policy instruments as well in the development or acquisition of new technology as in supporting their subsequent commercialisation (George and Prabhu, 2003). Both the positive role played by financial intermediation deepening and DFIs in supporting technology adoption imply that the development of a sufficient absorptive capacity in developing countries hinges on an adequate development of the banking services as well as the stock and bond markets.

3.3 Human Capital, Public Infrastructure and Diversification

For developing countries to engage in diversified productive activities, they must possess the required levels of absorptive capacity that enable them to identify, select, implement and disseminate various foreign technologies that can be applied in their production processes. This absorptive capacity, among many other definitions, can be defined at the national level as “the ability to learn and implement the technologies and associated practices of already developed countries” (Dahlman and Nelson, 1995). Following Lall’s (1992) taxonomy of capabilities, and national absorptive capacity components, we stress the importance of human capital, physical investment as well as basic and advanced infrastructure to provide a platform for industries to operate. These elements are necessary for firms to carry out and internalise technology flows, while formal and informal institutions to enable efficient interactions between economic actors and provide incentives for diversified economic activities.

3.3.1 Human Capital and Diversification

The importance of human capital for harnessing new technologies and carrying out all economic activities that lead to diversified production has been repeatedly underscored throughout this thesis. To give another example, Bowman and Anderson (1963) had already estimated that industrialisation and economic development of backward countries could not set in until the level of literacy among the male population had reached at least 40 percent[5]. The theoretical and empirical evidence presented in the previous section linking human capital and economic performance (see subsection 3.2) and the evidence linking diversification to economic growth (De Ferranti, 2000, Herzer, 2005) forms the basis for our hypothesizing a positive association between human capital and diversification as a by-product of technological learning and industrialisation. Following the findings of Borensztein et al.(1998), Azariadis and Drazen (1990), Xu (2000) and Benhabib and Spiegel (2002), whose results confirm a positive relationship between human capital levels and technological learning and diffusion, and Herzer (2005) who finds an empirical association between export diversification and growth performance through learning, we hypothesise a positive association between human capital at the disposal of a country and its capacity to diversify its export structure, therefore reduce the dependence on primary commodities.

3.3.2 Investment in Physical Capital

Likewise, we hypothesise a positive relationship between the level of investment in physical capital accumulation and the diversification potential of a country. However, as expressed in sub-section 3.2.2, although there is an empirical evidence of a strong association between gross domestic fixed capital formation rates and economic growth, the direction of causality is indeterminate. While growth can create investment opportunities that explain the subsequent expansion in investment and fixed capital formation, the accumulation of capital may also be the cause of labour productivity increase as the capital-labour ratio goes up, and therefore be the source of output growth. The relation between capital accumulation and the subsequent diversification

[5] They estimate however that beyond that threshold, further literacy has little additional effect on development until it exceeds 70% of the population.

may be expected to follow this latter logic and thus display a positive correlation. A country that invests a bigger proportion of its output in capital formation is likely to accumulate more rapidly the infrastructure and equipment necessary to allow the country to diversify its production basis. Chile and Botswana provide a good example for such reasoning, where the revenues from natural resource bonanza have been used for capital accumulation related to developing other sectors than the mere exploitation of the natural resources themselves.

3.3.3 Infrastructure and Diversification

Basic infrastructure is an important component of a country's absorptive capacity. In addition to human and physical capital, diversification in developing countries is dependent on the existence of sufficient basic and industrial infrastructure to provide energy, communication and transportation possibilities as well as train and cater for a skilled and healthy human capital. Basic infrastructure for health care and primary education to train and maintain a healthy and literate labour force is crucial for the structural transformation needed to diversify production. The more intensively a country can provide basic, advanced or technological infrastructure, the more various firms are likely to make use of it, thereby increasing the diversity of a country's production. If this diversity of production can be reflected in the export structure, then infrastructure will be positively associated with export diversification. However, countries also develop infrastructure that are specific to the exploitation and the transportation of primary commodities such as natural resources. Especially in developing countries, the provision of basic infrastructure is likely to be more linked to activities in the primary commodity sector than to other forms of industrial production. In SSA countries, where a majority of the population is dependent on agriculture, the importance of this activity must also be reflected in the infrastructure related to it. In that case, infrastructure will be associated with primary sector activities rather than diversification, especially at low level. The overall effect of infrastructure on diversification is thus dependent on its level and the intensity of its use by the various sectors of economic activity.

3.3.4 Other Factors Affecting Diversification

Obviously, the dependence on primary commodities in the export structure has various causes that are not directly linked to absorptive capacity. Natural resources endowment is the most salient reason why an economy may have a large share of primary commodities in its exports. As example, even a high-income, industrialised country such as Norway, with the world highest human development index in 2004, had 74% of its exports still composed of oil and fishing products because of its natural endowment in these products. This is valid for most oil exporters and other mineral rich countries such as Botswana, Democratic Republic of Congo, Zambia or Chile with their impressive reserves of diamonds, cobalt and other metal ores. A high share of primary commodities in exports means that the country's diversification is relatively low and this expected to be associated with low levels of human capital and infrastructure.

Other factors that are likely to influence the level of diversification include the level of per capita income and the population size. Countries with higher levels of income are more likely to be able to deploy larger resources in diversified economic activities, while at the same time the benefits of diversification are likely to foster per capita GDP growth. The link between per capita income levels and diversification is rooted in structural transformation, in which economic growth leads to a technological advancement that makes it possible to produce increasingly diverse goods and services, as argued among others by Kuznets (1971) and Matsuyama (2005). Diversification and growth in per capita income are thus intertwined aspects of the same complex phenomenon of "modern economic growth" as defined by Kuznets (1971). This also implies that increasing per capita output leads to modifications in the structure of the economy through a shift towards goods with higher demand elasticity. This mechanism, in turn, influences sectoral productivity which changes relative prices and consequently,modifies the structural composition of the economy, as highlighted by Parteka and Tamberi (2008). In short, not only does the number and quality of intermediate and produced final goods change, but also analogous changes are observable in all markets of supplied and demanded goods and services. The direction of causality between per capita income and the extent of diversification remains therefore indeterminate and using per capita income as an explanatory variable for diversification has the potency of carrying endogeneity bias. Moreover, many of the effects of per capita income are already captured by the infrastructure and investment variables effects, with which they are obviously correlated and from which they are hardly to be dissociated. Estimation of the diversification effects with the income per capita as one of the explanatory variables may thus entail, in addition to an endogeneity bias, also some multicollinearity problems[6].

[6] Parteka and Tamberi (2008) signal a similar problem of multicollinearity, whereby the significance of per capita as one of the explanatory variables for diversification (using a different measure of

As for the population size, countries with larger population sizes are more likely to develop varied technical and productive skills that can be deployed in different fields. Likewise, countries with populations spread over large geographical areas can benefit from distinct regional specialisation. Theoretical explanations on the link between the degree of diversification and the size of the country's economy can be found in the New Trade Theory (Dixit and Norman, 1980; Helpman and Krugman, 1985; Krugman, 1981) arguing that market size directly affects the degree of product differentiation. According to the view presented in monopolistic competition models, bigger countries can produce a wider range of products and thus reach a higher level of diversification, other things being equal. We therefore include country's population size as a control variable to capture these effects.

3.4 Estimation Model

In order to analyse the relationship between our components of absorptive capacity and the corresponding diversification, we express the diversification measure to be a multiplicative function of the levels of human capital, investment in physical capital accumulation and the available infrastructure. This means that for a country, the availability of human capital at a given point of time should increase the level of diversification observed at a future time. With a given level of human capital, a country investing more should also proportionally increase its diversification potential, while the availability of more infrastructure facilitate the business contacts and provides facilities and incentives for firms to engage in new activities. Intuitively, diversification should be positively related to each of these three variables.

In countries with a high reliance on products in the sectors of low value-added and low externalities, technological learning takes place only very slowly. Concentration is therefore expected to be decreased by increasing levels of absorptive capacity, at least when the latter's threshold levels have been reached. To account for these effects, our analysis will control for the measures of natural resources endowment for countries in which crude oil, natural gas or mineral ores represent an important share of their total export value. To control for the distortion that might be brought in this relationship by natural resources endowment, such as oil, natural gas or mineral ores, since the abundance of such resources tends to increase export concentration *ceteris paribus*,

diversification than ours) in a multivariate estimation disappears if this variable is put alongside other economic variables like free trade indicators.

we introduce the natural resources variable in the equation, which capture the effects of the endowment of these resources on the export concentration of the corresponding country.

We also control for the effects of population size as another source of diversification. We control for this effect by including population size variable in the model:

The simplified specification of this model takes the well known Cobb-Douglass functional form:

$$\begin{aligned} DIV &= C * HUMCAP^{\beta_1} * CAPINVEST^{\beta_2} * INFRAST^{\beta_3} \\ &\quad * NATRES^{\beta_4} * INCPC^{\beta_5} * POPUL^{\beta_6} * \xi, \end{aligned} \tag{3.1}$$

where $C, \beta_1, \beta_{2,}\ \beta_{3,}\ \beta_{4,}\ \beta_{5,}\ and\ \beta_6$ are constants, while $HUMCAP, CAPINVEST$, $INFRAST, NATRES, INCPC$ and $POPUL$ are respectively the measures of human capital stock, capital equipment investment, the relative infrastructure density, the share of natural resources in export, the level of per capita income and the population size in the period preceding the time at which the measure of diversification is recorded. $\xi$is a stochastic term representing the measurement error.

The length of the lag time between the measure of each element of absorptive capacity and its corresponding effect on export diversification/concentration can vary as a result of diverse factors. For example, the infrastructure usually changes only gradually and the level of infrastructure available at the beginning of the year of observation can reasonably be estimated to be operational and producing its effects in the same year. The infrastructure variable measure need therefore not be lagged. For human and physical capital to sort effects on productivity and diversification a more or less sizable period of time will be necessary. This form is analogous to the Cobb-Douglas production functional form, but without restriction on the exponent terms. This may be thought of as considering the diversification to be associated with the output produced with available infrastructure, human capital stock and capital accumulation as factor inputs. Taking the logs of both sides of equation (3.1), equating ln(C) to β_0 and $ln(\xi)$ to the stochastic error term ε, we obtain:

$$\begin{aligned} \ln(DIV) = {} & \beta_0 + \beta_1 * \ln(HUMCAP) + \beta_2 * \ln(CAPINVEST) + \\ & \beta_3 * \ln(INFRAST) + \beta_4 * \ln(NATRES) + \beta_5 * \ln(INCPC) + \\ & \beta_6 * \ln(POPUL) + \varepsilon \end{aligned} \tag{3.2}$$

3.5 Variable Measurement and Data

3.5.1 Measurement of Variables

Diversification (*DIV*): Our dependent variable, diversification, is a complex concept that is not directly measurable because it manifests itself under various aspects. It must reflect at the same time the spread of economic activities over various sectors and the degree to which each of these sectors contributes to the overall economy. However, there are measures that can be easily associated with the extent of diversification or conversely, with the extent of export concentration or dependence on primary commodities. We review briefly some indicators and indexes used in empirical literature to measure export diversification. The first and simplest indicator like the one used by Herzer (2005) measures export diversification by taking the number of export sectors (SITC-3 digit). An alternative way to this approach is to measure diversification indirectly by the share of primary commodities export in total exports. Primary commodities are the sum of all food items (SITC 0; 1; 22; 4) agricultural raw materials (SITC 2 less 22, 27, 28), fuels (SITC 3) and ores and metals (SITC 27; 28; 68). UNCTAD records data on primary commodities dependence in the export structure and these data are available in UNCTAD handbook for statistics.

Diversification can also be measured with a modified Finger-Kreinin (1979) measure of similarity in trade[7]. Such a diversification index is computed by measuring absolute deviation of the country share of trade from world structure and ranges from 0 to 1 reflecting the relative differences between the structure of trade of the country and the world average. However, as a result of its use of absolute value, this index is more difficult to handle in empirical analysis if one does not know exactly which observations have higher or lower shares than the average.

Another way to measure the export diversification structure of a country is to use the **Hirschman-Herfindahl concentration index** of the exports, such as the normalised index developed by the UNCTAD (UNCTAD,1995). It has been normalised to obtain values ranking from 0 to 1 (maximum concentration), according to the following formula:

$$H_j = \frac{\sqrt{\sum_{i=1}^{239} (\frac{x_{ij}}{X_j})^2} - \sqrt{1/239}}{1 - \sqrt{1/239}}$$

[7] See Finger and Kreinin (1979) for the definition and use of this measure.

where H_j = country j's concentration index; x_{ij} = value of exports of product i in country j;

$X_j = \sum_{i=1}^{239} x_{ij}$ and 239 = number of products (at the three-digit level of SITC, Revision 2).

The equivalent number (EN) of export sectors is the reciprocal of the Herfindahl concentration index (1/H) and can be directly used as a positive measure of diversification (see e.g. Neff, 1997). The UNCTAD data files contain records of both the Finger-Kreinin diversification index and the Herfindahl index as measure of respectively export diversification and concentration. They also record the shares of manufactured export in total export as well as the degree of dependence on primary commodities.

Another way of looking at diversification is taking the share of manufactured exports to total export. Instead of taking the concentration of primary commodities in total exports as a measure of primary commodity dependence, measuring the share of manufactured products in total exports provides a more direct indication of the extent to which the country in question has been able to establish forward linkages and reduce its dependence on primary commodities. This measure also inverts the expected signs of the association between the measure of diversification and the independent variables in comparison to the Herfindahl index measure. As our focus is on the dependence on primary commodities, we use the normalised Herfindahl index as a diversification measure to analyse how it is affected by the various components of basic absorptive capacity (see appendix 3A.1 for export diversification data).

For the explanatory variables, the measurement of the various indicators of absorptive capacity is done as follows:

Human capital ($HUMCAP$): Human capital is a broad concept that does not easily lend itself to measurement, since it is embodied in humans. It comprises, in addition to skills developed through education and formal training, all inherited and acquired skills and abilities, experiences, behaviours and attitudes that contribute to increasing the efficiency of economic activities. In empirical research, the measure of human capital has usually been a proxy related to educational attainment or literacy, because measures of the other aspects of human capital are more difficult to estimate reliably. In this study, we use educational attainment measures proposed by Barro and Lee (2001) in the form of the average number of years of schooling in the population and a measure of literacy as proxies for human capital.

Obviously, a measure of human capital that combines the aspects of quality and quantity of human capital stocks and flow measures would be more attractive. Measures such as those representing the per capita investment in human capital accumulation can play this role of incorporating quality, if one follows the logic that more resources invested in education per inhabitant increase not only the number, but also the quality of schools and the teaching they provide, and therefore improves the education quality as suggested by Hanushek (1995). However, owing to the lack of reliable data on educational expenditures and their relation to educational quality, such a measure cannot be used in this study. Other measures of human capital include the UNDP's human development records of educational attainment based on both literacy and combined gross enrolment rates in the primary, secondary and tertiary educational levels. The educational attainment and literacy data used for SSA countries are reported in Table 3.1.

Capital Accumulation ($CAPINVEST$): Investment in capital accumulation is measured by the ratio of gross fixed capital formation to total GDP. Such a measure has also been used in other studies measuring the role of physical capital accumulation, like Grier (2004). However, in a cross sectional analysis involving countries with a wide range of GDP magnitudes, the ratio may be less informative than the per capita investment. Indeed, a small developing country with a low population may for example be investing the same proportion of its GDP in capital accumulation as a rich, populous industrialised country, but since the outcome of investment in productive facilities is subject to scale economies, the effects of these two investments on diversification may be very different.

Infrastructure ($INFRAST$): For the measurement of infrastructure indicators, we start from the following three aspects of basic infrastructure as components of absorptive capacity that are also used by Fedderke and Bogetic (2006) for the case of South Africa:

- Telephones to provide communication services;
- Roads, railways, waterways, ports and airports for transportation facilities;
- Electricity and other energy sources and utilities.

However, as a consequence of the multiplicity of these various aspects, the measurement of infrastructure becomes much more complex than the other elements of absorptive capacity. Such a measure must take into account diverse aspects related to the public provision of basic facilities that facilitate economic activities in a country because they fulfil different functions. These basic infrastructure aspects can be measured by the density of paved roads and railways to allow transportation, the

TABLE 3.1. SSA countries and their educational achievement

Country	Popul 2002	GDPpc 2002	Literacy 19 99	Educ att	Country	Popul 2002	GDPpc 2002	Literacy 1999	Educ. att. (B& L)
Angola	11191768	2130	66.80	n.a	Liberia	3482211	840	52.12	3.35
Benin	7162921	1070	33.6	3.32	Madagascar	18040341	740	68.90	2.58
Botswana	1640115	8170	76.29	6.23	Malawi	12158924	580	59.29	3.63
Burkina Faso	13925313	1100	26.60	2.11	Mali	12291529	930	24.92	1.20
Burundi	6370609	630	46.80	1.23	Mauritania	3086859	2220	39.73	n.a
Cameroon	16380005	2000	70.00	4.15	Mauritius	1230602	10810	84.07	6.45
Cape Verde	418224	5000	72.92	n.a	Mozambique	19406703	1050	42.86	1.38
Central Afr. Rep	3799897	1170	45.33	3.42	Namibia	2030692	6210	81.32	7.11
Chad	9826419	1020	41.00	2.21	Niger	11665937	800	15.48	1.39
Comoros	671247	1690	55.67	n.a	Nigeria	1.29E+8	860	62.51	2.98
Congo (DRC)	60085804	700	65.50	4.14	Reunion	776948	5700	88.90	n.a
Congo, Rep of the	3039126	800	79.49	5.75	Rwanda	8440820	1270	65.53	2.98
Cote d'Ivoire	17298040	1500	47.65	5.16	Senegal	11126832	1580	36.47	3.15
Djibouti	476703	1990	67.90	2.10	Seychelles	81188	8232	91.90	7.48
Equatorial Guinea	535881	3130	85.70	2.14	Sierra Leone	6017643	520	29.60	3.13
Ethiopia	73053286	780	37.96	1.97	Somalia	8591629	520	37.60	n.a
Gabon	1389201	6590	63.20	2.33	Sudan	40187486	1820	56.48	2.65
Gambia	1593256	1720	40.10	3.02	Swaziland	1173900	4550	78.96	5.78
Ghana	21.029853	2130	70.32	5.67	Tanzania	36766356	670	73.84	3.09
Guinea	9467866	2100	35.90	1.86	Togo	5681519	1480	55.81	4.62
Guinea-Bissau	1416027	710	42.40	0.95	Uganda	27269482	1390	66.01	4.31
Kenya	33829590	1020	81.35	4.74	Zambia	11261795	840	77.26	5.97
Lesotho	1867035	2420	82.94	3.62	Zimbabwe	12746990	2400	87.87	5.99

Source: World Development indicators and Barro & Lee (2001) dataset production of electricity to supply the necessary energy to firms for their production activities, and the telecommunication facilities as measured for instance by the number of land and mobile telephone lines available per thousand inhabitants.

In order to circumvent the complexity caused by the diversity of basic infrastructure, we have constructed a measure of basic infrastructure score on the basis of relative density of roads and railways per land area, telephone lines per thousands inhabitants and electricity production in KWH per capita. The infrastructure score has been constructed as follows: for each of the three categories above (transportation, telecommunication, and energy), density has been computed for each country or territory as the total length of roads and railways per land area, total telephone landlines and mobile per thousand inhabitants and total KWH of electricity produced per inhabitant.

Then, for each country or territory, a relative score on each category was determined as its relative density with respect to that of the country with the best performance in that category. For example, Germany was found to have the highest density of railways and the relative scores on this category were calculated with respect to the German density. Finally, the country's basic infrastructure provision score was computed as an unweighted average of the different relative scores in each of the categories[8] (see appendix A.3.2 for details about the construction of infrastructure scores, data are reproduced for SSA alone).

$Natural\ resources$ ($NATRES$): Finally, the variable related natural resources endowment takes the value of the share of oil and mineral in export if the country is crude oil or natural gas exporter or when the share of mineral ores in exports accounts for more than 30 percent of its total exports.

3.5.2 Data Sources

The data on export diversification, Herfindahl export concentration index and share of oil, gas and other natural resources in export were taken from UNCTAD's Handbook of Statistics in its 2004 and 2005 editions and from COMTRADE. Data on per capita income are the PPP adjusted per capita GDP of the World Bank's World Development Indicators (WDI); educational attainment measures are those developed by Barro and

[8] Arundel, Bordoy and Hollanders (2002) indicate how the weighting indicators in a composite index can be an unsolvable problem unless one has a good and reliable measure of the underlying phenomenon. Most studies that developed a composite index either gave equal weightings to all indicators or a subjective weighting in simple units(see European Innovation Scoreboard 2002, Technical Paper no6: Methodological Report, p.11)

Lee (2001), and were corroborated by UNESCO data from the UIS data files. Data on infrastructure, and gross domestic fixed capital formation were also collected from the WDI and corroborated by data in CIA's World Factbook in its various yearly editions. Thanks for its extensive networks of information, these data seem highly reliable. All these data have been cross-checked from different sources to increase their reliability and where discrepancies were observed, they were relatively small and these differences could hardly affect the outcome of the regressions.

3.6 Empirical Results

For SSA and other developing countries, we expect the effects of human capital and infrastructure on diversification to be positive but weak in low-income countries in SSA, where the levels of educational attainment are presumably below the threshold levels needed to affect diversification in a significant way. We test the same relationship on SSA and on a larger sample comprising middle-income countries where the differences in level of human capital are more observable and the effects on diversification are likely to be significant. Our empirical analysis begins with the loglinear model, whose results are analysed in sub-sections 3.6.1 and 3.6.2. The model is further extended in section 3.6.3 with quadratic terms to deepen the analysis of the differences between SSA countries and the rest of the world. In section 3.6.3, we show that the quadratic model presents threshold effects that can help explain the differences between SSA and other countries.

3.6.1 Regression Results for the Log-linear Model

We begin our data analysis by running various cross-country regressions, starting with a global sample of all countries and territories for which we have data, and then distinguishing between sub-samples of SSA countries and non-SSA developing countries. For the full sample and each sub-sample, we estimate the effects of absorptive capacity components on diversification by regressing the log of the Herfindahl index for the year 2002 as the dependent variable on the various explanatory variables as presented above[9]. We also make use of two measures of human capital, the Barro and Lee measure of educational attainment and the rate of literacy, both of which taken for the year 1999, to check how sensitive the results are with respect to the used mea-

[9] Higher values of log of the Herfindahl index indicate higher concentration.

surement of human capital. The measure of infrastructure score used in the regression is also that calculated for the year 1999 while capital investment was calculated as average gross domestic fixed capital formation per capita over the period 1990-1999. All regressions are performed with White-heteroskedasticity robust standard errors.

Moreover, given the correlation between per capita income and most of the other independent variable as discussed above, our estimates as based on the specification of equation (3.2) would potentially suffer from problems of multicollinearity and endogeneity biases introduced by inclusion of the per capita income. One of the ways of dealing with this multicollinearity problem is dropping the most insignificant variable from the equation and observe what happens to our estimation. To show the effects of the biases introduced by the income variable, we present the results of regressions including it as one of the explanatory variables (Table 3.2 and Table 3.4) and without it (Table 3.3 and Table 3.5). These tables report the regression results where the first regression is performed on the full sample of cross-country data, the second on a sub sample consisting only of developing countries outside the SSA region and the third on the SSA sub-sample.

In the regressions featuring per capita income as one of the right-hand side variables (Table 3.2), all coefficients appear with the expected signs, but only the variables for human capital and natural resources are significant at the conventional level of 5%, while most other coefficients remain insignificant. This lack of significance is even more pronounced when we consider the sub-sample of non-SSA countries, where only the natural resource effects remain significant. The coefficient of per capita income regressor itself is also very insignificant throughout the three regressions.

In contrast to the previous results, the estimates of the regressions in which the per capita income has been dropped (3.3) the coefficients are significant at the 5% level for all regressors, with the exception of the capital investment, which remains insignificant in the three regressions. This is however not surprising since the causality between capital accumulation and diversification could be expected to be ambiguous as elaborated upon in the discussion of the causality between capital investment and growth. In the sub-sample of non SSA developing countries (regression B2) both the effects of educational attainment those of population size are very significant, while the effects of population size remain insignificant in SSA countries as can be observed in regression B3 run on the SSA sub-sample alone.

When we now use a different measure for human capital, namely the literacy rate (percentage of population aged 15 years and above that can read and write) that was present in 1999, the corresponding regressions run on the same sample and sub-

TABLE 3.2. Log linear estimates for diversification effects

Dependent variable: Diversification (log of Normalised Herfindahl index)						
Regression	Regressio A1: All countries		Regression A2: Non-SSA countries		Regression A3: SSA countries	
Variable(log)	Coeff	Std err	Coeff	Std err	Coeff	Std err
CONSTANT	1.798**	(0.838)	1.322***	(0.217)	-0.037	(1.647)
HUMCAP	-0.318***	(0.119)	-0.182	(0.179)	-0.231**	(0.108)
INFRAST	-0.143	(0.093)	-0.224	(0.136)	-0.142	(0.094)
CAPINVEST	-0.038	(0.066)	-0.031	(0.126)	0.022	(0.080)
NATRES	0.125***	(0.038)	0.173***	(0.039)	0.083***	(0.031)
INCPC	-0.014	(0.032)	0.009	(0.013)	-0.011	(0.024)
POPUL	-0.172	(0.119)	-0.197	(0.127)	-0.078	(0.058)
Prob. F-test	0.000		0.0000		0.012	
Adj. Rsquared	0.334		0.4784		0.439	
Root MSE	0.711		0.4902		0.422	
N0. obs	193		96		41	

White-heteroskedasticity robust standard errors in parentheses;
* = significant at10%, ** = significant at5%, *** = significant at1%.

TABLE 3.3. Diversification effects estimates (excluding per capita income from regressors)

Dependent variable: Diversification (log of Normalised Herfindahl index)						
Regression/	Regression B1: All countries		Regression B2: Non-SSA dev countr		Regression B3: SSA countries	
Variable(log)	Coeff	Std err	Coeff	Std err	Coeff	Std error
CONSTANT	1.815**	(0.816)	1.324**	(0.023)	-0.037	(0.635)
HUMCAP	0.327***	(0.118)	-0.243**	(0.119)	-0.202**	(0.107)
INFRAST	-0.141**	(0.063)	-0.214***	(0.076)	-0.191**	(0.104)
CAPINVEST	-0.039	(0.067)	-0.031	(0.125)	0.023	(0.081)
NATRES	0.114***	(0.037)	0.183***	(0.038)	0.082***	(0.030)
POPUL	-0.161***	(0.019)	-0.197***	(0.087)	-0.077	(0.057)
Prob. F-test	0.000		0.000		0.032	
Adj. Rsquared	0.485		0.528		0.492	
Root MSE	0.721		0.475		0.432	
N0. obs	193		96		41	

White-heteroskedasticity robust standard errors in parentheses;
* = significant at 10%, ** = significant at 5%, *** = significant at 1%

samples as in the previous tables show results that are congruent with the previous ones. As expected, the regressions featuring income per capita as explanatory variable (Table 3.4) suffer from the same multicollinearity bias problem as those presented in Table 3.2 and show insignificant results with the exception of natural resources and human capital. In the subsample consisting of SSA countries alone, even the significance of human capital drops out and only natural resources seem to affect export oncentration, while the infrastructure effect can be observed in the subsample of non SSA developing countries.

In contrast, when we drop this income variable from our estimation, all coefficients remain with the expected sign and are all significant at 1% level with the exception of capital accumulation rate (Table 3.5). The regression results are thus in line with our expectation that export diversification recorded in 2002 increased across countries with the increase of the measure of literacy that was present in the country three years earlier, as well as with the relative infrastructure density. If we exclude SSA countries from the sample, the regression results as reported in Table 3.5 (regression D2 in Table 3.5) show the same picture as the one provided under the educational attainment measure, with the coefficient of infrastructure also changing the significance level to 5% this time. The significance of all three variables in addition to natural resources is interesting, even though the explanatory power measure of the regression increases onl very marginally.

In the sub-sample consisting only of developing countries outside SSA (regression D3 in table 3.5), the coefficient for population remains highly significant, meaning that some differences in export diversification for non-SSA developing countries are attributable to differences in population size. The regression results do not remain in line with our expectation that exports concentration recorded in 2002 was a decreasing function of the measure of literacy that was present in the country three years earlier, but the effect of the level of basic infrastructure provision remain significant. It is interesting to note that infrastructure coefficients remain significant throughout all regressions.

If we now consider the SSA sub sample alone, regression D4 in the same table 3.5 run on the SSA sub-sample gives a somewhat different picture, in which only the coefficient for natural resources expressing the dependence on primary commodities, and the score of infrastructure provision remain statistically significant at 5%. Moreover, the rate of capital accumulation now seems to invert the sign and be positively associated with change in concentration, although its coefficient remains insignificant. For SSA

TABLE 3.4. Estimates of diversification effects with literacy as a measure for human capital

Dependent variable: Diversification (log of Normalised Herfindahl index)								
Regression	Regression C1: All countries		Regression C2: Non-SSA countries		Reg C3: Non-SSA, developing. ctr		Regression C4: SSA countries	
Variable(log)	Coeff	Std err	Coeff	Std err	Coeff	Std err	Coeff	Std err
CONSTANT	3.378***	(0.911)	4.63***	(1.233)	4.162	(1.573)	-0.338	(1.590)
HUMCAP(lit)	-0.465***	(0.154)	-0.621**	(0.293)	-0.292	(0.213)	-0.189	(0.207)
INFRAST	-0.168	(0.151)	-0.106	(0.074)	-0.147**	(0.069)	-0.229*	(0.126)
CAPINVEST	-0.048	(0.067)	-0.064	(0.075)	-0.127*	(0.073)	0.142	(0.086)
NATRES	0.111***	(0.034)	0.132***	(0.052)	0.187**	(0.036)	0.092***	(0.031)
INCPC	-0.012	(0.014)	-0.008	(0.011)	-0.011	(0.009)	0.007	(0.008)
POPUL	-0.168	(0.112)	-0.183	(0.118)	-0.216	(0.122)	0.095	(0.058)
Prob. F-test	0.000		0.000		0.000		0.021	
Adj. Rsquared	0.330		0.280		0.495		0.419	
Root MSE	0.708		0.156		0.483		0.424	
N0. obs	194		148		97		46	

White-heteroskedasticity robust standard errors in parentheses;
* = significant at 10%, ** = significant at 5%, *** = significant at 1%

TABLE 3.5. Estimates of diversification effects excluding per capita income from regressors

Dependent variable: Diversification (log of Normalised Herfindahl index)								
Regression	Regression D1: All countries		Regression D2: Non-SSA countries		Reg D3: Non-SSA, developing countries		Regression D4: SSA countries	
Variable(log)	Coeff	Std err	Coeff	Std err	Coeff	Std err	Coeff	Std err
CONSTANT	3.577***	(0.931)	4.740***	(1.259)	4.122***	(1.475)	-0.341	(1.587)
HUMCAP(lit)	-0.465***	(0.161)	-0.621**	(0.285)	-0.302	(0.252)	-0.192	(0.215)
INFRAST	-0.169***	(0.054)	-0.116**	(0.053)	-0.149**	(0.069)	-0.238**	(0.104)
CAPINVEST	-0.046	(0.065)	-0.063	(0.093)	-0.126**	(0.072)	0.174*	(0.087)
NATRES	0.122***	(0.037)	0.132***	(0.051)	0.189**	(0.037)	0.090**	(0.030)
POPUL	-0.180***	(0.019)	-0.192***	(0.018)	-0.207***	(0.022)	0.096	(0.061)
Prob. F-test	0.000		0.000		0.000		0.023	
Adj. Rsquared	0.352		0.291		0.496		0.424	
Root MSE	0.744		0.176		0.491		0.464	
N0. obs	194		148		97		46	

White-heteroskedasticity robust standard errors in parentheses;
* = significant at 10%, ** = significant at 5%, *** = significant at 1%

countries, infrastructure provision seem thus to be the factor with the most significant correlation with the export diversification. This underscores once again the crucial role played by infrastructure in building adequate absorptive capacity to stimulate the adoption of technologies that support export diversification. In addition to supporting diversification, infrastructure is however also intensively used by the primary sector itself and is indispensable for its expansion: some countries develop infrastructure that are specific to the exploitation and the transportation of natural resources to the ports for shipment abroad or for the exploitation of agricultural produce.

Such types of infrastructure play therefore a limited role in stimulating the development of other economic activities. A very familiar example of this is the Democratic Republic of Congo, where a high electricity production capacity was developed for the exploitation of copper and cobalt mines along with a railway link between the copper province of Katanga (Shaba) in the south-east of the country and the port of Matadi on the Atlantic coast for exporting the mineral ores. Moreover, railways are only exploited to a limited extent in many SSA countries and their density very often does not correspond to a proportional economic use relative to other developing and developed countries. In some of the SSA countries, extensive railway networks are often underutilised, if utilised at all in some areas, where seeing a train remains a remarkably unfamiliar event. In some other countries, the roads are also often in very bad maintenance conditions and unpaved ones remain impracticable during the rainy seasons that characterise many SSA countries.

The sign and significance of the results are thus entirely in line with our expectation as they also suggests that the absolute levels of infrastructure and their utilisation, investment and actual capital accumulation as well as educational attainment, though they are still low in many parts of SSA, have the potential to significantly affect the capabilities of African countries to break through into manufacturing and reduce the dependence on primary commodities. Moreover, it is reasonable to expect that, other things being equal, rich countries in terms of per capita GDP level will tend to have more diversified exports because they export a relatively higher total value of goods and services. However, although our results present coefficients pointing in that direction, these coefficients are not significant at conventional significance levels. This may be explained by the strong positive correlation between the other capacity variables and per capita income. The effects of per capita income on diversification may therefore have already been captured through infrastructure, capital investment and human capital, all of which tend to increase with the country's GDP per capita.

Another noteworthy result is that population size does not seem to have a sizable influence on explaining diversification differences in SSA countries in contrast to its high significance in explaining global differences and differences in other developing countries. This may express a somewhat uniform distribution of skills and economic activities across population groups in SSA and a low level of dissemination of specific knowledge and skills. Indeed, when the skills are similar and homogeneously distributed across the population, there are less diversification benefits to be gained from a larger population size in a country.

3.6.2 Is SSA Really Different?

It is irrefutable that Africa is badly endowed with educated labour. Wood (2000) has suggested that this is part of the explanation for Africa's lack of competitiveness in manufacturing. A comparison of the rate of return to human and physical capital in African manufacturing across five countries finds that the returns to human capital are systematically much lower than to physical capital (Bigsten et al., 1998). Low productivity is often attributed to a poorly educated labour force and defective or poor infrastructure.

The differences observed in regression results between the two samples, though small, call for further investigation of the contrast between SSA countries and other parts of the world. We check whether the above claims are supported by empirical evidence by performing the same regression on the sub-sample of only developing countries and removing all SSA countries to allow for a comparison. For simplicity in this operation, we take for developing countries in this sample only those whose PPP-adjusted per capita income was below USD 11,000 in 1999. If the difference is due, as we conjecture, to an overall low level of infrastructure, educational attainment, capital accumulation and a correspondingly low level of diversification, then running the regression on a sub-sample of non-SSA developing countries enables us to observe differences in the significance of the estimated coefficients as well as in the explained variances. This is precisely what happens in regression B2 of Table 3.3, whose adjusted R-squared is visibly higher, indicating that more variance is explained by the model in this sub-sample.

The significance of educational attainment vanishes, while that of infrastructure and population size as explanatory variables for diversification pattern increases tremendously as their p-values come again below 1%. This would tend to suggest that differences in diversification pattern in the other developing countries are more explained by the differences in infrastructure provision and population specialisation rather than by differences in educational attainment. We also note the higher and significant coefficient for infrastructure, meaning that if non SSA developing countries could increase their infrastructure level from their average of 10% of the most advanced countries to, say, 15%, which is a 50% increase, this would corresponds to a reduction of the export concentration index of 0.21*50%, or about 10% points on the normalised index from their average of 0.38 to almost 0. 34. Coefficients for SSA are somewhat lower.

Consistent with the Dutch disease hypothesis, the presence of natural resources tends to reduce the share of manufactured products in export and thus hamper export diversification. In this regression, the coefficient showing a positive relationship between population size and export diversification becomes highly significant again, confirming the idea that some relationships that are unobserved in SSA because of the too low values of the underlying driver of diversification may well be observed elsewhere in countries where the values are higher.

In contrast, SSA displays a completely different picture since apart from natural resources that are significant across regressions, only the infrastructure provision remains significant at 5% (regression D4, Table 3.5). The estimated coefficients for human capital, population and capital investment in the SSA sub-sample remain insignificant, which suggests that the relationship between these elements of absorptive capacity and export diversification is not observable when literacy is used to measure human capital. In regression D3, we also note the insignificance of the literacy coefficient, implying that diversification differences within developing countries are less explained by differences in literacy than global differences are. The relationships between the various components of absorptive capacity and the resulting potential for export diversification seem to present a different picture in SSA as compared to the rest of the world or to other developing countries irrespective of the measure of human capital we use.

3.6.3 Quadratic model and threshold level effects

In order to get a closer view of the contrast between Sub-Saharan African countries and the rest of the developing world in the relationship between its components of absorptive capacity and its export diversification, we investigate whether the relationship displays threshold effects by augmenting the above model with quadratic terms for human capital, infrastructure, investment and population in the regression. From here we leave the per capita income variable out of consideration for the problems of bias exposed above. The regression equation thus obtained is therefore:

$$\begin{aligned}
\ln(DIV) &= \beta_0 + \beta_1 * \ln(HUMCAP) + \beta_2 * \ln(CAPINVEST) + \\
&\quad \beta_3 * \ln(INFRAST) + \beta_4 * \ln(NATRES) + \beta_5 * \ln(POPUL) \\
&\quad + \beta_6 [\ln(HUMCAP)]^2 + \beta_7 * \ln[(CAPINVEST)]^2 + \\
&\quad \beta_8 * \ln[(INFRAST)]^2 + \beta_9 * [\ln(POPUL)]^2 + \varepsilon
\end{aligned} \tag{3.3}$$

Table 3.6 presents the regression results of the OLS estimation. The difference in patterns of significance of these estimates between the two sub-samples enables us to analyse the difference between SSA and the other developing countries. Since dropping the most insignificant regressors shifts the significance but wakens the regression fit by lowering the adjusted R-squared, we choose to use the estimates with the highest explanatory power for the purpose of comparison. The estimates as reported in regressions 8 and 9 are used to compare the two sub-samples on the basis of literacy as a measure of human capital, while the estimates of regression 8a and 9a make the same comparison on the basis of educational attainment in number of years of schooling. For the significance pattern, the estimates of regression 8 and 9 display remarkably significant quadratic terms for literacy, infrastructure and physical capital accumulation in the SSA suba sample as well as highly significant loglinear terms for literacy, infrastructure, capital accumulation and antural resources abundance. We note that both the the loglinear and the quadratic terms have significantly negative coefficients for infrastructure, while they display opposing signs for literacy and capital accumulation. The quadratic term for literacy has a negative coefficient with respect to the log of the normalised Herfindahl index while that for capital accumulation is positive. In the non-SSA developing countries only infrastructure present the same pattern of significancein both quadratic and loglinear terms (in addition to natural resource abundance, which has a positive association with export concentation in all regressions).With respect to the various components of absorptive capacity, there are thus clear indication of different effects between SSA and other developing countries. From the value of the coefficients in regression 8 for the SSA countries, we can compute the constrained maximum for literacy with regard to the concentration index, or, in other words, its minimum value for its association with more export diversification.

The partial regression relation with respect to literacy is:

$$\ln(DIV) = \tilde{} + 4.5804 * \ln(LITERACY) - 0.6598 * (\ln(LITERACY))^2 + constant \tag{3.4}$$

TABLE 3.6. Estimates of quadratic model: threshold effects

Dependent variable: Diversification (log of Normalised Herfindahl index)								
Regression/	Reg 8: SSA countr (literacy)		Reg 8a: SSA countr (educ. attainment)		Reg 9: Non-SSA, dev. ctr (lit.)		Reg 9a: Non-SSA, . dev. ctr (educ. att.)	
Variable(log)	Coeff	Std err	Coeff	Std err	Coeff	Std err	Coeff	Std err
CONSTANT	16.783**	(7.157)	1.136	(5.123)	30.847*	(6.538)	0.966	(1.662)
HUMCAP(ed att)			-0.148	(0.120)			-1.169	(0.177)
HUMCAP(lit)	4.580***	(1.696)			-9.723	(4.353)		
INFRAST	-1.764***	(0.606)	-0.069	(0.583)	-0.833***	(0.238)	-0.639***	(0.198)
CAPINVEST	-3.901***	(1.082)	0.227*	(0.118)	-1.567	(1.771)	-0.118	(0.099)
NATRES	-0.082**	(0.037)	0.073***	(0.033)	0.166***	(0.036)	0.172***	(0.039)
POPUL	-1.221	(0.772)	-0.472	(0.711)	0.181	(0.161)	-0.146	(0.181)
HUMCAPquadr			-0.037	(0.025)			0.036	(0.049)
HUMCAP(lit)quadr	-0.659***	(0.238)			1.116	(0.783)		
INFRAST quadr	-0.189**	(0.080)	0.027	(0.083)	-0.110***	(0.036)	-0.079***	(0.027)
CAPINVEST quadr	-0.195***	(0.054)	-0.005	(0.004)	0.064	(0.080)	0.003	(0.005)
POPUL quadr	0.037	(0.024)	0.013	(0.022)	-0.001	(0.005)	0.001	(0.006)
Prob. F-test	0.000		0.014		0.012		0.000	
Adj. Rsquared	0.445		0.311		0.538		0.522	
Root MSE	0.377		0.420		0.466		0.456	
N0. obs	46		41		97		87	

White-heteroskedasticity robust standard errors in parentheses;
* = significant at 10%, ** = significant at 5%, *** = significant at 1%

where˜stands for the remaining regressors. Taking the partial derivative with respect to ln(LITERACY), for a fixed left-hand side value and setting the partial derivative to zero, we can solve for the maximum value of ln(LITERACY) in this comparison or minimum positive association with export diversification of 3.47, corresponding to a literacy rate of approximately 32.17. Only for values above this maximum we get the effect of enhancing diversification. The SSA average is above this value. As can be seen in the literacy data for SSA in Table 3.1, some SSA countries still have a literacy rate below this level while many others are around or only slightly above it. However, the maximum value holds for the panel and not necessarily for single countries.

Likewise, looking at the coefficients for infrastructure we can compute the threshold level for infrastructure to be associated with more export diversification. The constrained (partial) extremum is given by differentiating the equation:

$$\ln(DIV) = \sim +(-0,1899) * [\ln(INFRAST)]^2 - 1,7637 * \ln(INFRAST) + constant \tag{3.5}$$

with respect to $\ln(INFRAST)$ and setting the derivative equal to zero. We obtain a maximum at the point where $\ln(INFRAST)$= -4.64, i.e. where infrastructure score is equal to 0.01. The SSA average of the infrastructure variable is larger than the threshold level, which implies that SSA as a whole has the potency to enjoy diversification benefits from increased infrastructure provision. Yet, from the data in Table 3.1, we note that although a large number of SSA countries are above this threshold, many SSA countries still have an infrastructure score that is close to or even below this calculated minimum level for diversification, though this minimum obtained for the sample of countries does not necessarily hold for individual countries.

By comparison, the same regression run on a the sub-sample of non-SSA developing countries (regression 9 in Table 3.6) does not present a significant quadratic term for literacy, which confirms the earlier highlighted contrast. The significance of both the linear and the quadratic terms in infrastructure, to the contrary, is visible in both subsamples and presents the same pattern, though the coefficients are somewhat larger in SSA. The appearance of a significantly positive quadratic term with a negative linear coefficient for the log of capital accumulation also reinforces the impression that countries with a more concentrated export structure tend to invest more in the accumulation of capital, most probably related to the exploitation of abundant resources.

When the Barro and Lee measure of educational attainment in average number of years of schooling is used for human capital variable, the quadratic term loses its significance in any of the SSA or other developing countries sub-samples (regressions 8a and 9a in Table 3.6). The adjusted R-squared of this regression also drops considerably, implying a better performance of literacy measure in explaining diversification differences. While we expected these effects to be present irrespective of the used human capital measure, their absence in regression 8a and 9a may suggests that differences in average number of years of schooling are relatively low across low income countries and do not sufficiently reflect human capital differences, therefore fail to explain export diversification differences. The higher adjusted R-squared values for regressions 8 and 9 as compared to 8a and 9a also justify the relative superiority of literacy in explaining cross country differences in diversification.

3.6.4 Robustness and Causality

Before drawing any meaningful conclusion about these results, we need to be reasonably assured that they are free from any gross misspecification errors and biases. Other elements such as openness, trade policies and institutions also have an influence on export diversification. Countries that export more are more likely to be open to trade in terms of trade restrictions, tariff and non-tariff barriers and other impediments. Various measures of trade openness exist which can be used to control for this dimension in the regression. Many other factors such as research and development efforts, market size and institutions like property rights and incentive regimes also play a role in stimulating diversification[10].

Obviously, diversification is driven by many other factors that are dependent on market conditions, competition, availability of resources and technologies necessary to invest profitably in new markets, goods and services. The precise relationship between these various factors and the level of the resulting export diversification is a complex issue and an attempt to exhaustively analyse the individual and collective effects of all relevant factors would be rather unnecessarily complicated.

In interpreting the results of the regression, the causality issue is crucial. Finding a statistical association is not enough to derive conclusions about the causality be-

[10] The effects of some of the institutional and policy variables on economic performance have been analysed in previous studies and do not necessitate to be dwelled on again here. Because there are many other factors affecting the diversification that cannot all be included in our specification, our estimated coefficients are likely to be slightly overestimated. However, even the inclusion of per capita GDP as a regressor to control for its effect turned out to lead to insignificant coefficients and has not yielded any additional information. Attempting to include more factors in our model would make it unnecessarily complex and reduce its usefulness.

tween the dependent and the independent variables. One of the ways to deal with this issue is to examine causality with the Granger method based on the idea that causes precede effects in time. In our cross sectional analysis it is unfortunately not possible to test causality between the dependent and the independent variables with the Granger method. However, we have implicitly incorporated this idea of causality by using values of the dependent variable to be explained by the lagged values of the independent that were measured a number of years before, to allow for these effects to take place. For education, a time lag of 3 years was chosen for their effects to manifest themselves while one year of lag was judged sufficient for capital investment. The constraints on consecutive data availability did not allow a panel analysis which would have permitted to better incorporate the time and causality effects. Lack of time series of the measure for diversification did not allow a proper causality test in the sense of Granger method.

3.7 Summary and Conclusions

The problems resulting from dependence on primary commodities in developing countries as well as the technological learning benefits attributable to diversification form the background of this inquiry into the factors affecting diversification and their effects on reducing primary commodity dependence. In this chapter, we have examined some of the factors that affect the level of export diversification and quantified their effect in a cross-sectional analysis. Our empirical results show that human capital stocks, infrastructure and population size significantly explain part of the cross-country differences in export diversification, while the endowment in natural resources constitutes a strong impediment to diversification across all countries. Overall, the rate of investment in physical capital accumulation does not seem to significantly explain the observed differences: if anything, capital accumulation seems to go in hand with the exploitation of primary commodities in Sub-Saharan Africa. An examination of the same relationships in the rest of the world outside SSA clearly indicates that human capital stock, infrastructure provision and investment in capital accumulation significantly affect the extent of export diversification, although other factors, such as the abundance of oil or mineral wealth tend to impede the expansion of the manufacturing sector.

A comparison of SSA countries with the rest of the world reveals that for human capital and infrastructure to lead to more diversification, some threshold levels in their indicators must be in place. Many SSA countries have levels of infrastructure and human capital stock that are below or around these thresholds, implying that their absorptive capacity is still too low to materially influence export diversification. Although the density of infrastructure matters in explaining diversification differences among SSA, sometimes barely benefiting other sectors of the economy.

While the levels of educational attainment constitute a strong explanation of worldwide differences in export diversification, they do not seem to constitute an explanatory factor for intra SSA differences as education levels are still relatively low overall on the continent. Also in contrast to the rest of the (developing) world, differences in population size do not seem to correspond to differences in diversification, suggesting lower levels of regional or specific specialisation. The low level of human capital stock seems thus to be one of the reasons why SSA has continuously been falling behind by all standards of economic, social and technological development. Natural resource endowed countries seem to be even more vulnerable to the threat of primary commodity dependence. Our results suggest that, although a sustained investment in education and training for human capital accumulation is still highly recommended in SSA, the poor level of infrastructure and the low level of capital equipment stock constitute the limiting factor for SSA to reduce its dependence on primary commodities and develop the manufacturing sector.

Deriving useful lessons from empirical observation is therefore often a much more difficult exercise that requires more diligence than that needed for observing and discerning the empirical relationship. Temple and Voth (1998) suggest that a policy of subsidy to equipment investment for stimulating industrialisation may be dominated by other policies. However the SSA idiosyncrasy in the relationship between human capital, infrastructure, capital stock investment on the one hand and diversification on the other implies that these three factors deserve a high level of attention. This relationship should be brought in line with that in the rest of the world so that a basis for industrialisation can be laid.

This observed relationship between the components of absorptive capacity in SSA and its diversification level needs to be brought in line with that in the rest of the world through a strong investment in human capital accumulation and a significant increase in infrastructure provision so that a solid basis for a diversified production system can be laid. External investment in physical and human capital in SSA is however constrained by many factors. Among the most often cited factors impeding foreign investment in SSA, the most common are the perceived political instability and the risk associated with it, bad governance and lack of adequate human resources and infrastructure. The continued suboptimal level of investment in absolute terms results in inadequate level of capital per worker. This in turn leads to a consistently low labour productivity in SSA, which further discourages investing in productive capacity. A strong impetus in large scale domestic investments is therefore necessary to break this vicious circle of low productivity.

3.A Appendices to Chapter 3

Appendix A.3.1 Importance of agriculture for the emergence of human civilisations

It is not a pure coincidence that human societies that as first were able to produce large food surpluses on fertile soil along large rivers, were also the first to develop flourishing and powerful civilisations (Sumerians on the shores of the Tigris and the Euphrates, Ancient Egyptians in the Nile Delta or the first Chinese civilisations along the Yangtze and the Huang He valleys). Sufficient surplus food production is thus a key factor in the ability of a society to free a part of member from food production and delegate them to higher value added, more productive activities. A few historical examples illustrate the fundamental role played by agricultural production in the emergence of the most notorious and culturally as well as economically dominant civilisations of their time.

Mesopotamia and Sumer

It is not surprising that writing originated from Mesopotamia, where Sumerians had developed core agricultural techniques including large-scale intensive cultivation of land, mono-cropping, organised irrigation, and use of a specialised labour force from as early as 5000 BC. Even the more known, but much later Roman agriculture, built on techniques pioneered by the Sumerians, with a specific emphasis on the cultivation of crops for trade and export. By 5000 BC, Sumerians had already developed core agricultural techniques including large scale intensive cultivation of land, mono-cropping, organised irrigation, and use of a specialised labour force.

As attested by discovered inscribed tablets, in Uruk and probably also in other cities of comparable size, intensive agriculture put the Sumerians in a position to develop a sophisticated civilisation that saw the emergence of a flourishing city life with impressive temples and residential districts. In this society, agriculture was a pillar of the economy and enabled the blossoming of highly specialised industries carried on by sculptors, seal engravers, smiths, carpenters, shipbuilders, potters, and workers of reeds and textiles. Part of the population was supported with rations from a central distribution point, which relieved people of the necessity of providing their basic food themselves, in return for their work all day and every day, at least for most of the year. The cities kept up active trade with foreign countries.

Egypt

The legendary fertility of the Nile valley has given birth to one of the longest continuously living human civilisations in history, namely the Egyptian. A continuous 6000 year record of a unique civilisation, with a highly productive agriculture at its base has been identified. From 4000 to 3000 BC, the mingled peoples of the lower Nile valley established a highly advanced agricultural technology which led to a surplus production that enabled them to form a powerful government, constructed the first pyramids and temples that we can still admire today. The ancient names for Egypt such as Ta Akht (the land of flood and fertile soil) underscore the relation between the land, the people, and its agriculture (Khattab, 2000).

China

The rich civilisation that emerged in the Far East also owed much to the early independent development of rice and millet agriculture in the fertile Yang Tse and Huang-He valleys. The lower Yang Tse region was home to flourishing rice agriculture from the Neolithic period and afforded an urban life to important settlement that developed various kinds of artisanal productions as attested by archaeological discoveries.

APPENDIX A 3.2: Construction of the infrastructure index

Infrastructure score is constructed in the following way: the land area data are the CIA world Factbook data on land mass excluding territorial or inland waters, Population data are also data on total population in the reference year 1999.The columns Tel, Mob, RoadsKM, and RailwaysKm represent respectively the number of total telephone landlines, number of mobile lines, total roads length in kilometres and total railways in kilometres. The next column is the total yearly electricity production in kilowatt hours. Road density and rail density are obtained by respectively dividing the total road length and rail length by the land mass. Telephone density is obtained by dividing the sum of land and mobile lines by the population size, while Electricity pc column representing the per capita electricity production is obtained by dividing the total production of electricity by the population size. Then, for each of the four density columns, the maximum density has been identified, relative to which a density score could be determined for each country. These scores are reported in the columns called road score, rail score tel. score and Enerscore. Finally, the basic infrastructure score was calculated as an unweighted average of these various partial scores.

Country	Area	Pop	Tel	Mob	Roads km	Railw km	Elec Prod kwh	Road density	Raild ensity	Tel density	Electr pc	Road score	Rail score	Tel score	Ener score	Infra score
Angola	1246700	11190786	96300	130000	51429	2761	1.71E+09	0.04	0.00	0.02	152.54	0.01	0.02	0.01	0.01	0.01
Benin	112620	7460025	66500	236200	6787	578	2.85E+08	0.06	0.01	0.04	38.23	0.01	0.04	0.02	0.00	0.02
Botswana	600370	1640115	142400	435000	10217	888	9.3E+08	0.02	0.00	0.35	567.03	0.00	0.01	0.20	0.03	0.06
Burkina Faso	274200	13925313	65400	227000	12506	622	3.61E+08	0.05	0.00	0.02	25.92	0.01	0.02	0.01	0.00	0.01
Burundi	27830	6370609	23900	64000	14480	0	1.32E+08	0.52	0.00	0.01	20.72	0.10	0.00	0.01	0.00	0.03
Cameroon	475440	16380005	110900	1077000	34300	1008	3.57E+09	0.07	0.00	0.07	218.01	0.01	0.02	0.04	0.01	0.02
Cape Verde	4033	418224	71700	53300	1100	0	43080000	0.27	0.00	0.30	103.01	0.05	0.00	0.17	0.01	0.06
Centr Afr Rep	622984	3799897	9000	13000	23810	0	1.06E+08	0.04	0.00	0.01	27.90	0.01	0.00	0.00	0.00	0.00
Chad	1284000	9826419	11800	65000	33400	0	96130000	0.03	0.00	0.01	9.78	0.01	0.00	0.00	0.00	0.00
Comoros	2170	671247	13200	2000	880	0	23840000	0.41	0.00	0.02	35.52	0.08	0.00	0.01	0.00	0.02
Congo(DRC)	2345410	60085804	10000	1000000	157000	5138	6.09E+09	0.07	0.00	0.02	101.29	0.01	0.02	0.01	0.01	0.01
Congo, Rep	342000	3039126	7000	330000	12800	894	3.48E+08	0.04	0.00	0.11	114.51	0.01	0.02	0.06	0.01	0.02
Cote d'Ivoire	322460	17298040	328000	1236000	50400	660	4.76E+09	0.16	0.00	0.09	275.12	0.03	0.02	0.05	0.02	0.03
Djibouti	23000	476703	9500	23000	2890	100	1.8E+08	0.13	0.00	0.07	377.59	0.02	0.03	0.04	0.02	0.03
Equat Guinea	28051	535881	9600	41500	2880	0	26690000	0.10	0.00	0.10	49.81	0.02	0.00	0.05	0.00	0.02
Ethiopia	1127127	73053286	435000	97800	33297	681	2.15E+09	0.03	0.00	0.01	29.42	0.01	0.00	0.00	0.00	0.00
Gabon	267667	1389201	38400	300000	8464	814	1.16E+09	0.03	0.00	0.24	835.73	0.01	0.02	0.14	0.05	0.05
Gambia, The	11300	1593256	38400	100000	2700	0	90310000	0.24	0.00	0.09	56.68	0.05	0.00	0.05	0.00	0.02
Ghana	239460	21029853	302300	799900	46176	953	6.92E+09	0.19	0.00	0.05	329.15	0.04	0.03	0.03	0.02	0.03
Guinea	245857	9467866	26200	111500	30500	837	8.55E+08	0.12	0.00	0.01	90.31	0.02	0.03	0.01	0.01	0.02
Guinea-Bissau	36120	1416027	10600	1300	4400	0	55000000	0.12	0.00	0.01	38.84	0.02	0.00	0.00	0.00	0.01
Kenya	582650	33829590	328400	1590800	63942	2778	4.48E+09	0.11	0.00	0.06	132.28	0.02	0.04	0.03	0.01	0.02
Lesotho	30355	1867035	28600	92000	5940	0	3.14E+08	0.20	0.00	0.06	168.18	0.04	0.00	0.04	0.01	0.02
Liberia	111370	3482211	7000	2000	10600	490	4.89E+08	0.10	0.00	0.00	140.37	0.02	0.03	0.00	0.01	0.02
Madagascar	587040	18040341	59600	279500	49827	732	8.4E+08	0.08	0.00	0.02	46.57	0.02	0.01	0.01	0.00	0.01
Malawi	118480	12158924	85000	135100	28400	797	1.09E+09	0.24	0.01	0.02	89.48	0.05	0.05	0.01	0.01	0.03
Mali	1240000	12291529	56600	250000	15100	729	7E+08	0.01	0.00	0.02	56.95	0.00	0.00	0.01	0.00	0.01
Mauritania	1030700	3086859	31500	300000	7660	0	1.9E+08	0.01	0.00	0.11	61.62	0.00	0.00	0.06	0.00	0.02
Mauritius	2040	1230602	348200	462400	2000	0	1.84E+09	0.98	0.00	0.66	1491.95	0.19	0.00	0.37	0.09	0.16
Mozambique	801590	19406703	83700	428900	30400	3123	8.86E+09	0.04	0.00	0.03	456.49	0.01	0.03	0.01	0.03	0.02
Namibia	825418	2030692	127400	223700	42237	2382	1.17E+09	0.05	0.00	0.17	574.68	0.01	0.02	0.10	0.03	0.04
Niger	1267000	11665937	22400	24000	10100	0	2.66E+08	0.01	0.00	0.00	22.82	0.00	0.00	0.00	0.00	0.00
Nigeria	923768	1.29E+08	853100	3149500	194394	3557	1.99E+10	0.21	0.00	0.03	154.15	0.04	0.03	0.02	0.01	0.02
Reunion	2517	776948	300000	489800	1214	0	1.17E+09	0.48	0.00	1.02	1500.74	0.09	0.00	0.57	0.09	0.19
Rwanda	26338	8440820	23200	134000	12000	0	1.67E+08	0.46	0.00	0.02	19.75	0.09	0.00	0.01	0.00	0.02
Senegal	196190	11126832	228800	575900	14576	906	1.74E+09	0.07	0.00	0.07	156.11	0.01	0.04	0.04	0.01	0.03
Seychelles	455	81188	21700	54500	373	0	2.18E+08	0.82	0.00	0.94	2685.13	0.16	0.00	0.53	0.16	0.21
Sierra Leone	71740	6017643	24000	67000	11300	0	2.55E+08	0.16	0.00	0.02	42.43	0.03	0.00	0.01	0.00	0.01
Somalia	637657	8591629	100000	35000	22100	0	2.36E+08	0.03	0.00	0.02	27.42	0.01	0.00	0.01	0.00	0.00
Sudan	2505810	40187486	900000	650000	11900	5995	2.58E+09	0.00	0.00	0.04	64.22	0.00	0.02	0.02	0.00	0.01
Swaziland	17363	1173900	46200	88000	3107	301	4.02E+08	0.18	0.02	0.11	342.45	0.03	0.13	0.06	0.02	0.06
Tanzania	945087	36766356	149100	891200	88200	3690	2.73E+09	0.09	0.00	0.03	74.17	0.02	0.03	0.02	0.00	0.02
Togo	56785	5681519	60600	220000	7520	568	1.09E+08	0.13	0.01	0.05	19.15	0.03	0.08	0.03	0.00	0.03
Uganda	236040	27269482	61000	776200	27000	1241	1.78E+09	0.11	0.01	0.03	65.09	0.02	0.04	0.02	0.00	0.02
Zambia	752614	11261795	88400	241000	91440	2173	8.17E+09	0.12	0.00	0.03	725.20	0.02	0.02	0.02	0.04	0.03
Zimbabwe	390580	12746990	300900	379100	18338	3077	8.84E+09	0.05	0.01	0.05	693.42	0.01	0.06	0.03	0.04	0.04

APPENDIX A.3.3: Extent of natural resources dependence for SSA countries, 2002

Country	*Natural resources*	*Herfindahl index*	*Number exp prod*
Angola	93.50	0.89	61
Benin	0.40	0.46	42
Botswana	0.10	0.83	113
Burkina Faso	0.00	0.60	53
Burundi	0.00	0.65	12
Cameroon	49.40	0.46	89
Cape Verde	48.50	0.48	12
Central African Republic	0.10	0.52	11
Chad	0.00	0.74	28
Comoros	0.00	0.88	5
Congo, Dem. Republic	83.60	0.70	33
Congo, Rep. of the	87.60	0.74	50
Cote d'Ivoire	12.80	0.43	138
Djibouti	0.00	0.13	58
Equatorial Guinea	89.00	0.90	20
Ethiopia	0.00	0.41	36
Gabon	83.30	0.81	58
Gambia, The	0.10	0.33	26
Ghana	4.90	0.38	127
Guinea	0.10	0.55	32
Guinea-Bissau	0.00	0.73	13
Kenya	19.20	0.30	166
Lesotho	0.00	0.35	32
Liberia	0.00	0.65	5
Madagascar	2.60	0.34	90
Malawi	0.00	0.61	50
Mali	1.90	0.71	139
Mauritania	0.00	0.53	44
Mauritius	0.00	0.28	154
Mozambique	0.00	0.55	69
Namibia	0.70	0.36	162
Niger	1.60	0.47	38
Nigeria	99.60	0.89	53
Reunion	0.20	na	na
Rwanda	6.80	0.50	7
Senegal	22.70	0.29	122
Seychelles	40.00	0.49	12
Sierra Leone	0.00	0.86	12
Somalia	0.00	0.43	52
Sudan	69.20	0.59	54
Swaziland	0.00	0.45	135
Tanzania	1.30	0.31	92
Togo	0.50	0.32	59
Uganda	0.10	0.29	89
Zambia	2.10	0.50	103
Zimbabwe	1.10	0.14	188

Source: UNCTAD Handbook of Statistics, 2004; 2005

Chapter 4

BOTSWANA'S ABSORPTIVE CAPACITY, TECHNOLOGY IMPORT AND MANUFACTURING SKILLS

4.1 Introduction

The sound management of its large diamond revenues allowed Botswana to achieve remarkable growth rates over several decades and the country seems thus a potential candidate for technological catch up with industrialised countries. However, in spite of consistent efforts aimed at economic diversification, the country's economy is still heavily dependent on raw diamond export and faces many challenges in its efforts to move to high value-added activities in other industries. Botswana has become one of the few success stories of development in Sub-Saharan Africa as the country's economy has been among the fastest growing in the world, driven mainly by diamond and beef export. Diamond export revenues represent more than 75% of total export earnings and account for almost 36% of GDP as illustrated in Table 4.1 on the next page.

It is therefore crucial for Botswana to develop other, more sustainable sources of income because diamonds are not forever. Over the last 25 years, the government's pursuit of economic diversification has been a central tenet of Botswana's economic policy framework. For example, the theme of the 8th National Development Plan (NDP8) was Sustainable Economic Diversification. However, even though some progress towards expanding the country's economic base was achieved during the NDP 8, the

TABLE 4.1. Botswana GDP decomposition per economic activity in selected years

GDP by economic activity in selected years					
Economic activity	1966	1975/76	1985/86	2000/01	2004/05
Agriculture	42%	20.7%	5.6%	2.6%	2.4%
Mining	-	17.5%	48.9%	36.5%	35.9%
Manufacturing	5.7%	7.6%	3.9%	4.1%	3.9%
Water& Electricity	0.6%	2.3%	2.0%	2.4%	2.5%
Construction	7.8%	12.8%	4.6%	5.8%	5.6%
Hotel, restaurant & Trade	9.0%	8.6%	6.3%	10.3%	10.5%
Transport	4.3%	1.1%	2.5%	3.8%	3.5%
Bank, insurance.& bus services	20.1%	4.7%	6.4%	10.9%	10.9%
Central Government	9.8%	14.7%	12.8%	16.0%	16.4%
Social and personal services	-	2.8%	2.5%	4.0%	4.0%
Total GDP at const. prices (mln Pula)	908.6	2,083.5	5,708.2	16,524.4	19,661.2
GDP excl mining (mln pula)	908.6	1,718.1	2,917.3	10,497.1	12,607.3
GDP per capita (Pula)	1682.5	2,861.9	5,175.0	9,793.4	11,112.6
Real GDP growth	-	18.4	7.7%	8.4%	5.6%
GDP growth excl. mining	-	11.8	11.6%	4.0%	4.3%

Source: Central Statistics Office

manufacturing sector's contribution to GDP has remained relatively low and the share of agriculture has plummeted to insignificant proportions.

The private sector has been invited to become a partner of the government in the latter's endeavour to diversify the Botswana economy. A pivotal meeting held in 1988 by the private sector, represented by the Botswana Confederation of Commerce, Industry and Manpower (BOCCIM), and the country's President and his entire cabinet under the banner of a National Business Conference (NBC), attempted to map out how the diversification of the economy could be brought about. This consultation process led to the adoption in 1997 of a "Long-Term Vision for Botswana: Towards Prosperity for All", known as the Vision 2016, which represents a blue-print of the type of society the country wishes to achieve by the year 2016. Among other areas that Botswana is most actively looking to develop are those where the country has a clear comparative advantage: its tourism industry; glass and jewellery manufacturing; diamond cutting and polishing; and tannery and leather products (which are by-products of the beef industry). In addition, the country is hoping to provide stronger push to its textile and garment industry as well as its information technology sector.

In order to achieve this diversification goal, Botswana has heavily invested in the accumulation of physical and human capital as one of the most important pillars of its development objectives. The government has been consistently devoting about 20%

of its recurrent expenditure to education while the composition of its physical capital accumulation is illustrated in Figure 4.1.

4.2 Botswana's SID and Absorptive Capacity

4.2.1 Capabilities

In this section, we briefly explore Botswana's capabilities as represented by its rate of physical investment and infrastructure, the stock and the accumulation of human capital, as well as the technological effort deployed to stimulate the ability of the country to harness foreign technologies and adapt them to local circumstances.We present the indicators of the current level of capabilities in the country and the institutions engaged in the technological effort.

Physical Investments and Public Infrastructure

Botswana's fixed capital formation over the last 15 years has been very substantial as a share of GDP. Figure 4.1 provides an indication of gross fixed capital formation as a percent of GDP using Bank of Botswana's data computed on the basis of constant 1993 USD. With 971 kilometres (603 miles) of rail lines, 19,372 kilometres of roads (of which only about 30 percent are paved), and 12 airports with paved runways, Botswana has a good infrastructure by African standards. Botswana's road network is well developed, and paved roads of a good standard link all major human settlement centres and neighbouring countries. Under the Eighth National Development Plan (NDP8; 1997-2003), road construction accounted for around 6% of total government expenditure, and the network of paved roads grew by about 40%. The Trans-Kalahari highway, linking South Africa to Namibia through Botswana, was completed in 1998, raising hopes that the country would benefit from its central position in the region. A study conducted a year after the motorway was opened revealed that traffic was only 46% of the projected volume because of delays at border crossings, lack of facilities, high fees and less traffic than expected to and from Walvis Bay port in Namibia.

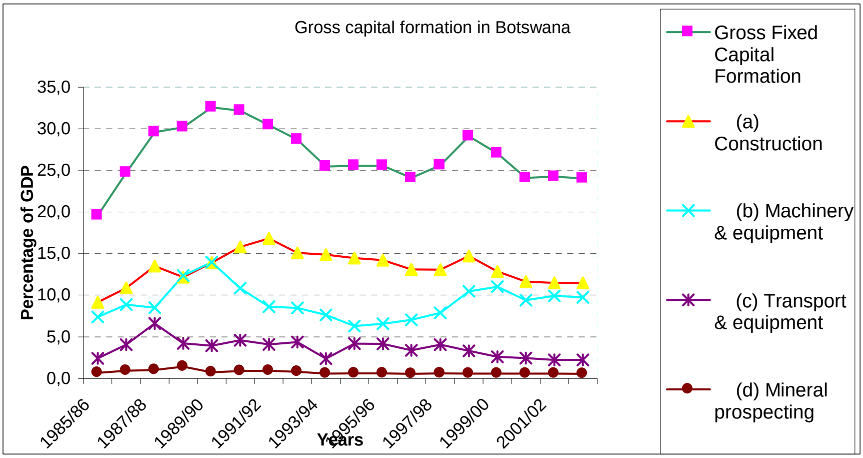
The country's main railway line runs for 640 kilometres from Zimbabwe to South Africa, via Francistown, Gaborone and Lobatse. There are spurs to the mining town of Selebi-Phikwe and the mines at Morupule and Sua Pan. Botswana Railways, a parastatal, operates the railway. The line carries the country's bulk exports such as copper, nickel, beef, soda ash and salt. It is an important transit route between Zambia, Zimbabwe and South Africa.

Botswana's telecommunications system is fully digital. Fibre-optic cables link the major population centres in the east. International calls can be made via satellite, using international direct dialling. The Botswana Telecommunications Authority (BTA) regulates the sector and has received international recognition as a model regulator. According to the BTA, the country had only 133,000 fixed-line connections at the end of 2005 serving 7.7% of the population, down from almost 150,000 in 2002. Customers have clearly opted for mobile phones of which there were 884,000 in operation at the end of 2005 serving 51% of the population. Botswana's rate of telecommunication coverage (teledensity) has been rising rapidly in recent years and reached 57% of the population at end of 2006.

As for the energy supply, domestically produced coal generates about 50 percent of the electricity consumption for Botswana, which was approximately 1.619 billion kilowatt-hours in 1998. Electricity consumption in Botswana has grown by an annual average of 10% over the past few years, and by the end of the Ninth National Development Plan (April 2003-March 2009), the government aims for 70% of the population to have access to electricity. The state-owned electricity company, the Botswana Power Corporation (BPC), currently meets about 70% of the country's energy requirements through imports from the Southern African Power Pool (SAPP) countries, mainly from Eskom of South Africa. The balance is met by the company's only power station at Morupule, a 132-mw facility close to the coal mine which provides its fuel. Every other source of energy, including oil, must be imported. The quality of infrastructure was greatly improved by the development of the mining industry, which required adequate transportation and communication networks. Botswana also benefits from its location next to South Africa. This has allowed Botswana access to South Africa's telecommunications infrastructure. Botswana's desire to become an international financial services centre is a key factor driving the improvement of the country's land line and cellular telephone networks.

Human Capital Accumulation

Botswana has heavily invested in the accumulation of human capital as one of most important pillars of its development objectives. With 20% of government recurrent expenditures devoted to education each year, the Botswana government gives a powerful signal of its commitment to human capital accumulation. The most commonly used indicators related education and human capital policies would put Botswana and its government in the class of the assiduous learners. However, as indicated here, the levels of human capital and their potential for technological learning are still diffi-



Source: Graph plotted by author with data from Central Statistics Office, Botswana

FIGURE 4.1. *Gross Fixed Capital Formation in Botswana*

cult to measure in Botswana as elsewhere. Our purpose here is to give a multifaceted picture of human capital accumulation in Botswana by providing data and analysing issue of concern on various aspects of human capital. This overview is provided by table 4.2 on the next page.

In the view of the stated goal to develop enough technical skills for the economy to break into manufacturing, the current weak link between vocational education in secondary schools and the world of work, the high rate of failure in vocational education and the bottlenecks in the educational system remain a serious element of concern for the accumulation of readily usable technical skills (Weeks, 1997).

Technological Effort

Like human capital, technological effort encompasses several dimensions which make its measurement equally complex. Design, experience with improvement on foreign technology, formal research and innovativeness are all aspects of technological effort. However, partly due to the unavailability of data on these aspects, we limited our analysis on aspects related to informal and formal research and development for the purpose of this study. One of the reasons is that the other dimensions are still much more difficult to observe in the context of Botswana. While design and innovation skills are being developed through the various technical and vocational training programs and the faculty of Engineering and Technology of the University of Botswana, there is no known record of long-standing design experience in the country and data on that would be difficult to obtain.

TABLE 4.2. Botswana's indicators of human capital

Measure of human capital	Definition	Score
Primary school enrollment rate	Number of children attending school as a percentage of the relevant age group	103 (2004)
Secondary Education enrollment rate	Number of children attending school as a percentage of the relevant age group	60
Literacy rate	Percentage of population aged 15 and above that can read and write	Total ppulation: 79.8 Male: 76.8 Female: 83 (est.2006)
Tertiaty education	Total number of students attending undergraduate and postgraduate studies	The University of Botswana has only limited capacity with approximately 15000 undergraduates and 900 graduate students

Source UNESCO

The government recognises that the financing of research and development is still suboptimal in comparison to developed countries. It has been estimated that optimal R&D investment is at least four times larger than actual investment. Similarly, the "*new growth theory*" has drawn the attention of economists and development specialists to the spillovers from investments in education and capital formation that raise social productivity above the gains that can be realised by the private- sector. The government's Science and Technology Policy Paper estimates that public funding of R&D as a percentage of GDP is still below 1%, while this rate is close to or sometimes above 3% in developed countries[1].

Other indicators of technological effort such as the number of patents issued to residents, show an equally low level of technological effort. There were in total 16 patents applications by residents between 1995 and 2006: one in 1995, five in 1996, one in 1997 seven in 1998 and one in 2001 according to the world development indicators. The rate of research scientists and engineers (RSE) as a proportion of population is still very low in comparison to for instance the East Asian miracle economies and data on pre precise number are unavailable in statistical records. The government sees the urgency of the need to pursue S&T-led economic development in future development plans in order to strengthen and consolidate national efforts towards sustainable economic diversification. That is why it has decided to put in place a more efficient coordination of the public science and technological effort which have so far been scattered in various ministries and parastatals.

Research institutes:

1. Botswana Technology Centre (BTC). The BTC is mandated to serve as a national focal point for the development and dissemination of S&T.

2. Food Technology Research Services (FTRS) to develop methods for preserving and processing food resources.

3. Policies and Programmes Research Unit at the Ministry of Commerce and Industry, to deal with S&T issues.

4. Botswana College of Agriculture, Agricultural Research Department.

   For a better coordination of the research activities the various research efforts of all these institutions are rationalised by the National Centre for Scientific

[1] The Lisbon target aims at bringing the rate of R & D to GDP at the 3% level to make the European innovation capacity competitive on the global stage

and Industrial Research. It is estimated that despite the substantial effort undertaken by the government to foster research and development, the scientific and technological output is still very low.

4.2.2 Incentives

Macroeconomic Incentives in Botswana

From its accession to independence, Botswana has been exemplary for all SSA in terms of fiscal and monetary discipline as underscored rating. Its dependence on diamond export and a possible levelling off of the diamond reserves, however, pose a challenge to the economy. The prevalence of poverty in large layers of the population and the persistence of HIV/AIDS pandemic are a worrisome threat to the further development of human capital and technological capability.

With its 1.7 million inhabitants, and a PPP adjusted per capita GDP of USD 14,157, Botswana is too small as a market for manufactured goods and services. With 47% of the population living below income poverty line and a Gini coefficient of 0.54, the purchasing power of a large fraction of the population remains very limited. As it has often been argued, regional cooperation for market expansion is indispensable to allow scale economies in the presence of market exiguity. In this view, Botswana's membership of the Southern African Customs Union (SACU, which it shares with South Africa, Lesotho and Swaziland) suggests that the market open to a potential manufacturing industry is somewhat bigger than the home market alone.

Incentives from Competition: Encouragement of Foreign Direct Investment

The country has been open to FDI since independence in 1966 because of the recognised critical role of private capital including foreign, in stimulating growth, creating jobs and reducing poverty. Foreign investment is allowed in all sectors except those reserved for small and micro enterprises. There is no binding requirement for foreign investors to establish joint ventures though this is encouraged. Moreover, there are no limits on foreign equity holdings and the processing of licences for foreign company is efficient and rapid. As a result, foreign investors play an important role in various sectors of the economy especially in the banking, the mining and tourism sectors. Development of indigenous entrepreneurship has been encouraged through the protection of small and micro enterprises from foreign equity ownership.

Incentives from the Factor Markets

Capital markets

Access to credit by enterprises and businesses is crucial to their operational performance and even their survival. Furthermore, a proper development of equity markets is indispensable to the sound functioning of a rapidly growing economy. The equity market is generally underdeveloped in SSA economies and Botswana, being a small economy, is no exception. However, Botswana is a dynamic economy with its own stock exchange, however small it may be judged. Its sheer existence underlines Botswana's determination to optimise the functioning of financial markets.

The banking sector is fairly developed in Botswana and the exchange rate has been liberalised for a long period. Bank and insurance play an important role in the economy of Botswana where they account for some 11% of GDP. The commercial banking sector in Botswana is highly profitable, although there is some criticism about the quality of service provided. There are seven main commercial banks, mostly foreign-owned or subsidiaries of larger South African banks. The use of banking services in Botswana, compared with other countries in the region, is high, and greater use is being made of new technologies such as Internet and mobile-phone banking. According to the survey results of a South African financial surveys firm, 82% of households made some use of the formal banking sector in 2003 (including parastatals that provide banking services), although according to other sources only 50% of the population have a bank account. These indicators are relatively high for Sub-Saharan Africa, although the government is still encouraging banks to try to expand their services further to cater for a larger proportion of the population.

The equity market is however still characterised by low market liquidity. The Botswana Stock Exchange (BSE) was officially established in 1995 after having started as an informal share market in 1989 with six registered companies. The first of the dual-listed foreign firms -most of which are South African- was registered in 1997. By May 2007, the domestic companies index (DCI) had 19 firms listed and a total market capitalisation of 31.7 bn Pula (USD 5bn), up from 9.4bn Pula at the end of 2002. There were 12 foreign companies listed on the BSE by end-2006 and the new entrants are all engaged in mineral-related operations. The BSE has experienced a bull run since 2005. This is partly because of the strong performance of major listed firms, in particular the three listed commercial banks, which have a combined weight of about 60% in the DCI.

BSE liquidity is consequently low, with a turnover of around 6% of market capitalisation, which is comparable to that of other stock markets in Africa. Most shares are owned by institutional investors. The government has stated its intention to introduce new legislation to bring the operations of the BSE into line with international standards. The bond market, although currently lacking in liquidity, is also being developed (25 bonds were listed on the BSE in mid-June 2007, compared with only eight in mid-March 2004). The rapid growth was due to the listing of government bonds (currently there are nine) and success in stimulating the market for corporate bonds, of which there are currently 15.

Labour market

Botswana's labour market is still characterised by an excess supply of unskilled workers, and a serious shortage of skilled labour for the modern sector. This mismatch has jeopardised the objective of rapid economic growth. A dual approach was followed to remedy this problem. A minimum wage equal to the average rural income of farmers with an allowance for any differential in the overall costs of urban living has been established for unskilled workers to achieve fairness and avoid the job destruction effects of excessive minimum wages observed in other countries. The government has also set wages and salary scale regulations for the modern sector to avoid bidding wars for the limited supply of a skilled labour.

Despite the sustained investments in human capital, Botswana has still to deal with chronic shortages of skilled workforce. Expatriates have been welcomed to fill in the gaps and the current supply of human capital in some specialised areas suggests that this will remain the case for quite some time. On the other side, Botswana has to deal with a relatively high rate of unemployment, especially among the young rural population where unemployment rates are still as high as 25% compared to an average rate of 21% for the total labour force.

4.2.3 Institutions

An interesting and rich analysis of Botswana's institutions is provided by Acemoglu, Johnson and Robinson (2003), who essentially attribute Botswana's economic success to its institutions of private property, which protect the property rights of current and potential investors, provide political stability, and ensure that political elites are constrained by the political system and by a broad cross-section of society. In turn, they explain these institutions in terms of the following five factors:

First and foremost, they stress inclusive pre-colonial traditions and institutions, namely the Kgotla which ensured that political elites faced effective constraints from their constituencies. Secondly, the relatively limited effects of British colonisation on these institutions because of Botswana's peripheral relationship (in the sense of

Botswana's "benign neglect" compared to other colonised countries). Thirdly, the political power of important rural interests upon independence and the alignment of the interests of the post-colonial elite with the protection of private property are credited for having enabled the political elite to get beyond the status quo. They consider it important that the political elites in Botswana did not fear becoming political losers from the process of growth, which both derived from and reinforced political stability.

Fourthly, the income of diamonds which generated sufficient rents to the main political actors so that it increased the opportunity cost of further rent-seeking, and together with the above institutional features ensured that diamond revenues could be productively utilised. Lastly, they credit far-sighted decisions by post independence political leaders. They argue that the particular combination of these factors in Botswana facilitated its successful growth. The authors acknowledge that they cannot test their hypotheses empirically.

Botswana's long-standing political stability is both exceptional and exemplary for SSA. Since independence, Botswana has been led by a freely elected civilian government in a multiparty democracy. From the beginning of her modern existence as independent state, Botswana has adopted a market economy and a free trade orientation that allowed it to prosper. This political stability along with the long-term vision of the government and the freedom from corruption allowed a sound management of diamond revenue that helped avert the spectrum of the resource curse encountered in other resources endowed countries.

This is remarkable and certainly laudable for a diamond rich SSA country, as the abundance of minerals is usually associated with high levels of rent seeking and corruption. In addition, Botswana has a strong commitment to maintaining stringent intellectual property rights regime which guaranteed full protection of IPR in order to encourage invention and foreign investment. It is party to the TRIPs agreements. Botswana adheres to standards in line with requirements by the International Organisation for Standards (ISO) and to raise the quality and variety of Botswana and foreign products for the local market.

4.3 Imported Capital Goods and Diversification: Evidence from Botswana's Manufacturing Sector

4.3.1 Introduction

In this section, we examine the effects of capital goods import on skills upgrading and productivity growth in Botswana's manufacturing sector to provide further empirical evidence for the import-led growth hypothesis. We aim to gain industry-level insights into the role played by capital goods import in fostering technology diffusion and economic diversification of the importing, resource dependent country. In contrast to models using aggregate growth to measure the impact of import, in this study we use a matching between imported machinery and manufacturing productivity growth of industries that can be more directly ascribed to the use of these machines.

Using the case of Botswana's manufacturing sector, we argue that the primary mechanism through which the acquisition of foreign technologies contributes to productivity growth is by widening the range of productive activities, especially by spurring new activities that can increase the diversity of export. An expansion achieved through industrial deepening should translate in a manufacturing diversification that reduces the concentration of economic activity in the mining sector for the case of Botswana. With a multivariate time series of capital imports, manufacturing productivity and technical skills data covering the period 1985-2005, we develop an analytical framework based on Mutz and Ziesemer (2008) trade and growth model to analyse how technology embodied in the imported capital has contributed to manufacturing productivity growth and sectoral expansion as measured by the creation of new firms.

We also use industry level productivity and technical skills data in a panel of 10 manufacturing industries (at SIC 4 digit level) to investigate whether such expansion has spurred an import-induced diversification into more technologically sophisticated industries. Our results from sectoral data show that import of capital goods has been accompanied by manufacturing productivity growth and sectoral expansion with technical skills intensification. These results are confirmed by the panel data analysis and industry technical skills growth decomposition. This implies that improvement in technical intensity has mainly resulted from the technological and skills upgrading of existing industries rather than from the emergence of more technologically sophisticated industries. The remainder of this part is organised as follows: the first sub-section reviews the role of imported capital goods in transmitting technological knowledge to the importing country. In the following sub-section we present the growth model based on Mutz and Ziesemer (2008) and Hunt and Tybout (2000) models from which we develop our analytical framework for manufacturing diversification. That model is then used to estimate the effects of importing capital goods on manufacturing productivity growth and sectoral expansion across industries in subsection 4.3.3 with sectoral as well as industry- level trade and productivity data. The last part of the third sub-section discusses the findings, and is followed by the final section (4.4) which discusses the implications for Botswana's diversification effort and provides a conclusion.

4.3.2 The Role of Imported Capital Goods

As already pointed out earlier in this dissertation, the lack of technology is widely seen as the main obstacle to economic growth in most developing countries and the foreign exchange gap impedes developing countries from financing the imports of these technologies. Since most of technological innovation takes place through deliberate research and development activities, and world R&D activities are highly concentrated in a small number of industrialised countries, many countries are dependent on technological knowledge developed outside their borders. Capital goods import can thus be viewed here as a structured way of acquiring relevant technologies that help countries deal with the constraints of existing production methods as well as building a long-term dynamic comparative advantage.

However, while the role played by technology embodied in machineries in rising productivity is visibly crucial to the development process[2], the cost of producing capital equipment could be prohibitively high in most developing countries as can be concluded from substantial empirical evidence showing developed countries' comparative advantage in producing capital goods (see Lee, 1995 for an overview). Mazumdar (1999) has therefore suggested that investing in imported machinery leads to higher growth in developing countries as opposed to lower growth resulting from investing

[2] In contrast to disembodied technologies, that are usually assumed to directly affect productivity growth trough technical change by shifting the production function, embodied technologies affect labour productivity growth by inducing learning effects in the acquiring firms and spillover effects in firms that have backward or forward linkages with it. For example, the acquisition of industrial equipment by one firm can help speed up its operations and thus increase its production. The improved operational efficiency means that the suppliers and customers alsger the opportunity to impove their own operations if the transactions with the firm in question previously presented a binding capacity constraint. These improvements in operations induce therefore new learning effects within the supplier and customer firms and can spill over further in the value chain, although only one firm purchased the equipment.

in domestic production of capital equipment. Using panel data analysis with country fixed effects, he found empirical evidence supporting this claim for developing countries, while no negative growth effect of domestic capital production was found in a panel of developed countries.

This led him to conclude that for developing countries, producing capital goods rather than importing them is misallocation of resources since they are at a comparative disadvantage in such a production. International trade in capital goods that embody new technology is thus of utmost importance in spreading the benefits of technological advance across the borders (Eaton and Kortum, 2001).This conclusion is congruent with empirical evidence showing that trade is the most widely used vehicle for domestic and international diffusion of technological knowledge across countries and industries as it transmits more than 50 % of the total technological knowledge flows (Keller 2002). Foreign trade boosts productivity growth, as underlined by the new developments in the theory of international trade, broadly through demonstration effects of products containing new technological knowledge (Akamatsu, 1962) and access to intermediate products. It also raises the consciousness of the producers towards quality improvements and spirit of competitiveness (Singh, 2004). International trade in capital goods that embody new technology is thus of utmost importance in spreading the benefits of technological advance across the borders (Eaton and Kortum, 2001).

Building on this evidence, a few studies have even gone a step further to comparatively analyse the performance of intra- versus inter-industry trade in conveying foreign technologies to the importing country (Keller, 1997; Jaumotte, 1998; Hakura and Jaumotte, 1999; Lederman and Maloney, 2003) or distinguishing between capital goods vintages and technological level (see e.g. Navaretti et al., 2000; Navaretti and Soloaga, 2002). To assess the relative performance of intra- versus interindustry trade in transferring technology to developing countries, Hakura and Jaumotte (1999) examined the effects of inter- and intra-industry trade on the productivity growth in importing countries in a sample of 87 countries, with trade and growth data between 1970 and 1993. Extending the technology gap framework in which total factor productivity is specified as a function of technological difference, weighted by the degree of exposure to foreign technologies, they applied the Grubel-Lloyd intra-industry trade index (IIT)[3] to determine each sector's involvement in intra-industry trade and its

[3]The Grubel-Lloyd intra-industry trade index is defined as:$IIT = 1 - \frac{\sum_{i=1}^{n} |X_i - M_i|}{\sum_{i=1}^{n} (X_i + M_i)}$ where "i" indicates a product category and "n" is the

effect on TFP growth. Both their linear and nonlinear specifications confirmed the expected technological catch-up and technological knowledge transmission to countries that trade with more advanced countries. In addition, they find evidence that intra-industry trade had a stronger effect on TFP-growth than inter-industry trade, presumably because countries are more likely to absorb foreign technologies when their import are from the same sector as their production and export sectors. This conclusion is further confirmed by Lederman and Maloney (2003).

An important contribution to the research area distinguishing between the technological vintage of imported machineries is Navaretti et al. (2000), who extended the established approach in a model that takes into consideration the technological progress embodied in new machinery and skill constraints faced by firms in developing countries. They tested hypotheses based on the model using data on U. S. exports of new and used metalworking machinery by country of destination. Their results corroborate the view that used equipment will be demanded by firms in lower-income developing countries. The proportion of each type of machinery bought second-hand was found to be especially high for "higher-tech" equipment requiring more sophisticated operating skills.

Econometric tests of the determinants of trade in used machinery indicated a significant role of technological factors, skills and (to a lesser extent) educational factors in the choice of used versus new machines and led the authors to conclude that the traditional emphasis on factor prices as the determinants of a firm's choice between new and used machinery may be misplaced. These findings support the hypothesis that the 'absorptive capacity' of a country (the ability to adopt and master a new technology) affects the choice of the type and vintage of machines. The fact that developing countries buy a larger share of old vintage when machines have a fast rate of technological progress may be of some concern because it implies that the technological gap between the North and South is likely to increase, the faster the rate of technological progress.

---

total number of products. This index varies between 0 and 1, and it shows the share of total trade that is

conducted among identical products (i.e., imports and exports of the same product category).

Alternatively, at the sectoral level it can be defined as: $IIT_s = \frac{(Xs+M_s)-|Xs-M_s|}{(X_s+M_s)}$

where s denotes sector, X denotes exports and M imports. It measures the level of intra industry trade in sector s. If there is no intra-industry trade in sector s (i.e when the country is exclusively exporting or importing it hat sector, the index takes the value 0. Conversely, when all trade is intra-industry, the index takes the value 1.

Likewise, Navaretti and Soloaga (2002) examined the impact of imported technologies on productivity by using a sample of developing and transition countries in Central and Eastern Europe and in the Southern Mediterranean. Distinguishing between the types and technological levels of the machines imported in those countries and matching between the imported machineries and the manufacturing industries using them in production[4] , they develop an econometric model to analyse how embodied imported technologies contribute to boost domestic productivity. Their findings showed that productivity growth in manufacturing depends positively on the type and the technological level of machines imported in a given industry. They concluded moreover that although the choice of developing countries to buy cheaper and less sophisticated machines is optimal, given relative factor prices and their endowments of technology, this choice has a cost in terms of long run productivity growth.

This suggests thus that countries can gain in the long run if they go beyond the short- run benefit of static comparative advantage in deciding which technology to import and adopt technologies that help them build an adequate dynamic comparative advantage. Contact with goods and machineries from technologically advanced countries induce demand for skills to use or operate them because a developing country is unlikely to benefit from leaders' technological knowledge without sufficient level of domestic technological capabilities, which requires massive investment in human capital (Abramovitz, 1986; Verspagen, 1991; Keller, 1995). The so induced skills upgrading improves the quality of labour and makes human capital acquisition easier for future generations through positive externalities.

Additionally, by forcing domestic producers to innovate and increase their efficiency to compete with the foreign imports, even imports of foreign final and intermediate goods can have a stimulating effect on labour productivity growth. The acquisition of foreign technologies can also translate in increasing the technological sophistication of the manufactured products or increasing the efficiency with which they are produced. Moreover, empirical evidence confirming import-led growth has been accumulating in recent years (Eaton and Kortum, 2001; Keller, 2004; Thangavelu and Rajaguru, 2004). Capital goods import can thus be viewed here as a structured way of acquiring rele-

[4] This matching is based on a correspondence in description between Harmonised Commodity Description and Coding System (HS) codes of the imported machines and the 3-digits ISIC codes (International Standard Industry Classification, revision 2) of the manufacturing industries using these machines to produce the described product in the importing countries. A correspondence between HS and the Standard International Trade Classification, revision 3(SITC. rev3) is also provided. We use a similar matching for Botswana, which is reported in the appendix.

vant technologies that help countries deal with the constraints of existing production methods as well as building a long-term dynamic comparative advantage.

4.3.3 Converting Primary Export Revenue into Manufacturing Productivity

In this subsection, we present the assumptions and the framework underlying our analysis of manufacturing productivity growth and sectoral diversification. The framework is based on the capital goods based trade growth model of Mutz and Ziesemer (2008) and the product sophistication model by Hunt and Tybout (2000).

Paying for Imported Capital Goods by Exporting Primary Commodities

One of the most applied analytical frameworks in technology acquisition and catch up process has been the technology gap theory of long-run economic growth, which emphasised the advantages of technological backwardness and opportunities to catch up and climb the technology leader by the developing countries (Gerschenkron, 1962; Fagerberg, 1987). According to the technological gap theory, technological laggards can derive growth advantages from acquiring technologies that already exist in technological leaders. By mastering foreign technologies and applying them in domestic production backward countries can grow fast and converge to the productivity of industrialised nations.

Obviously, the way technological flows impact productivity growth in the receiving countries is different between developed and developing countries. The industrial basis of developing countries being narrower than that of industrial ones, we have argued that the primary mechanism through which the acquisition of foreign technologies contributes to productivity growth is by widening the range of productive activities, especially by spurring new activities that can increase the diversity of export. In that same line of thought, we extend the technological sophistication framework used by Hunt and Tybout (2000) by adding to it the features borrowed from the capital goods trade framework developed by Mutz and Ziesemer (2008) and use the resulting framework to investigate how Botswana's manufacturing sector has used imported embodied technologies to expand its industrial basis or upgrade its existing production techniques.

Mutz and Ziesemer base their model on a modified version of a two gap growth model with imported inputs as introduced by Bardhan and Lewis (1970). That model emphasises the insight that for developing countries, imported inputs paid for by export are the major mechanism of growth in the relation between export and growth, as advanced by Khan and Knight (1988). Mutz and Ziesemer (2008) develop a full-fledged growth model in which:

- Imported capital goods are the only source of investment in developing countries;
- All capital goods are paid for by the revenue from export;
- Export revenue is not used to import consumption goods;
- There is no external debt and trade is balanced.

In this model, the importation of capital goods and the elasticity of export demand contribute to explaining the growth behaviour of developing countries. The simplifying assumption made of no domestic production of capital goods is a fair approximation for the reality of many least developed countries and is thus suited to the analysis of the Botswana case. The growth of capital goods is thus constrained by the export revenue and can be written as:

$$\widehat{K} = \frac{\dot{K}}{K} = p\frac{X}{K} - \delta \tag{4.1}$$

where$K$ denotes the capital stock, X represents the exports and p represents the terms of trade, defined as the price of domestic goods in terms of imported capital goods. $\widehat{K}$ stands for the proportional growth rate of K, while represents the change of K with respect to time.

Investments need to be paid for by exports (=domestic savings) measured in terms of imported capital goods. Investments need to be paid for by domestic savings measured in terms of imported capital goods. The savings rate s is assumed to be a constant proportion of output and depreciation δK is a constant portion of the existing capital stock:

$$\widehat{K} = \frac{\dot{K}}{K} = sp\frac{Y}{K} - \delta \tag{4.2}$$

Exports $X$are in turn assumed to depend on the trade partners' income, Z, and on the terms of trade p. For the sake of simplicity, a log-linear export function with a constant B and a stochastic term V is used:

$$X = BZ^{\rho}p^{\eta}V, \rho > 0; \eta < 0 \tag{4.3}$$

where ρ denotes the income elasticity and η represents the (negative) price elasticity of export demand.

Technological Learning by Increasing Product Technological Sophistication

We now turn to the model developed by Hunt and Tybout to analyse the change in technical skills, product sophistication and productivity. The Hunt and Tybout (2000) model is articulated on what they call the Lucas/ Krugman/ Stokey/ Young (LKSY) view, stating that growth is accomplished by concentrating resources in those goods whose production processes induce learning and knowledge spillovers. This model was developed to relate firm- and plant-level technological sophistication of the manufactured products and the productivity growth rate associated with each product to the knowledge flow accruing to the analysed industries. For so doing, Hunt and Tybout (2000) distinguished between two mechanisms through which increasing sophistication can take place, namely the continual shifting of resources toward high-end products as predicted by the LKSY product spectrum models and a general increase in the intensity of skilled input use among all types of products. The latter is the kind of human capital deepening that provides an engine for growth in models that do not distinguish a spectrum of products in terms of their potential to generate learning.

4.3.4 Estimation Model, Data and Empirical Results

In this subsection, we develop an analytical model from the Cobb-Douglas production function in order to estimate the relationship between import of capital goods and the productivity growth. This framework uses the growth accounting approach to estimate total factor productivity growth and the factor input shares.From the values of computed productivity growth rates and the data on capital good imports and the share of skilled labour in the manufacturing sector, the effect of these latter variables on productivity growth are estimated.

Estimation Model

Our analysis of manufacturing productivity growth begins by considering a multivariate time series regression relating manufacturing value-added (MVA) to the monetary value of investment in imported machineries used in the manufacturing sector. To estimate this regression, we first assume a Cobb-Douglas production function with constant returns to scale with respect to labour and capital inputs. At this stage the human capital factor in the form of skilled labour is abstracted from. We will deal with the intensity of skilled labour when we analyse the industry technical intensity. That increase in skills intensity will be taken to be fed by the increase in the general education level in the country. The output Y produced in year t can thus be expressed as a function of capital and labour inputs used in that period:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} \xi_t \tag{4.4}$$

whereK_t represents the capital stock used in the manufacturing sector at time t and L_t the labour input in efficiency units, while A_t is the level of productivity or the technology factor at the same period and ξ_t a stochastic factor that captures measurement and observation errors. α and β are the usual input factor shares. Taking natural logarithms on both sides, we obtain:

$$\ln(Y_t) = \ln(A_t) + \alpha \ln(K_t) + \beta \ln(L_t) + \ln(\xi_t) \tag{4.5}$$

in which $\ln(\xi_t)$ represents the error term.

If we now subtract the expression at period t-1 from equation (4.5), we obtain the first difference equation between the two periods:

$$\ln(Y_t/Y_{t-1}) = \ln(A_t/A_{t-1}) + \alpha \ln(K_t/K_{t-1}) + \beta \ln(L_t/L_{t-1}) + \varepsilon_t \tag{4.6}$$

The productivity growth rate can thus be derived from this expression by subtracting from the output growth the input-shares weighted growth in capital and labour.

Here, we assume that the capital is only acquired through import and paid for by a share θ $(0 < \theta \leq 1)$ of export revenue[5]. The capital stock thus increases over time between $t-1$ and t by imported equipment and machinery and is decreased by depreciation, which is assumed here to be a constant percentage of the capital stock[6]. For computational and practical reasons, no depreciation charge is applied to the newly imported equipment in the year of importation. The linear depreciation charge for machinery and equipment is set in line with commonly applicable useful lives of the corresponding machine categories.

From the estimated coefficients α and β, we thus compute the manufacturing productivity growth rate $ln(A_t/A_{t-1})$ for each period by subtracting the input-share

[5] As in Mutz and Ziesemer(2008), no capital is produced domestically

[6] Navaretti and Soloaga(2001) and Mutz and Ziesemer(2001) also use constant depreciation rates.

weighted growth of capital and labour from the output growth. From the so constructed values of manufacturing productivity growth, we can now use another time series regression to estimate the contribution of capital goods import to the productivity increase. To that end, we express $ln(A_t/A_{t-1})$ as a function of the logs of capital import, the share of skilled labour in manufacturing and their lagged values over two subsequent periods:

$$\begin{aligned}\ln(A_t/A_{t-1}) &= \Delta\ln(TFP) = b_0 + b_1\ln(CAPIM_t) + b_2\ln(CAPIM_{t-1}) + \\ &\quad b_3\ln(CAPIM_{t-2}) + b_4\ln(SKILL_t) + b_2\ln(SKILL_{t-1}) \qquad (4.7)\\ &\quad + b_6\ln(SKILL_{t-2}) + \varsigma_{t,t-1}\end{aligned}$$

CAPIM stands for capital import value in US dollar amounts and SKILL for the share of skilled labour to total labour in the manufacturing sector and ς stands for the error term. Skilled labour for Botswana is defined here as labour input of employees with at least completed secondary or technical vocational education or other formal or informal training leading to comparable qualifications[7].

It is obvious that the effects of imported equipment on productivity and technical intensity do not materialise immediately in the period in which capital has been imported. As discussed by Navaretti and Soloaga (2001), the presence of lagged independent variables in equation 4.7) allows us to test the intuition that a time lag of 1 to 2 years is necessary between the importation of the equipment and its effects on productivity. We apply this reasoning to the data of the manufacturing sector in diamond-rich Botswana in order to estimate how machinery and equipment import affects manufacturing productivity growth and the expansion of the manufacturing sector itself in terms of product diversification and entry of new firms.

In addition, by replacing the capital import variable of the previous equation by its expression in terms of export revenue from the Mutz and Ziesemer (2008) model, $X = BZ^{\rho}p^{\eta}V$ and by assigning to the export function the share θ of total imports spent on acquiring machines and equipment used for manufacturing, we get the following equation that enables us to analyse how a change in terms of trade or a shift in income in the trade partner countries could affect the manufacturing productivity growth:

[7] See also the definitions used by Hunt and Tybout(2000)

$$\begin{aligned}\Delta \ln(TFP) &= \beta_0 + \beta_1 \ln \theta_t + \beta_2[\rho \ln(Z_t) + \eta \ln(p_t)] + \\ &\quad \beta_3[\rho \ln(Z_{t-1}) + \eta \ln(p_{t-1})] + \beta_4[\rho \ln(Z_{t-2}) + \eta \ln(p_{t-2})] + \\ &\quad \beta_5 \ln(SKILL_t) + \beta_6 \ln(SKILL_{t-1}) + \beta_7 \ln(SKILL_{t-2}) + \varepsilon_t\end{aligned} \tag{4.8}$$

where the error terms also capture the log difference in the stochastic error V of the Mutz and Ziesemer (2008) model.

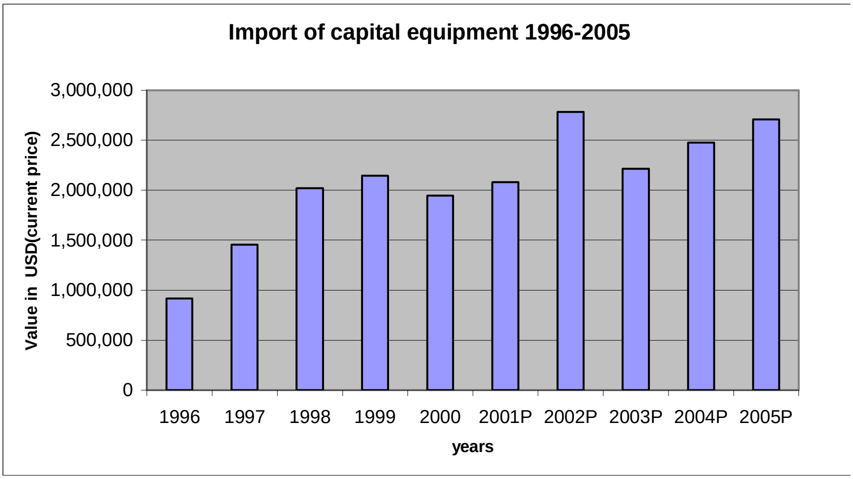
Botswana Trade and Industry Data

In order to adequately analyse the manufacturing productivity growth we first present an overview of country's economy and growth strategies. The data collected in this country and used in the analysis are also presented.

Data

Botswana capital import data were obtained and compiled from the records of the Botswana Central Statistics Office (CSO), a governmental department in the Ministry of Finance and Development Planning, and from the UN Comtrade database. The CSO records the current as well as the 1993 constant dollar value of capital imports from customs declaration documents. Goods declared at ports of entry/exit are classified according to the Harmonised Commodity Description and Coding System (HS) of Botswana, which is a locally adapted version of the internationally recognised Harmonised Commodity Description and Coding System. Additional data on capital goods import were retrieved from the COMTRADE database to cross-check and complete our dataset. The manufacturing value-added data of the selected manufacturing industries were compiled by the author from the records of the CSO, the Ministry of Trade and Industry, Botswana Confederation of Commerce, Industry and Manpower (BOCCIM) and the Exporters Association Botswana (EAOB) during his research in Botswana[8]. Data on manufacturing employment and labour input and wages were also compiled by the author from the EAOB, BOCCIM and CSO records. The so compiled data cover the period 1985-2005 and allow thus a time series analysis of the

[8] We gratefully acknowledge the precious help of our friends Daniel Chitsulo, Leah Ogtakazi and Seema Boitumile for assisting us in the access and compilation of the data in Gaborone. Our special thanks are further owed to Mrs Mien Vink of the Dutch GeneralConsulate in Gaborone as well as to Ms Leonie, Chargée d'Affaires of the Royal DutchEmbassy in Harare for their excellent consular assistance during my stay in Gaborone (July-September 2006). Financial support of UNU-MERIT is gratefully acknowledged.



Source: figure plotted by author with CSO data

FIGURE 4.2. *Current dollar value of imported machines and equipment, 1996-2005*

relationship between capital imports and manufacturing performance over 20 years. Figure 4.2 gives an overview of machinery and equipment (SITC Rev 3: codes 711-751) import values between 1996 and 2005 (exclusive of machinery and equipment destined for the mineral exploration) while figure 4.3 plots the values of capital goods imports against the corresponding value added created by the manufacturing sector over the period 1985-2005. As it clearly resorts from the numbers, the value of capital imports has fluctuated at times but displays a clear increasing trend over the period.

The industry-level data used in this analysis are based on the data files compiled by the author from the records of the Enterprises and Establishments Register (EER) as until the end of September 2005. The EER is a computerised database of enterprises and establishments in Botswana. It is mainly used as a sampling frame for economic surveys and contains relevant information on all business activities in the country. At the end of September 2005, there were 55,033 establishments listed in the Enterprises and Establishments Register compared to 54,875 at the end of September 2004. Out of these 55,033 listed establishments, 16,683 were known to be operating. In terms of number of firms, the manufacturing sector represents only 7.8 % of all registered economic entities in Botswana according to these records and accounts for only 4% of the total value added in 2005 as illustrated in Table 4.1, but employs 8.6 % of the active labour force.

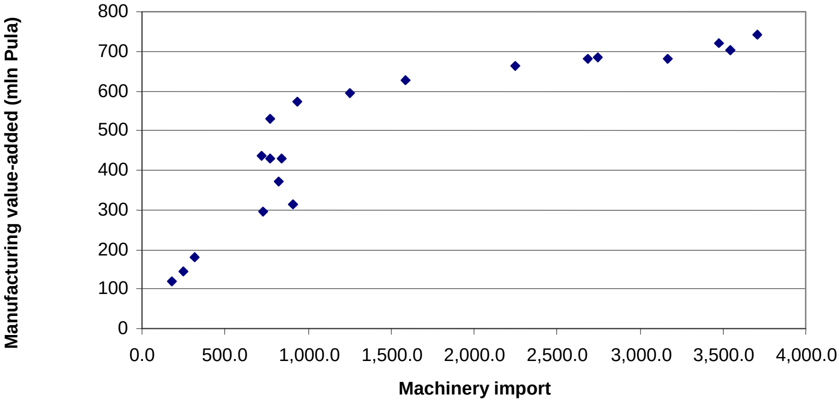


FIGURE 4.3. *Machinery import and MVA 1985-2005.*

TABLE 4.3. Botswana capital goods import and fixed capital formation (current prices, Pula mln)

Year	Import mach & eqpt (crt prices, mln P)	Total GDFC current prices (mln P)	Import mach & eqpt cst 1993 prices (mln P)	Total GDFC (cst 1993 prices) (mln P)
1985	178.6	474.3		
1986	249.6	696.2		
1987	321.0	1120.4		
1988	727.4	1776.9		
1989	913.6	2129.9		
1990	821.1	2433.8		
1991	720.9	2551.3	1134.7	3147.3
1992	771.3	2618.8	864.8	2922.4
1993	843.0	2813.8	824.6	2890.5
1994	771.6	3135.2	843.0	2813.8
1995	933.6	3632.3	689.7	2823.5
1996	1250.4	4275.9	769.5	3008.3
1997	1589.1	5170.2	958.5	3185.6
1998	2252.2	6263.3	1190.5	3723.3
1999	2749.4	6751.1	1648.2	4394.4
2000	2687.2	6898.2	1903.5	4463.2
2001	3167.8	7743.2	1723.8	4194.4
2002	3542.8	8735.7	1921.5	4450.8
2003	3917.7	9629.9	1946.7	4515.7

Source: Central Statistics Office

In terms of geographical spreading, the EER records show that most of the manufacturing establishments were located in Gaborone, which was home to 73.4% of the total manufacturing firms. Francistown and Kweneng followed with 8.9 and 5.9% respectively. Sowa Town, Chobe/Kasane and Jwaneng had the least number of operating establishments. Sowa Town had only 1 % of the total operating establishments, while Chobe/Kasane and Jwaneng had 1.2% each.

Table 4.4 shows the distribution of manufacturing entities into various activity types over the period 1991-2005. As it can be seen from the number of entities, the largest number of enterprises is active in basic manufacturing activities such as food and meat processing as well as the production of packaged or bottled beverages. In terms of geographical growth in the number of manufacturing entities the EER records show that Chobe/Kasane experienced the largest change. The number of manufacturing entities in Chobe/Kasane increased by 6.8% from the end of September 2004 to 24 at the end of September 2005; Francistown registered an increase of 2%, while Mahalapye and Kweneng followed with 1.5% and 1.1% respectively over the same period.

Sectoral Results

We first use the manufacturing value added data, the constructed capital stock data and the labour input to estimate α and β. We conduct an augmented Dickey-Fuller (ADF) unit root test to check the stationarity of the first differences. With a t-statistic of 3.831, 2.896 and 3.126 for respectively the $ln(MVA)$, $ln(K)$ and $ln(L)$variables, we found them to be $I(1)$ so that their first differences are $I(0)$. Although it would be interesting to perform a co-integration analysis to identify the nature of the long term relationship between these variables and use an error correction model to estimate this relationship, the time span covered by the available data is relatively short and co-integration test would not produce conclusive results. We estimate the relationship instead by assuming that the short-term relationships among the variables remain unchanged over time and we thus analyse the first differences. We assume ergodicity and exogeneity in the first differences and use the OLS method[9] to estimate the coefficients α and β of equation (4.8) in which we impose the input shares α and β to add up to one (constant returns to scale). The regression results for the Botswana manufacturing sector are reported in Table 4.5. We obtain an estimate of alpha=0,314

[9] Stewart (2005, p.826) notes that variables related in the short run may be legitimately described by an autoregressive distributed lag (ADL) model in first differences and be efficiently estimated by OLS.

TABLE 4.4. Number of operating firms in Botswana's manufacturing sector 1991-2005

Industry Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Meat and meat prod	7	7	11	8	8	10	9	9	10	11	11	11	11	11	11
Dairy prod	19	19	22	22	22	23	22	22	22	25	24	24	24	23	26
Grain mill prod	28	28	31	29	30	40	42	42	40	40	40	38	38	36	34
Bakery prod	66	65	80	80	88	90	107	104	107	112	110	105	105	103	106
Other food prod n.e.c	33	33	42	41	41	41	44	43	43	43	44	43	43	41	41
Beverages	5	6	6	7	10	9	11	11	11	10	11	10	10	10	11
Textile(excl clothing)	91	91	93	88	86	85	83	82	83	82	84	85	85	84	86
Clothing (excl footwear)	125	127	168	173	197	199	219	216	221	228	232	233	233	229	236
Tanning & leather prod	13	13	14	14	14	15	13	13	14	14	11	11	11	10	11
Footwear	1	1	3	4	3	2	2	2	2	3	4	4	7	7	7
Wood and wood prod	30	29	29	28	27	30	30	29	25	29	29	29	29	29	30
Paper and paper prod	24	24	30	30	30	29	32	32	32	35	36	34	33	30	28
Printing & publishing	64	65	73	73	75	76	81	81	82	91	93	91	91	89	94
Chemicals & chem. prod	41	41	47	46	47	50	55	55	57	60	58	59	60	58	57
Rubber & plastic prod	15	15	17	19	18	19	26	25	26	25	22	22	22	20	20
Cement manufacturing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Non-metallic min prod	73	82	86	89	92	96	102	102	103	103	107	107	107	102	108
Basic metals	4	4	7	7	9	9	9	9	9	7	6	6	5	5	5
Fabr.metal prod	133	134	165	164	175	179	198	195	198	195	194	192	190	186	181
Machinery & eqpt	9	9	11	11	11	11	19	19	19	22	23	23	23	20	23
Office & comput. eqpt	1	1	1	1	2	2	2	2	2	2	2	2	2	2	7
Electrical eqpt & app	0	0	1	1	1	1	3	3	3	5	4	4	4	4	4
Med., precis. & opt. instr	5	3	3	1	1	1	1	1	1	2	2	2	2	2	4
Motor vehicles & trailers	9	9	13	11	11	14	14	14	14	19	19	18	18	18	17
Other transp eqpt	0	0	2	2	3	3	3	3	2	3	3	2	2	2	2
Furniture	28	28	39	39	46	47	57	58	63	70	74	73	72	70	72
Jewellery	0	5	7	8	8	9	11	11	11	10	10	10	10	10	8
Manuf. other prod n.e.c	93	83	91	90	87	90	83	82	83	80	76	70	70	67	67
Total	918	923	1094	1088	1145	1183	1282	1269	1287	1331	1335	1314	1313	1274	1302

Source: Enterprises and Establishemnts Register, Botswana

TABLE 4.5. Factor shares estimates for the manufacturing sector 1985-2005

Dependent variable: $\Delta \ln (MVA)$		
Variable (log)	Coeff	std err
Constant	0.022	(0.039)
Δln (Capital stock)	0.314**	(0.154)
Δ ln (labour)	0.685**	(0.346)
R-squared	0.865	
Adj. Rsquared	0.855	
Sum of sq resids	0.088	
SE equation	0.082	
F statistic	91.293	
DW statistic	2.183	
N0. obs	20	

White-heteroskedasticity robust standard errors in parentheses;

* = significant at10%, ** = significant at5%, *** = significant at1%

and beta= 0,685. As we can observe from the estimation results, both coefficients are significant at 5% and can now be used to estimate productivity growth.

From the results of our estimates of the α and β coefficients, we compute the manufacturing productivity growth for each year over the considered period by subtracting from the output growth the input-share weighted growth of capital and labour input. We obtain estimates for manufacturing productivity growth with an average of value 2.1% over the examined period which is in line with other TFP estimates for Botswana[10]. Using these computed values, we construct a time series of productivity growth rates over the considered period according to equation 4.9 and use the so obtained results to estimate the parameters linking capital import and skills intensity to manufacturing productivity growth.

Before running the regression to estimate the coefficients of our equation, we perform an ADF test on the capital import and skills intensity variables to check their stationarity. As we have indicated above, the left hand variable is in first difference form and is stationary. The ADF test results also reject the unit root hypothesis for

[10] For example, Leith (1999) used data on growth of capital and labour input recorded in the country to calculate a TFP growth for Botswana over two decades running at 2.2 %, which is similar to that calculated for the very fast growing countries of East Asia.

both explanatory variables. However, as the time span of our data (19 time periods) is too short to allow conclusive ADF test results, we have to ensure that no hidden serial correlation biases our results. In order to reduce the problem of bias and inconsistency in the estimates as a result of serial correlation, we add one lag of the dependent variable and two lags for each of the explanatory variables on equation (4.8) as suggested by Verbeek (2004). The resulting equation (4.9) is superconsistent and can be efficiently estimated by the OLS method (see Verbeek, 2004). We therefore can use OLS to estimate the coefficients of the equation as specified in (4.9). The results of this estimation are reproduced in Table 4.6. We find positive and strongly significant coefficients for contemporaneous as well as the lagged capital imports and the share of skilled labour. The coefficient for the two-period lagged capital import is lower than that of one period lagged but its p-value remains below 5% while the coefficients of lagged skilled labour share are all insignificant. This corroborates our argument that the effects of imported capital on productivity growth are subject to time lags of between 1 and 2 years, while the effects of skilled labour input are likely to immediately affect productivity increase. The Granger causality test confirms the precedence of capital goods import on the corresponding productivity growth. Our results thus confirm the argument that capital imports in a given period has a positive influence on productivity in subsequent periods.

$$\begin{aligned}
\ln(A_t/A_{t-1}) \quad = \quad & b_0 + b_1 \ln(CAPIM_t) + b_2 \ln(CAPIM_{t-1}) + \\
& b_3 \ln(CAPIM_{t-2}) + b_4 \ln(SKILL_t) + b_5 \ln(SKILL_{t-1}) \\
& + b_6 \ln(SKILL_{t-2}) + \ln(A_{t-1}/A_{t-2}) + \varepsilon_t
\end{aligned} \tag{4.9}$$

Assuming balanced trade, we can also replace the import with the export function and estimate how exports affect productivity growth. Using the export data for Botswana as in equation (4.9), we find results that are somewhat different from those of the import data, in which the significance of the 2-period lagged machineries imports (expressed in terms of export) disappears, while the one period-lagged TFP appears to be strongly significant in explaining current manufacturing productivity growth. Of all explanatory variables, only exports, both current and those of the previous period seem to be significantly associated with the sectoral expansion of the manufacturing sector in terms of entry of new firms.

TABLE 4.6. TFP growth and sectoral expansion 1985-2005

	Dep var: manuf productivity growth		Dep var: sect expansion	
Variable	Coeff	Std err	Coeff	Std err
Intercept	1.636	(2.491)	2.393	(3.023)
$\ln(CAPIM_t)$	0.192**	(0.082)	0.086**	(0.041)
$\ln(SKILL_t)$	0.033***	(0.012)	-1.548	(1.367)
$\ln(A_{t-1}/A_{t-2})$	-0.021	(0.144)		
ln(sales new firms)			0.447	(0.414)
$\ln(CAPIM_{t-1})$	0.424***	(0.114)	0.129**	(0.043)
$\ln(SKILL_{t-1})$	0.074	(0.046)	0.453*	(0.222)
$\ln(CAPIM_{t-2})$	0.177	(0.082)	0.065	(0.069)
$\ln(SKILL_{t-2})$	0.206	(0.346)	0.279	(0.166)
R-squared	0.765		0.663	
Adj R-squared	0.744		0.643	
Sum sq resids	0.454		0.018	
SE equation	0.082		0.041	
F-statistic	91.293		47.617	
DW-stat	2.213		2.144	
N0 Obs	19		19	

*= significant at 10% ; **=significant at 5%; ***=significant at 1%

Moreover, the idea that a developing country importing capital goods from export revenues can see its productivity grow as a result of favourable terms of trade or an increased demand of its export product by its trade partners is confirmed when we use the Mutz and Ziesemer's (2008) export function and the US GDP data for the export partner's income[11], as it clearly resorts from Table 4.7.

We then analyse the sectoral expansion in terms of entry of new operating firms (expressed by their sales volumes) and find it to also be highly correlated with the lagged values of capital import. The strong significance of the lagged-imports coefficient of indicates that the import of machinery and equipment from abroad not only contributes to the productivity growth of existing firms but also boosts the creation of new manufacturing entities in Botswana in subsequent years. Alternatively, it can be argued that it is the entry of new firms that boosts the import of capital equipment, so that the sense of causality remains unclear. This growth of the man-

[11] Although the US is ot the main trade partner of Botswana, it is the main final destination of finished diamond products and is thus the most appropriate country to be used as a driver of export demand for Botswana

TABLE 4.7. Results with terms of trade and foreign income in the export function

	Dep. var: manuf prod.growth		Dep. var: sect. expansion (sales of new firns)	
Variable (log)	Coeff	(Std err)	Coeff	(Std err)
Intercept	1.326	(0.681)	2.162	(0.653)
Machinery share of import θ	0.014	(0.021)	0.001	(0.325)
Tr partner's income z (US)	0.255**	(0.114)	0.239	(0.149)
Terms of trade p	0.025	(0.157)	0.014	(0.126)
Skilled labour share	0.364**	(0.157)	0.267**	(0.127)
Sales new firms			0.073	(0.063)
Lagged tr. part. income Z_{t-1}	0.016***	(0.007)	0.018***	(0.007)
Lagged prod growth	0.206***	(0.056)		
Lagged terms of trade p_{t-1}	0.025**	(0.011)	0.022*	(0.012)
Lagged skill. lab. share	0.343	(0.257)	0.396	(0.215)
R-squared	0.642		0.636	
Adj R-squared	0.621		0.621	
Sum sq resids	0.414		0.018	
SE equation	0.07814		0.042	
F-statistic	78.043		48.121	
DW-stat	2.186		1.942	
N0 Obs	19		19	

Standard errors in parentheses;
*= significant at 10% ; **=significant at 5% ; ***=significant at 1%

ufacturing firms is, however, also found to be associated with sectoral productivity growth, which might indicate that newly entering firms import more technologically sophisticated capital goods that explain part of the increase in productivity. This productivity growth can at least partly be attributable to the continuous entry of more productive firms in the manufacturing sector as characterised by larger shares of skilled labour and/or more sophisticated machines. Whether this sectoral growth and the accompanying productivity increase is the result of the creation of new, more technologically intensive activities will be investigated in the next subsection.

Productivity Growth of Manufacturing Firms: A Panel Data Analysis

In order to investigate the possible shift of factors to more productive industries, we selected 10 industries in the Botswana manufacturing sector and matched their International Standard Industry Classification(SIC) description with the Standard International Trade Classification (SITC) Revision 3 and Harmonised Commodity Description and Coding System (HS) description of the types of equipment they use in production for a panel data analysis. This matching is partly based on the one used by Navaretti and Soloaga (2002) and is reported in table 4.8. Navaretti and Soloaga base their matching on the correspondence in description between HS codes of the imported machines and the 3-digit SIC codes of the manufacturing industries

TABLE 4.8. Matching between machines and industries using them

Industry (ISIC Revision 3)	Machines(SITC Revision 3)
Dairy(1520)	Dairy equipment(7123)
Beverages (155)	Food(beverage) machinery, non domestic(727)
Spinning, weaving and finishing of textiles (171)	Textile machinery(7244/5/6/7)
Wearing apparel, except fur apparel (1810)	Sewing machines(7243)
Paper and paper products (210)	Paper & paper mill machinery (725)
Basic chemicals (241)	Machine tools specialised for particular industries(chemical); parts and accessories thereof(728)
Rubber products (251)	Rubber and plastic working machines (72842)
Glass and glass products (2610)	Glass working machinery (72841)
Basic iron and steel (2710)	Metal working machinery (737)
Furniture (3610)	Machine tools for working wood and wood treating machines(331+332)

using these machines to produce the described products in the importing countries. A correspondence between HS and the SITC Revision3 is also provided. Table 4.8 uses a similar matching for some of the manufacturing industries operating in Botswana. This enables us to examine with panel data how the import of machineries and equipment impacts on the productivity growth, skills intensification and expansion of the various manufacturing industries and to assess where these effects are strongest.

One of the advantages of using a panel data analysis is that by disaggregating the manufacturing sector in its main constitutive industries, we are able to overcome the limitations of the short time period by increasing the number of observations. However, panel data analysis is much more than simply pooling the various time series/cross sectional (TSCS) data. Using OLS to estimate pooled TSCS data is only optimal if the errors are assumed to be spherical, i.e. if they have the same variance (homoscedasticity) and are independent of each other (Beck and Katz, 1995). A simple application of the OLS estimator on nonspherical data will thus not be the best choice as there will be other estimators that make more efficient use of the data. Another advantage of using panel data methods is that they enable the user to control for the effects of some types of omitted variables, even without observing them, only by observing changes in dependent variable over time. This controls for omitted variables that are different between industries but do not change over time. Such a control is achieved by the use of the fixed effects method. However, some omitted variables affecting the manufacturing productivity growth may rather be varying more over time than between industries: in the case where omitted variable may vary as well with the time as with the industries, the random effects method will give a more efficient estimation compared to the fixed effects method which often gives the most consistent estimator (Baltagi, 2005).

For the 10 industries in the table, we have collected yearly data on the number of firms active in that industry, the average firm size (based on number of employees), the percentage of foreign ownership, the yearly imports of industry specific capital equipment, the share of skilled labour relative to total labour and the industrial output value for the period 1991-2005. We have thus a total of 150 observations. In order to estimate productivity growth, we reproduce equation (4.3.9) for the whole set of 10 manufacturing industries in Table 4.8 assuming the coefficients do not significantly change over the considered period. For each industry j, dropping the lagged dependent variable which was only added to (4.3.9) to deal with serial correlation, we can thus write:

$$\begin{aligned} \ln(A_{jt}/A_{jt-1}) &= b_{0j} + b_{1j}\ln(CAPIM_{jt}) + b_{2j}\ln(CAPIM_{jt-1}) + \\ &\quad b_{3j}\ln(CAPIM_{jt-2}) + b_{4j}\ln(SKILL_{jt}) + \\ &\quad b_{5j}\ln(SKILL_{jt-1}) + b_{6j}\ln(SKILL_{jt-2}) + \varepsilon_t \end{aligned} \tag{4.10}$$

On the labour supply side, the general increase in education level in the country contributes to increasing the supply of skilled labour and thus also affects the change in the skilled labour share in all industries. Especially, vocational education is likely to fuel an increase in the technical skills of the labour force but the impact on each specific industry will eventually depend on the demand and availability of the needed curricula. The ownership structure (based on percentage of company's capital or voting rights controlled by foreigners versus the percentage controlled by domestic owners) and the size of the firms expressed in terms of total employment are other factors affecting the choice of technological content of the imported machines, the skilled labour intensity and therefore the productivity growth. We thus add as explanatory variables firm size expressed as the average number of employees per firm in each industry (SIZE) as well as an ownership variable (OWN) representing the share of foreign controlled firms in each industry. Joint ventures are arbitrarily treated here as foreign owned firms. As ownership in each firm changes only rarely over time in the considered period, we assume past ownership structure to be irrelevant for contemporaneous productivity growth, so that no lagged terms of the variable OWN are added. We thus obtain the following equation:

$$\begin{aligned} \ln(A_{jt}/A_{jt-1}) = b_{0j} &+ b_{1j}\ln(CAPIM_{jt}) + b_{2j}\ln(CAPIM_{jt-1}) + \\ &b_{3j}\ln(CAPIM_{jt-2}) + b_{4j}\ln(SKILL_{jt}) + b_{5j}\ln(SKILL_{jt-1}) + \\ &b_{6j}\ln(SKILL_{jt-2}) + b_{7j}\ln(SIZE_{jt}) + b_{8j}\ln(SIZE_{jt-1}) + \\ &b_{9j}\ln(OWN_{jt}) + \varepsilon_t \end{aligned} \tag{4.11}$$

As noted above, the application of pooled OLS to estimate this regression will only produce consistent estimate when the errors are spherical. In contrast, the fixed effects method uses a within estimator which is unbiased and consistent whether the individual effects are independent of the regressors or not, while the Generalised Least Squares (GLS) estimator of random effects is only unbiased and consistent if the individual effects are independent of the regressors but when this is the case, then it is asymptotically more efficient than the fixed effects estimator because it uses the available information more efficiently (Baltagi, 2005). Therefore, it the case there are no significant differences between the fixed effect and the random effects coefficients (i.e. if there is no bias or inconsistency disadvantage for the random effect estimator), and when individual effects are independent of the explanatory variables, the random effects method can be given the preference due to its higher efficiency. This choice can be determined by using the Hausman test: the essence of the Hausman specification test is to check whether the GLS estimator is not significantly different from the within estimator, so that consistency of GLS can be inferred. When the GLS estimates are too different from the within estimates, then the efficiency of GLS does not weigh up against its consistency disadvantage: in that case the within-estimator is preferred. We therefore produce estimates using successively the OLS with panel corrected standard errors[12], the fixed effect estimator, and the random effects method

[12] Beck and Katz'(1995) Monte Carlo results indicate that for time spans from 2 times larger than the number of units, PCSE model performs much better that the FGLS. Beck (2001) recommends it when the number of time points is larger than 15. Plümper and Tröger(2005) suggest the use of a 3-stage fixed-effects vector decomposition(FEVD) as an even more efficient estimation method in the presence of rarely changing or time-invariant variables, or when the within variance is small.

using the Wallace-Hussain estimator. This will enable us to compare the results of each of these estimation methods.

The OLS (with panel corrected standard errors), the fixed-effects and random effects estimation results of the regression as specified in (4.11) are reported in Table 4.9 . At a first glance, apart from the ownership variable, which shows a significantly positive relationship with productivity growth irrespective of the estimation method, all the other coefficients display insignificant values. Since the coefficients of the 2-period lagged explanatory variables and the contemporaneous skills intensity show the lowest significance in the three estimations, we refine our estimation by dropping them out of the regression. We thus estimate equation (4.11) in its reduced form (4.12) with the three methods:

$$\begin{aligned}\ln(A_{jt}/A_{jt-1}) = b_{0j} + b_{1j}\ln(CAPIM_{jt}) + b_{2j}\ln(CAPIM_{jt-1}) + \\ b_{3j}\ln(SKILL_{jt-1}) + b_{4j}\ln(SIZE_{jt}) + b_{5j}\ln(OWN_{jt}) + \varepsilon_t\end{aligned} \tag{4.12}$$

The corresponding regression results of the three estimation methods are displayed in Table 4.10. This time, the OLS estimator shows statistically significant positive effects of past capital import, skills intensity in the previous period and the degree of foreign ownership in the industry. Size seems to be negatively correlated with productivity growth, which can be interpreted as implying a stronger productivity growth in the industries where the average firm size is smaller as compared to industry with large, already established firms. The fixed effects estimator yields similar results with respect to the positive effects of capital goods import and skills intensity, but the negative effect of size is no longer significant. The same picture is also shown by the random effects estimator, be it with slightly different coefficients.

We run the Hausman specification test to check which panel estimator is more appropriate for the data at hand. The test results are displayed in the last two columns of Table 4.10 and indicate insignificant differences between the coefficients estimated with GLS random effects and the corresponding coefficients produced by the fixed effects estimator, which implies that the random effects estimator is preferable because of its higher efficiency, as explained by Baltagi (2005).

In order to assess the diversification effects of capital goods imports and labour skills intensity, we run similar regressions relating the relative expansion in each industry (measured by the sales growth of new firms in that industry, i.e. not longer than 2 years

TABLE 4.9. Productivity effects of capital import, skills intensity, ownership structure and size

	Dependent variable: Manuf productivity growth					
Method	OLS(PCSE)		Fixed effects		Random Effects	
Variable	Coeff	Std err	Coeff	Std err	Coeff	Std err
$\ln(\text{CAPIM}_t)$	-0.011	(0.034)	0.012	(0.021)	-0.006	(0.029)
$\ln(\text{CAPIM}_{t-1})$	0.052	(0.045)	0.034	(0.027)	0.053	(0.038)
$\ln(\text{CAPIM}_{t-2})$	-0.023	(0.033)	-0.023	(0.021)	-0.020	(0.028)
$\ln(\text{SKILL}_t)$	-1.009	(1.012)	-1.279	(0.904)	-1.123	(0.905)
$\ln(\text{SKILL}_{t-1})$	1.031	(1.013)	1.748*	(0.920)	1.136	(0.902)
$\ln(\text{SKILL}_{t-2})$	-0.272	(0.068)	-0.289	(0.165)	-0.276	(0.233)
OWN	0.076**	(0.030)	0.08**	(0.033)	0.069**	(0.028)
SIZE	0.252	(0.306)	0.117	(0.236)	0.293	(0.336)
SIZE_{t-1}	0.262	(0.307)	-.393*	(0.231)	-0.276	(0.333)
SIZE_{t-2}	-0.185)	(0.134)	-0.242	(0.166)	-0.189	(0.125)
Intercept			1.012	(0.702)	0.236	(0.216)
R-squared	0.482		0.465		0.087	
Adj R-squared	0.419		0.437		0.042	
DW-stat	1.7402		1.984		1.740	
N0 Obs	130		130		130	

Standard errors in parentheses;
*= significant at 10% ; **=significant at 5% ; ***=significant at 1%

in operations) as dependent variable, to the same explanatory variables that we used to analyse productivity growth. The extent of sales growth of new firms is an indication of the viability of newly created companies, which implies that the manufacturing sector is becoming more diversified in its ranges of products. As in the manufacturing productivity regression, many of the lags as specified in equation (4.11) turn out to be insignificant. By successively dropping out the most insignificant coefficients, we obtain more informative results displaying a high degree of significant association between current and past capital goods imports and skills intensity in the proceeding period on the one hand and industry expansion on the other, as shown in Table 4.11 The Hausman test, in contrast to the previous situation, finds a significant difference between the coefficient of lagged skills intensity and the fixed effects estimator will thus be more appropriate here. According to our estimates capital goods import and the level of skilled labour intensity are thus important factors associated with industry expansion. This time, foreign ownership does not significantly affect expansion and its coefficient is rather negative. In contrast, the average firm size seems to be strongly but negatively associated with sales growth, which implies that new firms are mainly thriving in the business areas where the average firm size is smaller.

As in the aggregated data, we thus find capital goods import to have a significant influence both on the productivity growth and on the industry expansion expressed in sales of new firms in the various industries. The share of skilled labour is also very

TABLE 4.10. Manufacturing productivity growth effects of capital import: panel estimates for 10 industries 1991-2005

	Dependent variable: Manufacturing productivity growth							
Method	OLS(PCSE)		Fixed effects		Random Effects		Hausman test	
Variable	Coeff	Std err	Coeff	Std err	Coeff	Std err	Var (diff)	Prob
ln(CAPIM$_t$)	-0.015	(0.033)	-0.008	(0.031)	-0.012	(0.029)	0.0001	0.699
ln(CAPIM$_{t-1}$)	0.033***	(0.013)	0.0336***	(0.013)	0.036***	(0.013)	0.0002	0.862
ln(SKILL$_{t-1}$)	0.026**	(0.012)	0.2587**	(0.123)	0.027**	(0.013)	0.055	0.294
OWN	0.074***	(0.013)	0.120**	(0.041)	0.078**	(0.037)	0.007	0.553
SIZE	-0.088**	(0.306)	-0.052	(0.038)	-0.064	(0.037)	0.038	0.450
Intercept			1.007	(1.084)	-0.205	(0.210)		
R-squared	0.692		0.682		0.732			
Adj R-squared	0.639		0.644		0.713			
DW-stat	1.744		1.761		0.746			
N0 Obs	140		140		140			

*= significant at 10%; **=significant at 5%; ***=significant at 1%

TABLE 4.11. Sectoral expansion effects of technology import: panel estimates for 10 industries 1991-2005

Dependent variable: Sales growth, new firms						
Method	OLS(PCSE)		Fixed effects		Hausman test	
Variable	Coeff	Std err	Coeff	Std err	Var(diff)	Prob
$\ln(\mathrm{CAPIM}_t)$	0.043**	(0.019)	0.044**	(0.020)	0.000	0.684
$\ln(\mathrm{CAPIM}_{t-2})$	0.048**	(0.019)	0.053***	(0.020)	0.000	0.741
$\ln(\mathrm{SKILL}_{t-1})$	1.927***	(0.182)	1.593***	(0.142)	0.037	0.000
OWN	-0.031	(0.040)	-0.027	(0.026)	0.0002	0.369
SIZE	-0.571	(0.093)	-0.605**	(0.103)	0.001	0.211
Intercept	9.595***	(0.606)	8.784***	(0.645)		
R-squared	0.797		0.698			
Adj R-squared	0.795		0.693			
DW-stat	1.744		1.761			
N0 Obs	130		130			

*= significant at 10% ; **=significant at 5% ; ***=significant at 1%

important in increasing productivity and fostering the emergence of new firms, while size difference does not seem to translate in significant productivity differences but affect differences in industry expansion. Firms of different sizes appear to benefit in similar ways from the utilisation of skilled labour and imported capital goods but new firms mainly emerge in activities with relatively small firm size. However, unlike in the aggregate data, our panel data estimates have shown that industries with a higher proportion of foreign owned firms tend to derive more productivity growth from their operations and skills intensity than those with a higher predominance of domestic ownership. This may suggest that foreign owned companies tend to have management and investment advantage which allow them to benefit more from the utilisation of imported capital goods and their stock of skilled labour. Nonetheless the ownership control structure does not produce significant differences in the emergence and growth of new firms.

Technical Intensity of Manufacturing Firms: Growth Decomposition

As the number of active firms in each industry has been growing over the considered period, it is interesting to investigate the LKSY hypothesis and check whether the manufacturing productivity growth came from the newly created firms or from existing ones. In order to account for the possible diversification into more technologically advanced firms with higher shares of skilled labour and higher productivity corresponding to Hunt and Tybout's (2000) technological sophistication, we check whether industry level productivity increased because all firms became more sophisticated, or because of intra-industry market share reallocations toward more sophisticated firms.

In order to distinguish these two types of increases in the sophistication of production, we use the Hunt and Tybout (2000) model, which decomposes the growth of manufacturing-wide technological sophistication, e, between two subsequent periods, $t-1$ and t as the sum of two components:

$$\frac{\Delta e_t}{e_{t-1}} = \frac{\sum_{j=1}^{J} \Delta e_{jt} \overline{\theta_j}}{e_{t-1}} + \frac{\sum_{j=1}^{J} \Delta \overline{\theta}_{jt} \overline{e} j}{e_{t-1}} \tag{4.13}$$

Here, e represents the relative number of technicians in manufacturing, expressed as the share of technician workers to total manufacturing employment. Subscripts j and $t$indicate the industry and time period, respectively, θ_j is the j^{th} industry's share in manufacturing-wide employment, and indicates the simple average of these variables over the time periods, and Δ is the difference operator between the periods $t-1$and t. The same expression can be used, *mutatis mutandis*, to decompose changes in manufacturing-wide technician wages as a share of some manufacturing-wide normalizing variable (total wages, expenditures, or production).

The first term on the right-hand side captures the change in manufacturing-wide technological sophistication due to within-industry deepening of technical intensity, and the second term represents the reallocation of skilled workers across industries. If the second term is positive, then the technician-intensive industries are growing relatively rapidly, indicating the type of resource reallocation consistent with LKSY-type productivity growth. In contrast, if all of the change in aggregate technical intensity comes from intra-industry deepening, there is no evidence of this type of broad resource reallocation. Nonetheless, it may still be the case that within particular 3-digit or 4-digit industries, resources are being shifted toward high-end products, in which case further disaggregation is needed to detect the LKSY growth mechanism.

Applying the Hunt and Tybout approach, we analyse the productivity growth on the industry level in all industries classified by the BSIC as belonging to the manufacturing sector (See Appendix A.4.1). The firm number in each industry and their evolution over the period 1991-2005 is reported in Table **??**. This analysis allows us to isolate the technological deepening by industry from the shift to more technologically sophisticated firms in new industries (= industrial diversification).

Each Δe_{jt} term in equation (4.13) is decomposed into the effect of intra-industry changes in technical intensity, and the effect of changes in the allocation of skilled workers across firms. This exercise is basically the same as the sectoral decomposition; however it is complicated by extra terms to deal with the entry and exit of producers over the sample period. The expression derived from the sectoral decomposition becomes:

$$\Delta ejt = \overline{\alpha}_j[\sum_{j=1}^{J} \Delta e^c_{ijt}\theta_{ij} + \sum_{i=1}^{I} \Delta\overline{\theta}^c_{ij}\overline{e}_{ij}] + \Delta a_j[\overline{e}^c_j - \frac{e^b_j + e^d_j}{2}] + (e^b_j - e^d_j)(1-\alpha_j) \quad (4.14)$$

Here c, b and d indicate continuing, entering (beginning) and exiting (dying) firms, respectively and i subscripts refer to firms belonging to a given industry, while α_j is the share of continuing firms in total employment within industry j.

The first term on the right-hand side resembles equation (4.13), derived from the Hunt and Tybout model. Its components disaggregate changes in technician intensity among incumbent producers into two subcomponents: one is incumbent upgrading, and the other is shifts in market share among incumbents. The second term measures the effect of changes in the market share of incumbent firms. This term indicates that when incumbents are more intensive in skilled labour than entering and exiting firms, then reductions in the amount of turnover (increases in θ_j) will increase industry-wide technology intensity. Finally, if entering firms are more technical-intensive than the exiting firms they replace, ongoing producer turnover will also increase industry-wide technology intensity. This replacement effect is described by the third term of the right hand side expression.

A selection of the results of this analysis is presented in Table 4.12. From our results, it is clearly visible that although technological sophistication as measured by skilled labour intensity has been increasing over the considered period, this increase was mainly due to upgrading within each of the industries, rather than a replacement of less technological sophisticated by more technologically sophisticated industries. Firm growth accounts for a negligible portion of the total increase in skilled labour intensity, while the entry of new firms slightly increased the level of skills intensity in the industry in the considered period. Aggregate growth in technical intensity is therefore driven by a deepening of technological sophistication in all industries considered in our analysis, not because some more technologically performing industries grew relative to other industries. We therefore do not find convincing evidence of a capital import driven diversification in more technologically advanced industries in the case of Botswana.

Hunt and Tybout (2000) point out that other studies (e.g. Chenery and Syrquin, 1986) have documented a systematic shift of production away from simple manufactured products as the development process unfolds, thereby validating the LKSY hypothesis. In the case of Botswana, we thus do not observe an inter-industry shift of resources towards more productive industries at the expense of less technical intensive

TABLE 4.12. Sources of change in skills intensity 1991-2005

Industry	Growth incumbent firms	Upgrading skills existing firms	Entry new firms	Total change
Beverages	-0.0276	0.5457	0.2137	0.7318
Textile	0.0067	0.0394	0.0198	0.0658
Clothing	-0.0011	0.0385	0.0216	0.0590
Chemical products	0.0580	0.4663	0.0410	0.5653
Paper products	0.0022	0.0373	0.0042	0.0437
Furniture	0.0044	0.0407	0.0204	0.0655
Glass products	-0.0028	0.0325	0.0179	0.0476
Metal products	0.0048	0.0530	0.0198	0.0775
Average	0.0056	0.1567	0.0448	0.2070

industries. This is not surprising given the relatively young stage of industrialisation of Botswana in which most of industries are still in the growth phase. Interestingly, similar decompositions such as those made by Behrman, Machin and Bound (1996), suggest that most of the rise in the skill intensity of production is due to skill deepening within existing industries, rather than shifts in the product mix toward skill-intensive industries.

4.4 Extension: Primary Commodity Export-Growth Nexus

The empirical evidence for the contribution of primary commodity exports to Botswana's economic growth is based on the augmented production function models. The augmented production function models assumes that, along with conventional inputs of capital and labour used in the neoclassical production function, unconventional inputs like exports and other variables may be added into the model to capture their contribution to economic growth. Such a model was also used by, among others, Feder (1983) and Fosu (1990). In the following, we specify an augmented production function model to estimate the contribution of export mineral and that of manufacture exports to Botswana economic growth.

To that end, we express the country's output (Y) as a function of the conventional inputs (capital K and labour L) augmented with non-conventional inputs, including import of capital equipment (M_{cap}), exports goods and services (X) including of primary commodities and manufactured goods as well as the trade shares weighted average income Z of the country's trade partners because over the last three decades, the exportation of the beef and diamond has been driven by foreign demand which is a function of trade partners GDP growth[13].

$$Y = AK^{\alpha}L^{\beta}M_{cap}^{\gamma}X^{\lambda}Z^{\chi}\xi \tag{4.15}$$

where ξstands for the stochastic factor to capture observation and measurement errors.

In order to gain more disaggregated insights and distinguish the contribution of primary export (X_{pr}) as opposed to the export of manufactured products (X_{manuf}) we further split export X into these components and obtain the following equation:

$$Y = AK^{\alpha}L^{\beta}M_{cap}^{\gamma}X_{pr}^{\lambda 1}X_{manuf}^{\lambda 2}Z^{\chi}\xi \tag{4.16}$$

All these variables are assumed to play an important role in the economic development of Botswana and the empirical examination will enable us to assess to what extent they have contributed to growth. Discrimination between the primary commodity exports, which constitute the traditional export basis, and the manufactured export, which come from the industry stimulated by diamond revenues, is important for assessing the separate contribution of each of them to total growth. Taking the natural logarithms of both sides of equation (4.16) and adding time subscript to the production factors to follow them over time we obtain:

$$\ln Yt = \ln A_t + \alpha \ln K_t + \beta \ln L_t + \gamma \ln M_{cap,t} + \lambda 1 \ln X_{pr,t} + \lambda 2 \ln X_{manuf,t} + \chi \ln Z_t + \varepsilon_t \tag{4.17}$$

where the error term ε_t captures $ln\ (\xi)$.

Using Botswana data covering the period 1980 to 2004 (see Table 4.13) and taking world income as a proxy for foreign trade partners' income[14], we first test for the stationarity using the augmented Dickey-Fuller (ADF) test. The results reject the unit root hypothesis, but as stated earlier, the validity of these test results is to be taken with the due caution since the relative short time period does not warrant conclusive ADF results. For the same reasons, we do not attempt to conduct a co-integration test because the period covered by the data is not long enough to warrant a valid use of the error correction model (ECM). We thus simply run an OLS regression,

[13] See also the relation between export and foreign trade partners'income mentioned in equation (4.6)

[14] In contrast to the number of trade partners for diamonds, when we include manufactured products the number of export destination becomes larger.

whose results are reported in the first column of table 4.14. The DW statistic of 1,512 indicates there might be problems due to serial correlation. To mitigate this problem, we add lagged dependent variable to the right-hand side of the regression and get the results as reported in the columns of regression 2 in Table 4.14.

These results are important because they show the impact of both primary exports and manufactured exports on Botswana's economic growth. Looking at the results of the second regression, and specifically at exports which are the main focus of the study, we note that other things being equal, a 1 percent increase in Botswana's primary commodity exports (X_{pr}) would lead to an increase in annual economic growth rate of 0.6 percentage point. Likewise, for non-traditional exports, namely the manufactured export (X_{manuf}), there would be a reduction in annual economic growth rate of 0.079 percent.

These results for manufacturing seem paradoxical but are similar to those of Ghatak, and Price(1997) Ghatak, Milner and Utkulu (1997) or Sentsho(2000), who also found that for developing countries which have not yet achieved a critical level of economic development, primary exports and manufactured exports carry opposite signs. The study of export composition and economic growth in eight developing low-income African countries also comes to the same conclusion on the role played by primary exports on economic growth (Ukpolo, 1994). The study however, cautions policy makers not to rely on this sector for long term growth because of the potential problem of deterioration in the terms of trade for primary products.

The results also suggest that Botswana's unemployment problem is quite serious. The results in the last column of Table 4.14) indicates that a 1 percent annual growth in the labour force would result in a 3.76 percent fall in annual real GDP growth, *ceteris paribus*. This contrasts sharply with capital (K), whose growth contributes to economic growth by 0.18 percent for each percentage point. Equally important is the variable for trade partners growth, which indicates that a 1 percent growth in this variable would result in an annual real GDP growth of 2.21 percent.

4.5 Concluding Discussion

In this section, we have analysed the effects of imported capital goods on the labour productivity increase and on the diversification into more technologically advanced manufacturing industries. Our aggregate results show that labour productivity has benefited from the import of foreign machinery and that the intensity of skilled labour

TABLE 4.13. The role of mineral export in Botswana's GDP growth

Year	Real GDP (Pula mln)	Percentage of real GDP				Exp earnings (Pula mln)	% of exp earnings			Govt rev (Pula mln)	Minerals % Govt rev	Forex res USD mln	Import cov Months
		Agric	Govt	Manuf	Mining		Beef	Diam	Manuf				
1980	1380	11.7	14.2	4.1	29.7	1040.32	7.2	60.7	11.3	609.63	32.9	344	6
1981	1511	10.5	13.2	6.7	3501	654.00	18.2	40.6	17.2	571.94	23.9	253	4
1982	1623	9.9	13.3	7.7	38.7	873.68	17.0	52.0	17.2	598.44	25.3	293	5
1983	1884	7.5	12.6	6.1	48.8	1469.54	11.3	66.6	12.6	824.22	34.4	396	7
1984	2101	5.8	12.5	5.7	50.7	1603.50	7.3	71.9	13.0	1.25.97	46.9	472	10
1985	2252	5.3	13.4	4.2	48.8	2241.58	7.0	75.7	8.6	1300.06	51.3	748	18
1986	2420	5.5	13.5	5.1	46.8	2130.19	7.4	74.5	10.5	1507.11	54.6	1198	20
1987	2636	4.7	14.9	5.6	46.5	2909.83	3.1	84.6	7.9	1987.37	56.7	2013	24
1988	3039	6.7	16.2	6.3	41.5	2905.15	4.2	73.9	8.1	2764.44	59.0	2257	24
1989	3702	5.0	14.9	6.5	40.5	3644.120	3.6	76.4	7.4	2683.60	58.1	2803	21
1990	3911	4.9	14.6	6.5	37.1	2224.00	3.2	78.7	9.9	2506.50	53.6	3331	21
1991	4252	4.7	14.6	6.4	37.3	2431.23	3.3	78.7	10.1	2646.76	46.4	3719	24
1992	4522	4.5	16.1	6.4	34.9	2223.09	2.9	78.9	10.4	2814.29	40.1	4031	26
1993	4516	4.4	16.7	6.3	33.3	1303.64	3.8	78.2	12.9	2890.78	42.5	4097	30
1994	10413	4.2	15.5	3.9	35.8	2557.56	3.7	74.9	16.2	5359.41	52.5	4402	33
1995	10889	4.0	15.5	4.7	34.2	2602.83	3.0	67.0	24.4	4472.52	47.4	4696	30
1996	11510	3.6	15.4	4.8	33.9	3369.13	2.5	70.3	21.7	5464.43	49.2	5028	38
1997	12165	3.5	15.8	5.9	33.9	3197.78	2.2	73.8	19.5	7394.84	56.5	5675	37
1998	13136	3.1	16.0	4.7	34.4	4958.71	2.4	74.1	19.1	8281.35	41.5	5748	38
1999	14558	2.7	16.3	4.6	32.1	4286.62	2.3	76.4	18.3	7677.65	55.9	5978	34
2000	15941	2.7	16.2	4.6	33.7	3785.84	3.2	73.9	16.5	11963.14	59.2	6143	32
2001	16339	2.6	16.0	4.5	36.5	2260.92	3.4	77.2	16.2	14115.16	57.8	6258	31
2002	17261	2.4	16.9	4.1	34.7	3024.44	2.9	74.5	17.5	12458.73	56.4	7011	34
2003	18945	2.4	16.4	4.0	35.9	3695.93	3.1	74.2	18.4	15341.25	57.6	7562	37
2004	19364	2.3	16.5	3.9	34.6	4429.10	2.9	76.2	17.5	16468.61	58.8	7694	35
2005	21159	2.2	16.6	3.8	33.9	4579.05	2.7	74.5	16.5	17245.42	56.7	8123	36

TABLE 4.14. Primary commodity and manufactured export growth vs GDP growth

Variable	Regression 1		Regression 2	
	Coeff	t-values	Coeff	t-values
Intercept	3.912	(0.416)	3.6702	(0.406)
Capital K_t	0.174	(1.295)	0.1820	(1.423)
Employment L_t	-3.959***	(-2.869)	-3.755***	(-2986)
Capital import $M_{cap,t}$	1.112*	(1.804)	0.1030	(1.813)
Primary exports $X_{pr,t}$	0.059**	(2.086)	0.061**	(2.218)
Manuf exports $X_{manuf,t}$	-0.081*	(-1872)	-0.079*	(1.902)
World income Z_t	2.352**	(2.190)	2.211**	(2.232)
Lagged GDP Y_{t-1}			-0.579***	(-2.728)
Adj. R-sq	0.469		0.507	
DW-stat	1.512		1.825	
No Obs	26		25	

t-values in parentheses; *= 10%, **=5%, ***=1% significance level

in the manufacturing sector has been growing as more capital was being imported. To gain more insights in the diversification effects of imported embodied technology, we analysed our data on a disaggregated level and examined whether the import of foreign capital has been accompanied by the emergence of new, more productive manufacturing industries. Our results did not identify any sizable emergence of diversification into more technologically sophisticated industries in that sector. The growth of the manufacturing sector associated with the growth of the capital stock was rather evenly distributed across existing industries and the technological content of the imported machines and equipment translated more into technological deepening in the form of increased skills intensity across all industries.

We frame the discussion of these results in Botswana's development objectives as outlined in Vision 2016 and the Science and Technology Policy Paper approved by the parliament in 1998. Vision 2016 has among other objectives the eradication of poverty in Botswana and the diversification of Botswana's economy by the year 2016. In fiscal 2005, manufacturing still accounted for only 4.3 percent of GDP compared to 35,6 for the mining sector and its contribution to export is fairly negligible compared to more than 86% of export revenue accounted for by mineral products. The manufacturing sector in Botswana remains thus relatively small in terms of output compared to mining, and its slow growth is not likely to spur a significant diversification any time soon. As a result, the problem of economic diversification in Botswana remains of such a complexity that it does not have any easy answer.

The positive and significant association between primary exports and growth confirms the hypothesis that primary exports revenues are a major investment input for the generation of growth in Botswana, while the negative but significant association between manufactured export and aggregate growth indicates that the growth in Botswana's manufactures is mainly achieved by drawing resources from the rest of the economy, which is achieved through the provision of economic investment and tax incentives. Even though government policy to develop the economy through private sector initiative has undeniable merits, the contribution of the latter is still too weak to make a significant contribution to the country's economic growth. The privatisation initiatives and the withdrawal of the state in favour of the private sector could take place only in areas where the latter has gained efficiency, and appears likely to succeed. Furthermore, this implies that a critical level of economic development is required for manufactured exports to have a positive and significant impact on Botswana's economic growth.

The striking feature that despite consistently high reported growth rates, the country has not managed to lay a strong basis for diversified industrialisation and its economy remains characterised by high unemployment rates, is partly explained by consistently large current account surpluses since 1985, indicating that large sums of money are invested abroad as foreign assets (36 billion Pula in 2005 according to World Bank's world development indicators). Moreover, World Bank's world development indicators data show that Botswana pays substantially more money to foreigners than it receives from abroad as labour and capital income. This calls into question to what extent foreign workers and foreign investors are contributing to the country's development by reinvesting profits. If Botswana is to diversify away from the dependence on diamond and other mining products, it needs to develop a more substantial production capacity in manufacturing and /or services by bringing home these sums of foreign assets and investing them domestically in plants and equipment for manufactured production.

In addition, large investments in free education and health care, however laudable they are, have not been matched by correspondingly large investment in technical skills and productive assets. As a result, despite these sustained investments in human capital, there are structural imbalances on the labour markets and Botswana has still to deal with chronic shortages of skilled workforce. Expatriates have been welcomed to fill in the gaps but the current supply of human capital in some specialised areas suggests that this will remain the case for quite some time. At the same time, Botswana has to deal with a relatively high rate of unemployment, especially among the young rural population where unemployment rates are still as high as 25 to 28%, compared to an average rate of 21% for the total labour force.

According to Collier (2002), whether African countries in general can break into mass production manufacturing depends primarily upon whether they can find sufficient political impetus necessary for a radical reform of the investment climate. Botswana's fixed capital formation over the last 15 years has been very substantial as a share of GDP. The graph in figure 4.1 provides the values of gross capital formation as a percent of GDP using Bank of Botswana's data computed on the basis of constant 1993 USD. However, scale economies being important in infrastructure and industrial production, absolute rather than relative values of investment are more informative because it directly conveys the idea of the value of the investments that are being made. With 10 paved airports, more than 10,000 kilometres of paved roads, infrastructure for communication, transport and energy production and distribution is fairly developed in Botswana, though the country must import half of its electricity consumption.

Although Botswana has constantly invested in infrastructure to facilitate the possibility of entrepreneurial initiatives, it is no exception to the observation that much still needs to be done to make African countries ready for the manufactured production. Even though existing infrastructure has allowed the country to host a Hyundai car assembly factory, car manufacturing has unfortunately had to close in 2000, in the wake of the financial troubles that affected many of the biggest Korean Chaebols. The mere existence and good operating performance of such a car assembly facility is however a serious indication that Botswana is ready to enter the manufacturing era.

However, the attractiveness of Botswana as an investment destination has also proven its limits. Despite the relatively good infrastructure and the broad spectrum of incentives, the country is landlocked and is situated at relatively large distances to the ports in South Africa and Namibia. The completion of road link to Namibia in 2004 has considerably facilitated the access to the port of Walvis Bay. Since much of the export success of East Asian economies has been built upon the establishment of the so-called Export Processing Zones (EPZs), one can ask whether Botswana should not emulate this strategy and expand its export capacity. If well conceived, EPZs can be local zones for good public service delivery and even for good governance. EPZs also have some potential for the coordinated entry of new, export-oriented firms. Were Botswana to be successful in establishing EPZs, it could benefit from preferential access to OECD markets through initiatives along the lines of the Africa Growth and Opportunity Act, which gives African manufactures some preferential access to the US market, and the European market through the Lomé convention. However, EPZs have usually failed in Africa probably because of their conception and Botswana has not been an exception in that (Collier, 2002).

The main objective of the section 4.4 was to assess whether export revenues derived from a primary export sector like the case of mining in Botswana can lead to a positive and significant economic growth in a country. The study was based on evidence from statistical data and econometric analysis of the economy of Botswana. The results indicate that Botswana has been able to manage its primary export revenues in such a way that the country has been able to cover both recurrent and development expenditure as well as financing government effort to initiate industrial development for economic diversification through the financial assistance policy (FAP). In addition the country has been able to accumulate foreign reserves of well over 36 months of import cover. These statistical results indicate the importance of good governance and financial management in achieving sustainable economic growth in a primary exporting country.

For obvious reasons, it can be argued that Botswana's dynamic comparative advantage would be to move up from mineral exporting to the processing of diamonds. And indeed, the government of Botswana is currently embarked on an effort to move to processing minerals so as to add more value to diamonds before exporting them. It aims especially at the polishing of diamonds and jewellery production. However, diamond processing is highly capital intensive and uses little unskilled labour. The recent licensing of Israeli and Indian diamond cutting companies to set cutting and polishing facilities underscores this need of foreign capital and technology. Whether this path of vertical diversification can be crowned by success remains thus to be seen. Botswana's comparative advantage in the diamond processing will therefore partly depend on its ability to bring the necessary technology to the country and the bargaining power *vis-à-vis* the diamond processing companies that currently dominate the market. The current level of human and physical capital rather suggests that substantial investment in human skills and technological capabilities will still be required before Botswana can move to processing its diamonds.

These results are important in that they show that, when properly managed, primary export revenues can lead to positive and significant economic growth as in a country. However, though important, this result should be seen as a short-term transition strategy as the economy moves towards sustainable long term economic growth based on manufactures and services as the main engines of growth.

Appendix A. 4.1: Botswana domestic industries Standard Industry Classification (BSIC)

	Manufacturing (includes repair of machinery & equipment)
1510	Meat and meat products
1520	Dairy products
1530	Grain mill products includes maize, sorghum, millet etc. human & animal feeds
1510	Bakery products
1545	Other food products not elsewhere classified (e.g. Chocolates, Sweets)
1550	Beverages (beer including traditional beer, soft drinks, etc.)
1600	Tobacco Products - Cigarettes, etc.
1700	Textiles (exc. Clothing) includes preparation of textile fibres, natural or synth material
1800	Clothing and other wearing apparel (incl. leather)
1910	Tanning and leather products (excluding clothing/footwear) e.g. handbag, souve etc
1920	Footwear
2000	Wood and Wood Products excluding furniture but including building materials straw products (mats, baskets etc)
2100	Paper and Paper Products, e.g. Newsprint, tissues
2200	Printing and Publishing (including periodicals, journals etc.
2400	Chemical and Chemical Products (including Soap, Paint, Fertilisers and Pesticides
2500	Rubber and Plastic Products (including tyre rethreading)
2610	Cement Manufacturing.
2620	Non-Metallic mineral products excluding cement but including glass ceramic cement products e.g. bricks, tiles, pots.
2700	Basic metals, e.g. Iron Foundries
2800	Fabricated metal products exc. machinery and equipment
2900	Machinery and equipment including refrigerators and other domestic equipment
3000	Office, accounting & computing machinery, e.g. Photocopying Machines
3100	Electrical machinery and apparatus e.g. Lightning Arresters, Voltage Limits
3200	Radio television and communication equip. and apparatus
3300	Medical, precision, optical instruments, watches, clocks
3400	Motor vehicles, trailers and semi-trailers
3500	Other transport equipment, e.g. Ships & Boats, Railway Locomotives
3610	Furniture (all types including of wood, also mattresses)
3691	Manufacture of Jewellery
3692	Manufacturing of other products not elsewhere classified Pens, Pencils
3700	Recycling, Processing of Metal & Non Metal Waste

Source: Ministry of Trade and Industry, Botswana

4.A Appendices to Chapter 4

APPENDIX A.4.2: Matching between imported machines and manufacturing industries by Navaretti & Soloaga (2001)

Appendix 2

Table 1. Matching between machines and products

Machines			Products		
Harm.	SITC/3	Description	Nace	ISIC rev.2	Description
8437/38(excluding 84384)/79	727	Food machinery, non domestic	411-423	311	Food
84384/842121/842122/8435	727	Food machinery, non domestic	424-28	313	Beverages
847810/90	72843	Tobacco working machines	429	314	Tobacco
8444-51	7244/5/6/7	Textile machinery	431-9	321	Textile
8452	7243	Sewing machines	453-6	322	Clothing
8453	7248	Skin, leather working machines	441-2/ 451-2	323+324	Shoes and leather
84793/8465/6	72812/72819/ 72844	Machine tools for working woods and wood treating machines	461-7	331+332	Wood and wood furniture
8439/41	725	Paper etc mill machinery	471/2	341	Paper and Pap. Prods.
8440/2/3	726	Printing and binding machry	473	342	Printing
8456-8463/8466	731/3/5	Machine tools for metal	312-9/321-8/ 351-3/361-5	381+382+384	Metal products and Machines (incl transport excl electrical)
8454/5/8468/8515	737	Metalworking machinery	221-3 311	371	Iron and steel
8475/8464 2019	72841	Glass working machinery	247	362	Glass
8477	72842	Rubber and plastic working machines	481-3	355/356	Rubber and plastic

Chapter 5

MAURITIUS' SID AND DIVERSIFICATION STRATEGY

5.1 Introduction

Mauritius is one of the few sub-Saharan African countries that managed to enter the market for manufacturing export and it is exceptional in that it has transformed itself from a monocrop agrarian economy into an impressive industrial performer. At independence in 1968, the country had only negligible industrial and managerial experience to rely on, while investment capital was lacking as a result of inexistent financial institutions and intermediaries. Mauritius has now developed from a low-income, agriculture-based economy, to a middle-income, diversified economy with growing industrial, financial and tourist sectors. For most of the period, annual growth has been in the order of 5% to 6% (see figure 5.1). This remarkable achievement has been reflected in more equitable income distribution, increased life expectancy, lower infant mortality, and a modern infrastructure (Subramanian and Roy, 2003). Sugarcane is however still grown on about 90% of the cultivated land area and still accounts for 25% of export earnings (World Factbook, 2006).Its rate of investment and growth compares favourably with that of other developing and developed countries.

These achievements are the more remarkable when one takes the difficult initial conditions into account. Back in the 1960s, when it gained independence from Britain, it was a poor developing nation with a dualistic economy based primarily on a highly productive sugar export sector and an inefficient subsistence agriculture sector. Like

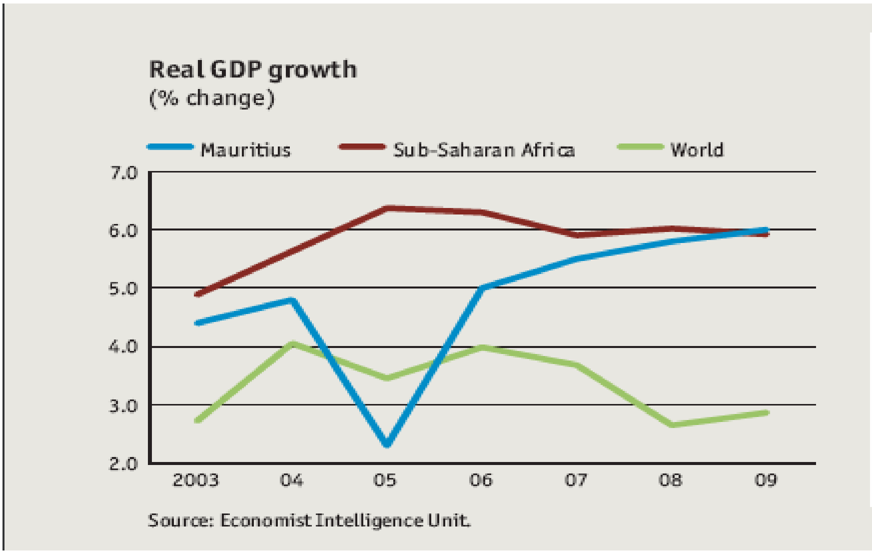


FIGURE 5.1. *Growth rate of GDP at basic prices, 2003 – 2009 (forecast)*

any other typical poor developing country, it started from economic dependence on a single primary commodity, a very small domestic market with low per capita income, remote from developed western markets and lacking raw material and other natural resources (Wingnaraja, Lezama and Joiner, 2004).

As rightly remarked by Subramanian and Roy (2003), Mauritius has thus accomplished an industrial performance defying even the most optimistic expectations despite a host of unfavourable initial conditions and even a doom scenario predicted in 1961 by James Meade, who was later to became the Nobel Prize laureate in Economics. Its transformation from a sugar dependent economy into one of the leading export manufacturers in Africa, owing mainly to the Export Processing Zone (EPZ) base export orientation policies of the early 1970s, has set standards for other African countries to emulate. With almost 75 % of its exports consisting of manufactures today, it is the uncontested SSA leader in making the transition from dependence on primary commodities to diversifying productive activities (Wingnaraja, Lezama and Joiner, 2004).

The quick growth of a globally competitive EPZ-based textile and apparel industry has been a source of a strong dynamism in this economic transformation. By 2006, manufactured exports have reached the value of USD1487 per capita, the highest in Africa. The creation of this internationally competitive industrial base has spurred an impressive rise in living standards of the Mauritian population. Driven by the textile and other apparel export, the gross domestic product has seen an appreciable growth rate averaging almost 6% between 1973 and 2004. This buoyant export has meant for Mauritius favourable current account balance (fluctuating around zero) since 1985 and saving rates that were enough to finance domestic investments (Subramanian and Roy, 2003).

Realizing the need to diversify its economy, Mauritius has embarked on an ambitious development strategy oriented towards finding new drivers for economic growth. The government is putting emphasis on the development of the ICT sector and the promotion of Mauritius as an offshore financial centre in the region and a seafood hub, using existing facilities at the Freeport (free trade zones at the port and airport). Measures are also being taken to modernise and restructure the sugar and textile sectors through better technology and greater capitalisation. The country is convinced that this is best achieved by the building on its existing strengths and has initiated a comprehensive reform program to move to its next phase of development by capitalizing on human resources, information technology and higher value-added activities (Mauritian Research Council, 2006).

Currently, Mauritius has one of the strongest economies in Africa; 2004 GDP at market prices was estimated at USD 6 billion and its PPP adjusted per capita income reached USD 13,500 in 2006 (World Factbook, 2006). Over the past two decades, real output growth averaged just below 6% per year, leading to a more than doubling of per capita income and a marked improvement in social indicators. Economic growth was first driven by sugar, then by textiles and tourism, and more recently by financial services (particularly offshore companies). The information and communications technology (ICT) sector is now emerging as the fifth pillar of the economy, following massive investment by government in the last three years in related infrastructure and training (the newly built Ebene Cyber City is one example).

However, the economy is now facing some serious challenges, including the decline in the rate of economic growth, increasing unemployment, an increasing public sector deficit, and an increasing domestic debt. Today, Mauritius stands thus at the crossroads of its future development. The main engines of growth in the Mauritian economy, namely the sugar and textile industries, are faced with the erosion of preferential trade arrangements stemming from the reforms of the European Union (EU) sugar regime, the phasing out of the Multi-Fibre Agreement (MFA) as from January 2005, and the increasing trend towards the globalisation of world trade. The prospects of intensified global competition from low-wage countries (particularly China and India) and limited future opportunities for preferential trade arrangements in a globalised trade regime represent serious constraints on future growth. As a result, the manufactured value-added to GDP ratio, which grew from 15 to 25% between 1977 and 1987 has stagnated at this level from 1987 to 1999 and has been falling ever since (Mauritian Research Council, 2006).

The island's membership of several regional groupings such as the Common Market for Eastern and Southern Africa (COMESA), Southern African Development Community (SADC), Indian Ocean Rim-Association for Regional Cooperation (IOR-ARC) and the Indian Ocean Commission (IOC) positions Mauritius as a key interface between Asia and Southern and Eastern Africa.

5.2 Mauritian Absorptive Capacity

This section analyses Mauritius's absorptive capacity and technological capabilities along Lall's (1992a) taxonomy based on the OECD's approach involving the interplay of incentives, capabilities and institutions to analyse numerous factors that influence technological learning. Like Lall, we group technological capabilities at the national level under physical investment, human capital and technological effort. Incentives are equally divided in three broad categories: macroeconomic stability, competition and factor markets conditions. After this analysis of the Mauritian SID, we present a growth model that allows to estimate the impact of foreign demand growth for Mauritian export product on domestic growth through the income and price elasticities of demand. The model is then empirically applied with Mauritius's data to carry out an estimation of the steady state growth effects for different assumptions of employment growth rate.

5.2.1 Capabilities

Physical Investments

The Mauritian economy has been expanding for almost four decades at a sustained rate as a result of continuous accumulation of physical and human capital. Figure 5.2 below gives the rate of savings and investments as a percentage of GDP. Gross domestic fixed capital formation as a percentage of GDP has been stable at 22% between 2001 and 2004 and grew slightly to 22.5% in 2005. This rate of investment compares favourably with that of other developing and developed countries.

Recognizing the indispensable role played by physical infrastructure in fostering economic development, Mauritius has put in place a modern and efficient infrastructure

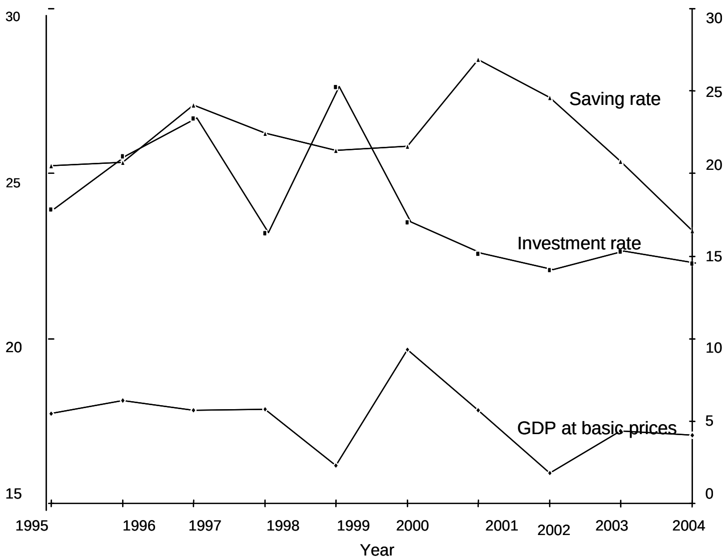
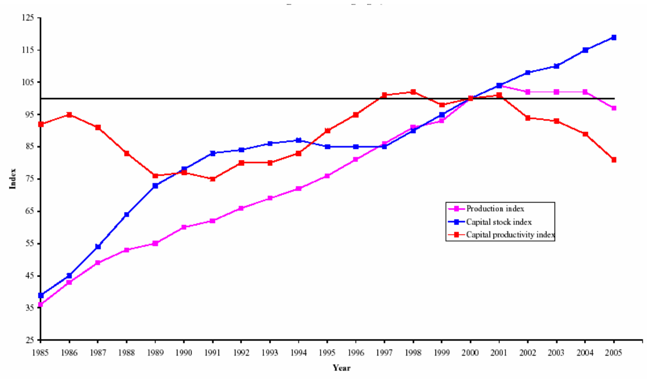


FIGURE 5.2. *Mauritius' saving rate and GDP growth 1995-2004*

for communication (fibre optic submarine cable that provides connectivity to Europe and Asia, microwave and satellite links), for transport (port, airports, expressway and approximately 2000 kilometres of paved road) and for energy production (electricity). This has helped reduce the capital and operating costs of productive enterprises by offering them facilities in an efficient and cost effective way. Firms can thus be scattered throughout the island in small groups or individual industrial estates and still benefit from excellent infrastructure facilities.

Since the early 1970, industrial estates have been provided both publicly and privately. Moreover, tourism facilities and amenities are very modern and contribute to the flourishing of high-end tourism on the island, which attracts foreign tourists from all over the world.

Recognizing the indispensable role played by physical infrastructure in fostering economic development, Mauritius has put in place a modern and efficient infrastructure for communication (fibre optic submarine cable that provides connectivity to Europe and Asia, microwave and satellite links), for transport (port, airports, expressway and approximately 2000 kilometres of paved road) and for energy production (electricity). This has enabled the country to reduce the capital and operating costs of productive enterprises by offering them facilities in an efficient and cost effective way. Firms



Source: Bank of Mauritius

FIGURE 5.3. *Capital productivity index for the manufacturing sector 1985-2005*

can thus be scattered throughout the island in small groups or individual industrial estates and still benefit from excellent infrastructure facilities. Since the early 1970, industrial estates have been provided both publicly and privately. Moreover, tourism facilities and amenities are very modern and contribute to the flourishing of high-end tourism on the island, which attracts foreign tourists from all over the world.

Human Capital

Mauritius can be justifiably proud of its highly competent and skilled labour force with good proficiency in both English and French. The literacy rate is high by African standards: 88.7% of adult population are literate and with the high rate of primary and secondary enrolment, it is growing fast. The government's commitment to human capital accumulation is also apparent in the public resources committed to education: yearly average is 15% of GDP.

With its excellent records on education and schooling and a sustained investment in primary and secondary education since independence, it has achieved universal primary education for the whole population and produced a literate, bilingual labour force that can be trained for industrial activities. With an enrolment rate above 60% of the relevant age group, the secondary school curriculum meets fairly good standards with reasonable social sciences and math contents coupled with an emphasis on language proficiency.

The expansion of the Mauritian textile industry has greatly benefited from the availability of this abundant supply of skilled workforce that was accumulated throughout the 1960 and 1970 as a result of massive investment in education and training. Through the industrial and Vocational Training Board (IVTB) the country has also created important reserves of qualified manpower for various industrial function such as plant supervisors, quality management experts, equipment maintenance technicians and clothing designers.

With the current high enrolment rates at the primary, secondary and tertiary education, Mauritius pursues powerful policies of human capital accumulation. In 2003, enrolment rate was 102 at primary level and 66% at secondary level with a percentage of 75% of school leavers obtaining their high school certificates. Though a small island of only 1.23 million inhabitants, Mauritius has an expanded tertiary educational system comprising the University of Mauritius, the Mauritius Institute of Education, The Mahatma Gandhi Institute, the University of Technology, the Mauritius Institute of Health, the Swami Dayanand Institute of Management the Institut Supérieur de Technologie and various Industrialand Vocational Training Board Centres.

The increased living standards with a relative equal distribution of wealth allow many families to spend substantial amount of money for the education of their children home and abroad, as a means of fulfilling their rising aspirations. However, despite this impressive host of training and education possibilities, concern have been raised that the Mauritian educational system has not developed sufficient technical skills and that it will need to radically increase technical training programs in order to meet the challenges its ever increasingly technologically intensive industry will pose.

Technological Effort

Mauritius has long heavily relied on licensing and foreign consultants in its initial phase of technology acquisition. As underlined in the previous section, her skilled labour force has generally not been considered as technically oriented. However, the success and expansion of the strong textile industry has resulted in increased living standards and the unavoidably accompanying rise in wage rates. This increased labour cost level presses for an industrial transformation that will require a more technically skilled workforce. The Mauritian government has given priority to establishing research and development capabilities in the country and devotes substantial resources to financing basic and applied research.

In the period 1987–97, 361 scientists and engineers and 158 technicians per million people were engaged in research and experimental development, with expenditures totalling 0.4% of GNP. Research intensity as expressed in Research Scientists and Engineers (RSE) active in R&D per million population is still lower in comparison to East Asian NICs, but this rate has recently been steadily increasing as a result of the commitment to more research, and the provision of the necessary funds by the private and public sectors. An additional source of technological capability for Mauritius is also its influential diaspora composed of Mauritians established in Europe, South Africa and Australia, but who retain close ties with their families on the island. They contribute new ideas and attitudes which they disseminate through family network and influence this way the process of change and technological advance.

The Mauritian Research Council (MRC) acts as a central body to advise Government on Science and Technology issues and to influence the direction of technological innovation by funding research projects in areas of national priority and encouraging strategic partnerships. The Mauritius Institute in Port Louis, founded in 1880, is a research centre for the study of local fauna and flora. The Mauritius Sugar Industry Research Institute, founded in 1953, is located at Réduit. The University of Mauritius, founded in 1965 at Réduit, has schools of agriculture, engineering, and science. In 1987–97, science and engineering students accounted for 14% of college and university enrolments. The Regional Sugarcane Training Centre for Africa, located in Réduit, is sponsored by the United Nations Development Program.

The country began promoting export very early and has maintained a steady support. As a result, by studying the technological capability of Mauritian firms on the basis of their size, Wingnaraja (2001) found some large garment firms to have developed technological capabilities that are probably on par with international best practices. In Addition, Mauritius has a good support system for industry with several institutions to provide quality assurance services and to support technology diffusion (these are covered in the subsection on institutions).

5.2.2 Incentives

Macroeconomic Incentives

The Mauritian economy is characterised by a pro-business government where business associations are regularly consulted on economic policy matters affecting their interests. The macroeconomic environment has been stable and prudently managed since independence. Coherent fiscal and monetary policy has been carefully used to ensure macroeconomic stability characterised by low inflation, competitive real exchange rates, and reasonable real interest rates enabling optimistic macroeconomic expectations. This allowed domestic and foreign investors to develop trust in the predictable policy regimes and increase their investment and resulting exports.

Moreover, the Mauritian bureaucracy is relatively competent and typically keen to get things done with a relatively low level of red tape. This considerably reduces transaction costs to businesses and contributes to attracting foreign investors to the island. At independence in 1968, the country's economy depended almost entirely on sugar, which accounted for 98% of total exports. Since the early 1970s, a large mix of incentives has been initiated to encourage industrialisation in Mauritius. Concrete policies measures taken include the entitlement of income tax and other advantages to certain selected firms to encourage import substitution industrialisation, and the establishment of the Development Bank of Mauritius to help meet the financial needs of the industry.

During the 1970 as the export oriented industrialisation became the focus of attention, fiscal and import duty concessions were used to facilitate the creation of EPZs. This has resulted in the emergence of a dynamic textile and clothing industry, mainly as a consequence of massive inflow of foreign capital from Hong Kong and a few other countries. As international technology transfer was taking place, local entrepreneurs also joined in this process by investing the surplus revenues from sugar booms and contributed greatly to the success of this sector.

The enabling macroeconomic policy environment has supported this dynamism by providing unrestricted tariff free import of machinery and raw materials, no restriction on ownership or repatriation of profits, a ten-year income tax holiday. Wide availability of financial resources to provide credit to enterprises, a good infrastructure and the preferential trade agreements with US and the European Union have allowed Mauritian export-oriented textile industry to expand and flourish.

Incentives from Competition

The performance of Mauritius on the industrial front has indeed been impressive since 1982. During the past decade, the country has emerged as a dynamic economy with a fast-developing network of industries and offering a wide range of products and services which have been able to gain entry into world markets due to their quality and price competitiveness. In fact, the Mauritius Export Processing Zone (MEPZ) has asserted itself as a reliable supplier of fashionable garments to the fashion conscious and demanding importers in Europe and the United States. The Scandinavian countries, Japan, Australia and South Africa are also increasingly sourcing from Mauritius as they have realised that Mauritian goods compare very favourably, both price-wise and quality-wise, to imports from other competing locations.

The outward looking trade and investment strategy of Mauritius has many features that distinguish it from the majority of other African economies. Instead of focusing on the orthodox inward oriented, state-dominated development strategies of the 1960 and 1970s that emphasises import substitution, Mauritius followed a mixed trade policy based on import substitution coupled with the promotion of EPZ since 1970. This policy resulted in the emergence and coexistence of efficient enterprises serving the home market and those serving the export market. Starting from 1983, Mauritius initiated a trade liberalisation that has gradually resulted in a regime that is one of the more liberal in Africa. Quantitative restrictions have been removed, import bans eliminated and local content requirements abolished.

Additionally, the creation of Export Processing Zones has been accompanied by a series of incentive measures available to both domestic and foreign investors and aimed mainly at attracting the latter to the island. Among the incentives offered are: duty-free access to raw material for the production of export final goods, low corporate tax rates (10-15%), and no withholding taxes on dividends and capital gains. In the face of increased labour costs and international competition in textiles, Mauritius is gradually becoming a production base for more technologically advanced goods and services. The development of new industries (including printing and publishing, jewellery, watches, sporting articles etc.), is expected to complement existing industries, thereby creating clustering advantages especially in the EPZ.

Incentives from the Factor Markets

Capital market:the banking sector

The economic success achieved in the 1980s engendered the rapid growth of the financial services sector in Mauritius. The Development Bank of Mauritius has played a crucial role in the whole development process by providing the necessary loans to the expanding industry since its creation in 1978. The banking sector in Mauritius is now modern, well developed and has been expanding during the last decade as a result of inflows of financial resources from offshore entities. This is illustrated by the large contribution of the banking sector to the gross domestic product. The presence of significant offshore financial industry and the government's commitment to boost offshore banking by a good regulation of the banking industry has resulted in modern, good functioning credit institutions that have helped the manufacturing and the service industries to grow constantly at relatively high rates.

Equity market

An adequate development of the equity market is an important pillar of the good functioning of an economy. Indeed, equity investments are indispensable for providing a stable, long-term financial basis for firms to conduct their operations. The equity

TABLE 5.1. Transaction costs on SEM

Value of transaction (MUR)	Stockbroking Company (%)	SEM (%)	FSC (%)	CDS (%)	Total fee claimed for apportionment (%)
Not exceeding 3 million					
Between 3 and 6 million	0.70	0.25	0.05	0.15	1.15
More than 10 million	0.50	0.25	0.05	0.10	0.90

FSC=Financial Services Commission, CDS=Central Depository and Settlement Co. Ltd
Source: Stock Exchange of Mauritius

market in Mauritius is relatively well developed in comparison to the size of the Mauritian economy. The stock market started with the institution of the Stock Exchange of Mauritius (SEM) under section 14 of the Stock Exchange Act of 1988. The SEM is operated and maintained by the Stock Exchange of Mauritius Ltd, incorporated in Mauritius on March 30, 1989 as a private limited company with a public mandate, whose mission is to operate and promote an efficient, liquid, fair and transparent securities market. The Stock Exchange has been appointed as the competent authority responsible for the listing of securities on the Official List under the supervision of the Stock Exchange Commission. The law also confers the authority on SEM to adopt rules governing the conduct of its members and listed companies and to enforce these rules. All the rules of the SEM are subject to the prior approval of the FSC.

The SEM operates two markets: the Official Market and the Development and Enterprise Market (DEM). The Official Market started its operations in 1989 with five listed companies and a market capitalisation of nearly USD 92 million. The SEM Official Market has currently 42 listed companies representing a market capitalisation of nearly MUR 128,325,757,055.60 or USD 4,536.42 million as at 20 May 2007. The listing is expected to uphold and even increase its past growth.

The liquidity of the market is ensured by transparent regulations and relatively affordable transaction costs and listing fees (see table below). Furthermore, the SEM is a member of the World Federation of Exchanges (WFE) and is committed to becoming a World Class Stock Exchange.

The listing rules govern the admission to the Stock Exchange, the continuing obligations of listed companies, the enforcement of those obligations and suspension and withdrawal from the official list of the Stock Exchange. The rules are aimed at ensuring that the business of the Stock Exchange is carried on with due regard to the investors interests.

The stock market was opened to foreign investors following the lifting of exchange control in 1994. Foreign investors do not need approval to trade shares, unless investment is for the purpose of legal or management control of a Mauritian company or for the holding of more than 15% in a sugar company. Foreign investors benefit from numerous incentives such as revenue on sale of shares can be freely repatriated and dividends and capital gains are tax free. Over the years, efforts have been geared towards ensuring that the SEM remains at the forefront of institutional reform and development while offering quality services to its stakeholders and contributing to the deepening and broadening of the financial sector in Mauritius. Much of the focus has been put on updating the operational and regulatory framework to reflect the ever-changing standards of the Stock Exchange environment worldwide and the requirements of the Securities Act 2005.

The successful implementation of the Central Depository System (CDS) in January 1997 has brought about prompt, efficient clearing and settlement of trades and at the same time reduced some of the inherent risks in the process. With the support of the Bank of Mauritius which acts as clearing bank, CDS ensures delivery versus payment (DVP) on a T+3 rolling basis. The CDS also provides for a Guarantee Fund Mechanism to guarantee settlement failures of participants.

SEM's Automated Trading System (SEMATS) was launched on June 29, 2001. It constitutes a state-of-the-art electronic trading system built on third generation technology. SEMATS puts an end to traditional trading patterns which have typified the Stock Exchange of Mauritius since its inception. Trading in securities is conducted through dedicated trading workstations located at intermediate dealers and linked by communication lines to the SEM trading engine.

Similarly, the trading of treasury bills on the market has been introduced by the SEM in December 2003, a first step of a process aimed at the setting up of an active secondary market for government instruments. New listing rules are underway in the setting up of an appropriate operational and regulatory framework to cater for the listing of offshore funds and international products. The attainment of the membership status of the World Federation of Exchanges (WFE) in November 2005 also constituted an important milestone that has enabled the SEM to join the league of stock exchanges that are compliant with the stringent standards and market principles established by the WFE. The latter is a central reference point and standards setter for exchanges and the securities industry in the world. Membership identifies the SEM as having assumed the commitment to prescribed business standards, recognised as such by users of exchanges, as well as by regulators and supervisory bodies.

SEM's most recent undertaking concerns the setting up of the Development and Enterprise Market (DEM), which is a market designed for Small and Medium-sized Enterprises (SME's) and newly set-up companies which possess a sound business plan and demonstrate a good growth potential. It is meant for companies wishing to avail themselves of the advantages and facilities provided by an organised and regulated market to raise capital to fund their future growth, improve liquidity in their shares, obtain an objective market valuation of their shares and enhance their overall corporate image. Listing requirements include publication of financial statements in compliance with International Financial Reporting Standards (IFRS) with an unqualified auditor's opinion in accordance with International Standards on Auditing (ISA). The DEM is also in line with Government's policy to foster the development of a dynamic business environment in Mauritius and the emergence of a diversified financial services sector, where companies can raise financial resources from a variety of sources and where investors can have access to a wider array of investment opportunities.

The DEM has been launched on 4 August 2006 and by 30 April 2007, there were already 49 companies listed on this market with a market capitalisation of nearly USD 1,539.22 million. One of the key challenges of the Exchange during the next few years will be to increase the range of products available to investors. In the wake of the bull phase during the last few years on the local front as well as on the African continent, investors have been looking for investment opportunities in new stocks and/or in new products. The launching of the DEM was in part meant to address some of these investors needs.

The prevailing stellar performance of African stock markets is being driven by strong foreign investor interest, and such influx of foreign investors is being viewed as a statement of confidence for African bourses. In this light, Mauritian authorities intend to step up their efforts to place the Stock Exchange of Mauritius on the radar screen of institutional investors who are keen on frontier emerging markets that are well regulated and adhere to international best practices. The SEM has made some important strides in its development process since 1989 and looks well poised to undertake a number of reforms in order to contribute towards the enhancement of the operational and regulatory efficiency of the local market. In the forthcoming years, the SEM aims at consolidating its position with a view to further contributing to the development of the Mauritian economy and of capital market activities on the national and regional fronts.

Labour market

The structure of the labour market in Mauritius has evolved over time, with the advent of fundamental structural changes in the Mauritian economy over the last 30 years. The rapid development of the manufacturing sector in the 1970s and 1980s led to a rapid expansion of relatively low-skilled job creation to meet the need of the fast growing EPZ sector. However, by the end of the 1980s and early 1990s, the emergence of new sectors, namely in the domain of tourism and financial services required another level of labour skills. In the wake of the new millennium, the demand for high skilled labour was further accentuated as the Mauritian government moved forward to promoting new poles of growth in high value added services such as those in the ICT sector. This economic transformation has necessitated some adjustment costs: the economic cycle entailed the decline of certain traditional sectors and saw the birth of new ones, which require very different labour inputs. Such a transformation requires not only additional academic qualifications but also additional skills in communication and negotiations and a higher degree of technological know-how.

As noted above, Mauritius's labour force is bilingual and competent, while remaining relatively cheap and thus attractive for investors. Nonetheless, as in the case of South Korea in its early development stage, the large investments in education and training during the 1960s and 1970s have resulted in large imbalances between the school leavers and the job opportunities, but this reserve of skilled human capital has been crucial to development later on when export oriented industrialisation expanded and needed a competent workforce. During the phase of technology acquisition in the textile industry, labour market measures have been taken to promote steady and moderate wage increase and ensure industrial peace at the same time. This has thus greatly contributed to the rapid expansion of the economy and the absorption of excess labour supply.

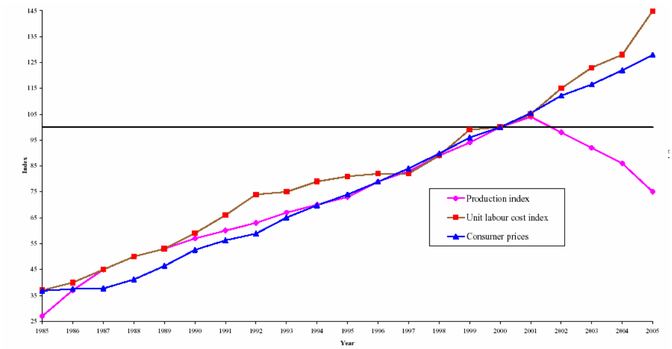
As was also the case with the first generation of newly industrialised Asian states, investors welcomed Mauritius's cheap labour, political stability and lack of fixed export quotas to the EU and the USA. With the years, wages have increased in Mauritius, creating more wealth. Nowadays, a Mauritian garment worker can hope to earn at least 150 US dollars a month, which is four or five times more than in many Asian countries or other African countries. Even trade unionist reports agree that whilst things are far from perfect, working conditions and wages are less exploitative than those in many other countries specialising in the clothing industry. By now, as can be read from the labour cost index outpacing labour productivity index in Table5.2 and figures 5.4 and 5.5, the wage level in Mauritius has increased to the extent that some firms are beginning to feel the need for upgrading to capital intensive production technology or could be tempted to consider relocating their operations to neighbouring countries with lower wages.

Moreover, it is worth noting that the Mauritian labour market is relatively rigid, in part as a result of the particularities of its labour market institutions. In Mauritius, the wage determining institutions are the Tripartite Committee, the National

TABLE 5.2. Productivity and labour cost indices 1985-2005

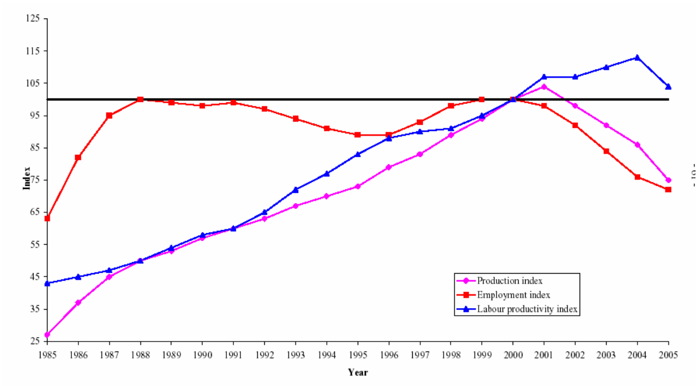
Year	Production index(A)	Empl index	Lab prod index	Capital stock index	Capital prod index	Multifactor prod index	Lab cost index(B)	Unit lab cost index(B/A)
1985	36	66	54	39	92	70	12	34
1986	43	79	54	45	95	72	15	36
1987	49	88	56	54	91	64	20	41
1988	53	92	58	64	83	70	25	46
1989	55	93	60	73	76	68	29	52
1990	60	94	63	78	77	70	35	58
1991	62	95	66	83	75	71	41	67
1992	66	95	70	84	80	75	48	72
1993	69	95	73	86	80	77	51	74
1994	72	95	75	87	83	80	57	79
1995	76	95	80	85	90	85	63	83
1996	81	96	84	85	95	90	67	83
1997	86	100	86	85	101	94	73	85
1998	91	103	88	90	102	95	83	91
1999	93	103	90	95	98	94	92	99
2000	100	100	100	100	100	100	100	100
2001	104	98	106	104	101	103	108	103
2002	102	95	107	108	94	99	113	111
2003	102	91	112	110	93	100	116	114
2004	102	86	119	115	89	98	117	115
2005	97	84	116	119	81	92	120	125

Source: Bank of Mauritius



Source: Bank of Mauritius (base year=2000)

FIGURE 5.4. *Labour cost index 1985-2005*



Source: Bank of Mauritius (base year =200)

FIGURE 5.5. *Labour productivity index 1985-2005*

Remuneration Board and the Pay Research Bureau. The Tripartite Committee is responsible for the determination of wages at the national level through consultations involving Government, trade union and representatives of the private sector. These wage agreements of the Tripartite Committee are legally binding on all sectors of the economy. The National remuneration Board sets minimum wages by worker category for 29 sectors in the private sector. There are more than 400 of these minimum wages. However, changes to them are not made uniformly. The pay Research Bureau makes recommendations only regarding salaries in the public sector, which may or may not be followed by the private sector.

The determination of wages by such a centralised bargaining system discourages sector-specific competitive wage setting, resulting in a strong relationship between wages in the traditional sectors and those in the emerging sectors. While new sectors create demand for skilled labour, wage increases typically follow in the traditional sectors leading to a loose relationship between wages and productivity in traditional sectors. The rise of wages in the traditional sectors reduces domestic demand for unskilled labour and tends to increase unemployment rate of these workers. From the labour supply side, skill premium, expressed by wage differential between the two sectors is constrained by this staple relationship, resulting in fewer incentives for the young to invest in education and to supply skilled labour for the new sectors of the economy.

Here, it is worthwhile to recall that the education system plays a central role in supplying the needed skilled labour. Although Mauritius is ranked as having a comparatively high literacy rate, it has some weaknesses in its secondary and technical education, especially in the teaching of natural science, engineering and vocational subjects. The education system is rather academic and still based on traditional curricula, which may be at odds with the demand for technical skills in line with the current situation of the labour market. There has been, until recently a lack of training and reorientation programmes that would prepare the labour force for the newly emerging sectors, such as ICT and other high value added services. The consequence has obviously been a sizable deficit in the skilled labour market, especially in those emerging sectors. The Mauritian government can be credited for coming up with a comprehensive reform programme in the education system since 2004, which present certain remedial measures to this problem, such as training and reorientation programmes, technical curricula and additional university courses geared towards meeting the challenges of the new realities of the country's economy.

In conclusion, both the capital and the labour market incentives provides the Mauritian economy with strong tools to deal with the challenges of adopting new technologies that are necessary for the economic transformation of the country. While the banking sector and the equity market are undergoing a increasing modernization to meet the needs of global investors, the supply of a still relatively cheap but increasingly skilled and competent labour force makes Mauritius prepared to continue to be an attractive location for business and investment.

5.2.3 Institutions

Mauritius has an attractive blend of institutional advantages that are available to both domestic and international investors. These include: political stability, pleasant and peaceful living conditions, efficient telecommunication facilities, pool of qualified bilingual professionals fluent in both English and French, investment promotion and protection agreements, international stock exchange, freeport activities and the absence of exchange control. The country has a stable democracy with regular free elections and a positive human rights record, which attracted considerable foreign investments and has earned one of Africa's highest per capita incomes (in 2004, the PPP-adjusted per capita GDP was USD 10,600). Its political stability and democracy as well as an abundant supply of relatively cheap, skilled labour force, have provided an attractive business climate for foreign investors and allowed the economy to grow at considerable rates.

Democracy, political stability openness to trade as illustrated by the EPZ and the liberalisation of business activities, unrestricted access to credit and foreign exchange, encouragement of FDI through fiscal and tariff measures, have been the trumps of Mauritian economic success. After the period of import substitutions the country has strongly emphasised market-oriented policies and by the 1990, it had become very market friendly. Today, Mauritius has one of the most liberal regimes in Africa. Mauritius adheres to strict observance of intellectual property rights and industrial standards compatible with the ISO 900. As a result, Mauritian institutional quality has been consistently high, especially in comparison to other African countries and to developing countries in general as illustrated by the data in Table 5.3 from Subramanian and Roy(2003).

Successive governments have pursued policies aimed at fostering economic transformation by diversifying into export manufacturing. They were successful in achieving technology acquisition through a mixture of policies including machinery import and hiring consultants, encouragement of massive FDI and purchasing of licenses for new

TABLE 5.3. Mauritius'institutional quality in comparative perspective

Institutional quality index	Mauritius	Africa	Fast growing countries	Other developing countries
ICRG*	7.23	4.54	6.86	4.29
Protection against expropriation	8.06	5.75	8.54	6.47
Democracy**	0.75	0.25	0.47	0.51
Participation index**	0.80	0.30	0.49	0.44

Source: Subramanian and Roy (2003)

* ICRG (International Country Risk Guide) index is a measure of institutional quality that contains aspect of government affecting property rights or the ability to carry out business. It is published by a private firm providing consulting services to international investors and has values ranging from 0 to 10, higher values reflecting better institutional quality.

**Participation index measures the extent to which non elite are able to access institutional structures for political expression and is scaled from 0 to 1, like the democracy index.

technologies for domestic production. The current government's development strategy focuses on expanding local financial institutions and building a domestic information telecommunications industry.

5.3 Export Demand Elasticities as Determinants of Growth: Estimates for Mauritius

This section outlines a growth model in which export demand elasticities and the import of capital goods (embodying foreign technology) by developing countries explain their growth opportunities[1]. In order to address the question of how demand elasticities explain growth, we use a growth model based on imported capital goods to compute estimates for total-factor productivity growth and for economies of scale. The implications of the presence of low or high export demand elasticities are discussed by relating them to various strands of literature on trade and growth. Based on the results of this estimation, we calculate steady-state growth rates, engine and handmaiden effects of growth as well as dynamic steady-state gains from trade for this latecomer export economy. The implications steady state results are also discussed in the light of the Mauritian employment and growth perspectives.

[1]This section is based on the UNU-MERIT paper "Export Demand Elasticities as Determinants of Growth: Estimates for Mauritius "co-authored by Thomas Ziesemer

5.3.1 Export-Led versus Import-Led Growth Hypothesis

The spectacular development of export-oriented East Asian economies in the 19980s and 1990s and the more recent emergence of China as an impressively thriving economy driven by strong export growth rates have once again underscored how exports can act as an important source of growth. However, for a developing country to achieve export-based growth, it must be able to convert export revenues into domestic investments that will generate output growth. In this process, since export revenues depend mainly on foreign demand, income and price elasticities of export demand are important determinant of growth for several reasons:

First, as argued by Khan and Knight (1988), Esfahani (1991) or Wacziarg (2001), the imported inputs invested in domestic production and paid for by exports are the major mechanism explaining the link between exports and growth in the short and the long run. For a developing country that mostly relies on imported capital goods for production technology, if imported capital goods are paid for by export revenues, then income and price elasticities of export demand determine the change in the amount and value of machinery and equipment that can be imported for investment. Price and income elasticities determine thus how strongly growth of foreign trade partners is translated into domestic export growth. They have therefore a significant impact on domestic growth and on dynamic gains from trade.

Secondly, they determine the impact of balance of payment constraints on domestic productivity growth when imports are constrained by the foreign exchange gap that impedes developing countries from financing the imports of the needed foreign technologies. Exports of primary commodities and labour-intensive goods could fill the foreign exchange gap and thus provide the needed finance for the importation of the required technologies into the domestic economy. In the presence of high price-elasticity of export demand, devaluations of currency or depreciation of the real exchange rate increase the value of exports and thus the amount of imports that can be bought from abroad, while they negatively affect the amount of goods that can be imported if export demand is price inelastic (see for example Bahmani-Oskooee and Miteza, 2002). If imports are investment goods, as we will assume in this study[43], devaluations will increase investment when export demand is price elastic and reduce it otherwise (Khan and Knight, 1988; Esfahani,1991). If these real devaluations or exchange rate depreciations take place for a capital goods importing country, then export demand elasticities are likely to have a significant impact on (future) domestic labour produc-

[43] Khan and Knight (1988) and Esfahani (1991) also assume all imports to be investment inputs

tivity growth through exports of primary commodities or labour-intensive goods and technology imports θ.

Thirdly, export demand elasticities determine the speed and intensity of self-curtailment of export booms caused by technological progress. Indeed, if technical progress leads to lower terms of trade, this effect is translated into changes in the growth rates of exports and investments. Therefore, if booming exports drive up the terms of trade, price elasticities also determine the magnitude of the self curtailment of the boom by boosting export prices and thereby slowing down the demand for exports. For all these reasons, we present a growth model that enables to simultaneously estimate the price and income elasticities of export demand as well as the productivity growth and scale economies for a developing country.

This model is developed from a slightly modified version of a two-gap growth model with imported inputs, introduced by Bardhan and Lewis (1970) and is used here to estimate and analyse the income and price elasticities of export demand for Mauritius, a country reported among the fastest growing economies in the world, but whose exports remain dominated only by textile and sugar products, therefore vulnerable to demand shifts in any of these products. The model also yields estimates for the total factor productivity growth and scale effects. This study contributes thereby to some strands of literature dealing with growth effects of the trade between developing countries and technologically advanced economies:

First, in this model, the importation of capital goods and the elasticities of export demand provide explanations for the link between foreign income and domestic growth rates of developing countries. The current study contributes thus to further explaining the relationship between labour intensive goods and primary commodity export, capital goods import and growth in developing countries. The literature on the trade-growth nexus has followed two main hypotheses to explain the impact of trade on the growth of the trading economy: the export-led growth hypothesis and the import-led growth hypothesis. The export-led growth hypothesis (ELGH) postulates that export expansion is one of the main determinants of growth. The ELGH links to the endogenous growth theories and points mainly to the access to inputs and global markets and the resulting efficient reallocation of existing resources, economies of scale and various labour training effects as a source of growth (see e.g. Bhagwati, 1978 or Balassa, 1978; 1985). According to its advocates, exports can act as an "engine of growth" [44].

---

[44] See Medina-Smith (2001) for an extensive review of the literature dealing with export-led growth hypothesis. Criticism on this hypothesis include the difficulty of measurement of its indicators (Ro-

Second, as stressed by Thangavelu and Rajaguru (2004), there are stronger theoretical and empirical reasons to believe that in open economies, import-led growth rather than export-led growth could be the main driver of productivity increase in developing countries. In contrast to the ELGH that emphasizes market access, the import-led growth hypothesis stresses the importance of the modernization process and the acquisition of advanced technologies through the import of sophisticated equipment and machineries (Marwah and Klein, 1998; Keller, 2002; Navaretti and Soloaga, 2002). Access to foreign capital goods boosts productivity growth, as underlined by the new developments in the theory of international trade, broadly through demonstration effects of products containing new technological knowledge. International trade in capital goods that embody new technologies is thus of utmost importance in spreading the benefits of technological advance to developing countries (Mazumdar, 1999; Eaton and Kortum, 2001; Caselli and Wilson, 2004).

Third, our estimates enable us to calculate the steady-state part of the dynamic gains from trade conditional on some assumptions about future employment growth. As the growth model presented in this section emphasises the growth advantages derived from technology embodied in imported capital goods, paid for by export revenues, our results show that the larger the income elasticity of export demand, the larger the amount of capital goods that can be imported from abroad and therefore the larger the growth rate of the domestic economy in this model. Our growth model is thus also a contribution to the literature on the role of imported technologies in the growth of the importing country. By this growth model based on imported inputs paid for by export revenue, we bring together both export-led and import-led growth hypotheses and reconcile the corresponding theories as two sides of the same medal.

Finally, the literature on balance of payments constrained growth is closely linked to that of two-gap models. In these models, the standard approach has been to solve the balance of payments for the relative growth rate of the country in question and the trade partners by assuming that terms of trade are constant or have no impact [45]. Even in models that made terms of trade endogenous such as Fagerberg (1988) or Verspagen (1993), demand has no direct effect on the terms of trade. By adding the demand side to that literature, we are able to estimate not only the effects of technological change, but also those of demand shifts on the evolution of terms of trade.

---

drigues and Rodrik, 1999) and the direction of causality as pointed out by a.o Bernard and Jensen (1999) who argue that export growth might be the result of growth rather than its cause.

[45] See Bertola et al. (2002) on this literature

The remaining parts of this section are organised as follows. The next subsection outlines the model and its assumptions and presents its solution in the transitional path and steady state. Subection 5.3.3 presents Mauritian data that will be used to estimate the model and its price and income elasticities of demand as well as productivity growth with the general method of moments (GMM) estimator in subsection 5.3.4. In particular, we estimate the elasticities from the equation as derived from the model with linear estimators, thus maintaining theory and empirical analysis as closely linked as possible. Mauritian data on trade balance, on equipment import and investment show that the country is fairly close to the assumption of the model. The results of this estimation are used to calculate the main steady state components of the growth dynamics, namely the engine and the handmaiden source of growth, conditional on assumptions about employment growth. Dynamic gains from trade are also calculated as the difference between the resulting growth rate and the corresponding growth as predicted by the habitual Solow model with the same parameters[2]. The final subsection discusses the various findings in the light of the existing literature on trade and growth, and derives some concluding implications for Mauritius' diversification strategy.

5.3.2 The Imported Inputs Growth Model

The model outlined below is based on a modified version of a two-gap growth model with imported factor inputs, introduced first by Bardhan and Lewis (1970). That model emphasizes the insights that for developing countries, imported inputs paid for by export revenues are the major mechanism of growth in the relation between export and growth, as put forward and empirically supported by Khan and Knight (1988).

Since the lack of technology is widely seen as the main obstacle to economic growth in most developing countries, capital goods import can be viewed here as a structured way of acquiring the relevant technologies that help countries deal with the constraints of existing (sometimes archaïc) production methods as well as building a long-term dynamic comparative advantage. This model is modified into a full-fledged growth model of imported inputs that reflects the situation of Mauritius with some simplifying assumptions:

- Imported capital goods are the only source of investment[3];

[2] Similar work for Brazil has been carried out by Mutz and Ziesemer (2008).

[3] Since most of sophisticated machineries are produced in advanced countries, this assumption holds for a majority of developing countries for diverse types of machinery and investment equipment.

- All capital goods are paid for by the revenue from export;
- Import of consumption goods from export revenue is fairly negligible;
- There is no external debt to finance imports and trade is balanced.

In this model, the importation of capital goods and the elasticity of export demand contribute to explaining the growth behaviour of developing countries. The simplifying assumption made of no domestic production of capital goods is a fair approximation for the reality of many developing countries and is thus suited even to the analysis of the Mauritian case. In order to deal with the question whether imports of capital goods and the magnitude of export demand elasticities could account for the relative speed of growth in comparison to the Solow (1956) growth model, the current model assumes flexible wages and exogenous employment and uses Cobb-Douglas production function with exogenous technical progress:

$$Y = e^{bt} A K^{\beta} L^{\alpha} U, 0 < \alpha, \beta < 1; \alpha + \beta \geq 1 (\leq 1) \tag{5.1}$$

Y denotes the output, K the capital input, L the labour input, b the rate of technological progress. 'A' is a time independent constant, U a stochastic term and α and β the elasticities of production of labour and capital respectively. The model allows for increasing, decreasing and constant returns to scale. Labour is assumed to grow at rate ε, which is determined exogenously:

$$L(t) = L(0)e^{\varepsilon t}, \widehat{L} = \varepsilon \tag{5.2}$$

$\widehat{L}$denotes the proportional growth rate of labour input L.

Some of the most fundamental obstacles for developing economies are due to the fluctuation of the already limited export demand and the resulting foreign exchange constraint that limits the capacity to import capital goods for investment. Importing less luxury consumption goods may be helpful in reducing the foreign exchange gap, but cannot be a solution by itself. In this model, we therefore assume that no consumption items are imported so that all export revenue is used to import capital goods. However, problems related to the terms of trade or export growth may occur despite the absence of imports of consumption goods. Producing capital goods domestically is also not a viable solution, because the cost of producing capital equipment could be prohibitively high in most developing countries as can be concluded from substantial empirical evidence showing developed countries' comparative advantage in producing capital goods[4]. Mazumdar (1999) has therefore suggested that for developing countries, producing capital goods rather than importing them is misallocation of resources since they are at a comparative disadvantage in such a production. In this model, we consequently assume that no capital goods are produced domestically and all capital goods invested in developing countries must thus be imported (see footnote 5.3.2).

$$M = \dot{K} \tag{5.3}$$

$\dot{K}$denotes the derivative of K with respect to time, and M represents imports. For reasons of simplicity, we assume capital goods to be the only imports so that all export revenues are used to finance capital investments. This assumption is not binding since the model still holds if we assume capital goods import to be only a large share of total import; the requirement of financing import by export revenue stems from the trade-balance equilibrium. Investments are therefore limited by exports, denoted X, which are expressed in terms of the imported capital goods. The growth of capital goods in the domestic economy is thus constrained by the export revenue and can be written as:

$$\widehat{K} = \frac{\dot{K}}{K} = p\frac{X}{K} - \delta, \widehat{\widehat{K}} = \widehat{p} + \widehat{X} - \widehat{K} \tag{5.4}$$

where $\widehat{K}$denotes the proportional growth rate of the capital stock K, while X represents the exports and p represents the terms of trade, defined as the price of domestic goods in terms of imported capital goods. Here again, a hat on a variable means a proportional growth rate while a dot on a variable represents change with respect to time. The balance of payment equilibrium condition means that investments need to be paid for by domestic savings, which must equal exports measured in terms of imported capital goods. The savings rate s is assumed to be a constant proportion of output and depreciation δK is a constant portion of the existing capital stock:

$$\widehat{K} = \frac{\dot{K}}{K} = sp\frac{Y}{K} - \delta, \widehat{\widehat{K}} = \widehat{p} + \widehat{Y} - \widehat{K} \tag{5.5}$$

The value of export revenue determines thus the amount of capital goods that can be imported and invested in the domestic economy. Exports $X$are in turn assumed to depend on the trade partners' income, Z, and on the terms of trade p. For the sake

[4]See for example Lee (1995) or Mazumdar (1999) for an overview

of simplicity, a log-linear export function with a constant B and a stochastic term V is used:

$$X = BZ^{\rho}p^{\eta}V, \rho > 0; \eta < 0 \tag{5.6}$$

where ρdenotes the income elasticity and η represents the (negative) price elasticity of export demand. Together, these six equations explain the six variables Y, L, M, p, K, and X. Inserting the functions for exports and output, (5.6) and (5.1), into the export and saving constraints for investment, (5.4) and (5.5), respectively, and taking into account the depreciation rate δon the left hand side and then taking natural logarithms, denoted ln, yields:

$$\ln(\widehat{K} + \delta) = \ln(B) + \rho \ln(Z) + (1 + \eta) \ln(p) - \ln(K) + \ln(V) \tag{5.4a}$$

$$\ln(\widehat{K} + \delta) = \ln(S) + \ln(p) + bt + \ln(A) + (\beta - 1) \ln(K) + \alpha \ln(L) + \ln(U) \tag{5.5a}$$

In addition, we assume that firms know L and K (from the end of previous period) with certainty and produce after U has become known. Households then decide to save a fraction s of their income $Y$and this determines gross investment. When the V-term in the export function is known, the terms of trade p can adjust to determine external trade balance equilibrium. All rigidities and the implied consequences for the future are assumed to be absent for the sake of simplicity. In particular, downward adjustment of K is assumed to be lower than the depreciation rate and therefore of no relevance here. In this model, the output per worker in units of domestic goods is considered a rough indicator of welfare. The driving forces behind the per worker output growth are the rate of technical progress b and the growth rate of the capital-labour ratio, which is denoted by k.

$$\widehat{y} = b + \beta\widehat{k} + (\alpha + \beta - 1)\widehat{L} \tag{5.7}$$

The last term corrects for scale economies. Since the rate of technical progress is given, the remaining question is whether a low income elasticity of export demand hinders rapid growth of the capital-labour ratio by restricting the importation of capital goods. The growth rates for the long-term equilibrium growth path are of crucial interest in this respect. Solving equations (5.4a) and (5.5a) for the natural logarithms of the terms of trade and the left hand side variable yields:

$$\ln(\widehat{K}+\delta) = \frac{-\ln(B)}{\eta} + \frac{(\eta+1)}{\eta}\ln(A) + \frac{(\eta+1)}{\eta}\ln(s) + \frac{b(\eta+1)}{\eta}t +$$

$$\frac{(\beta\eta+\beta-\eta)}{\eta}ln(K) + \frac{\alpha(\eta+1)}{\eta}\ln(L) - \frac{\beta}{\eta}\ln(Z) + \frac{(\eta+1)}{\eta}\ln(U) - \frac{1}{\eta}\ln(V) \quad (5.8)$$

$$\ln(p) = \frac{\ln(A)-\ln(B)}{\eta} + \frac{1}{\eta}\ln(s) + \frac{b}{\eta}t + \frac{\beta}{\eta}\ln(K) + \frac{\alpha}{\eta}\ln(L)$$

$$-\frac{\rho}{\eta}\ln(Z) + \frac{1}{\eta}(\ln(U)-\ln(V)) \quad (5.9)$$

In order to solve for the steady state growth of capital, the next step is to take the derivative with respect to time of these two equations, set both sides equal to zero and assume a constant saving rate in the steady state. The expected value of equation (5.8) is a differential equation in K with a negative slope. K has an impact on equation (5.9) but lnp has none on (5.8). Thus, setting $ln(U) = ln(V) = 0$, the steady-state growth rate can be written as follows:

$$\widehat{k} = \frac{\rho\widehat{Z} - \varepsilon - (1+\eta)[(\alpha+\beta-1)\varepsilon + b]}{-\eta(1-\beta)+\beta} \quad (5.10)$$

If we now insert this solution into the equation determining the change in the terms of trade and into equation (5.7), we obtain the following solutions for the terms of trade p and income per capita y, respectively:

$$\widehat{p} = \frac{(1-\beta)(\rho\widehat{Z}-\varepsilon) - (\alpha+\beta-1)\varepsilon - b]}{-\eta(1-\beta)+\beta} \quad (5.11)$$

$$\widehat{y} = \frac{\beta(\rho\widehat{Z}-\varepsilon) - \eta[(\alpha+\beta-1)\varepsilon + b]}{-\eta(1-\beta)+\beta} \quad (5.12)$$

The numerators of equations (5.10), (5.11) and (5.12) consist of three terms, the first of which reflects the "engine of growth" part from the export demand function: the growth rate of trade partners' income multiplied by the income elasticity of export demand minus the labour growth rate. The product of trade partners' income and income elasticity is the driving force on the demand side. Hence, here the causality runs from exports (financing the import of capital investment) to growth. The second part captures the view that technical progress leads to an increase in exports through decreased prices if exports are price elastic. It represents the handmaiden part of growth dynamics (see also Kravis 1970). As a consequence, the causality of this last effect runs from growth to exports. This model contains both parts, but the handmaiden part drops out if a country has no technical progress. The third part is only relevant in the case of non-constant returns to scale. With increasing or decreasing returns to scale, we have an additional cost reduction or increase which drops out if ($\alpha + \beta = 1$) in equations (5.10) through (5.12).

The direct effect of technical progress and returns to scale is to decrease production costs and to reduce the terms of trade as can be observed in equation (5.11). One would then ask whether this will cause exports and investments to rise or to fall. If exports are price-elastic, exports and investments will increase, and so will the capital-labour ratio as suggested by equation (5.10). Conversely, if exports are price-inelastic, technical progress will have a negative impact on the growth rate of the capital-labour ratio. As for the growth rate of per capita income, it is obvious that technical progress has not only a direct, but also an indirect effect on this variable. The indirect effect is due to changes in the capital-labour ratio (capital deepening) induced by technical progress. For a primary commodity exporting developing country, this question has relevance mainly when the technological progress takes place in this export sector.

The implications of these elasticity values for the steady-state growth can be interpreted from the relationships between output growth, income elasticity of demand and the accumulation of capital goods as plotted in Figure 5.6 for alternative values for the price elasticity. Under the assumption of constant returns to scale, the slope in Figure 5.6 increases with the price elasticity of exports. The more price-elastic the exports are, the less steep the slope will be. For income elasticities higher than one, the economy grows at a faster rate than that predicted by the Solow model. These conclusions however do not hold for a price elasticity of minus infinity, since this is the small country case of a price taker, which yields the results of the Solow growth model.

To explain the interplay between the growth rate of the terms of trade and the income elasticity of export demand, figure 5.7 plots this relationship also for alternative values of export demand price elasticities. The less price-elastic the exports, the steeper the slope and the more negative the vertical intercept. For income elasticities smaller than one, the growth rate of the terms of trade fall and real wages grow at a lower rate than in the Solow model. For income elasticities higher than one, terms of trade do not deteriorate and real income grows at a higher rate than in the Solow

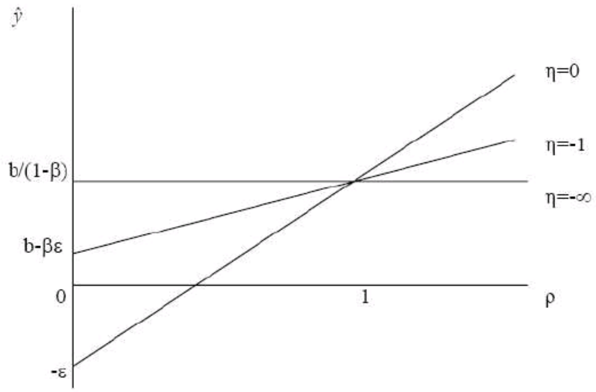


FIGURE 5.6. *Price and income elasticities vs domestic income growth (Ziesemer, 1995)*

model if the technological progress and scale economies do not shift the supply (i.e. if employment growth remains moderate). There is thus a close relationship between the movement in terms of trade and the real domestic output growth. The driving force behind both of them is the income elasticity of export demand. Its effects are only partly counterbalanced by a relatively high price elasticity of export demand. As a general rule, a high price elasticity will thus weaken the impact of the income elasticity of export demand on the evolution of real income and the terms of trade.

The estimated elasticities also mean that technological change increase labour productivity at an estimated annual rate of about 2% as a result of the technological content of imported capital goods and a human capital accumulation. This positive rate of technical change is likely to contribute to lowering the terms of trade and increasing the domestic real wage rate. It works thus in opposite direction compared to high income elasticity of demand. The price and income elasticities of export demand are crucial determinants for a developing country's growth prospects.

To summarise, technical progress and increasing returns to scale have a negative impact on the terms of trade while they influence per capita income positively. The higher the income elasticity, the higher the growth of export demand for any growth rate of trade partners income and the higher the growth rate of capital imports in equation (5.10). The latter aspect causes income in equation (5.12) to grow at a higher rate and the growth rate of the terms of trade is driven up as well. A higher growth rate of income in the trade partner countries will lead to an increase in exports. Yet, the critical point is whether the change in income multiplied by the income elasticity

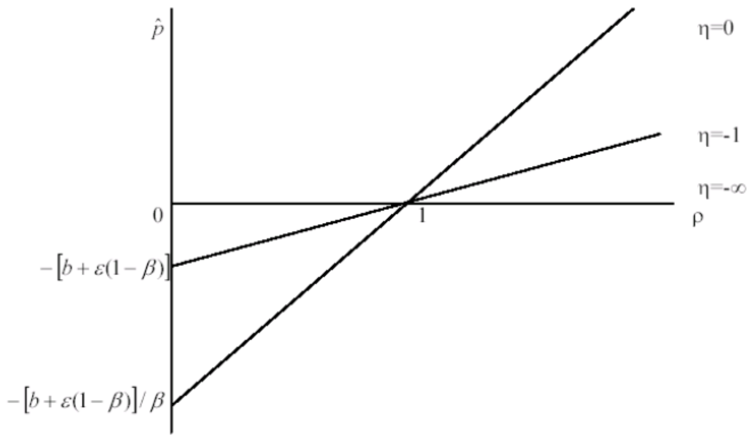


FIGURE 5.7. *Price and income elasticities vs evolution of terms of trade(Ziesemer, 1995)*

of export demand -representing capital investment growth rate- exceeds the labour growth rate ε. This difference governs the growth rate of the capital-labour ratio in equation (5.10). In the case of constant returns to scale, if the income elasticity of export demand is low and the labour force growth rate is high, the effect on the growth rates on the terms of trade, the capital-labour ratio, and income per capita will be negative in the absence of technical progress.

In conclusion, the terms of trade will fall on condition that the rate of technical progress and scale economies is not exceeded by a large difference between the export growth rate and the labour growth rate in equation (5.12). The growth rates of the capital-labour ratio and income per capita may be negative because of low price- and income elasticities. On the other hand, with a high income elasticity of export demand, a low labour force growth rate and a high rate of technical change in the presence of positive scale economies, high steady-state growth rates are possible as well. With respect to income elasticity and trade partners' income growth, the terms of trade are an indicator of economic development, because they boost both per capita income and the capital accumulation if exports are price elastic.

5.3.3 Mauritius' exports, terms of trade and capital accumulation data

Economic overview

In this section we present a brief overview of the Mauritian economy and the data used to empirically estimate the growth model for Mauritius. The Mauritian economy has been expanding at a sustained rate for almost four decades as a result of continuous accumulation of physical and human capital. Gross domestic fixed capital formation as a percentage of GDP has been strong, fluctuating at around 25% between 1990 and 2000 and stabilising to 22.5% between 2001 and 2005. This rate of investment compares favourably with that of other developing and developed countries.

Mauritius is one of the few sub-Saharan African countries that managed to enter the market for manufacturing export and it is exceptional in that it has transformed itself from a monocrop agrarian economy into an impressive industrial performer. Its transformation from a sugar dependent economy into one of the leading export manufacturers in Africa, owing mainly to the Export Processing Zone (EPZ)-based trade policies of early 1970s, has set standards for other African countries to emulate. With almost 75 % of its exports consisting of manufactures today, it is the uncontested SSA leader in making the transition from dependence on primary commodities to diversifying productive activities (Wingnaraja, Lezama and Joiner, 2004).

These achievements are even more remarkable when one takes into account the difficult initial conditions. Back in the late 1960, when it gained independence from Britain, it was a poor developing nation with a dualistic economy based primarily on a highly productive sugar export sector and a poorly performing subsistence agriculture sector. Moreover, it had only negligible industrial and managerial experience to rely on, while investment capital was lacking as a result of inexistent financial institutions and intermediaries. Like any other typical poor developing country back then, it started from economic dependence on a single primary commodity, a very small domestic market with low purchasing power and remote from developed western markets, while also lacking raw material and other natural resources (Wingnaraja, Lezama and Joiner, 2004). This remarkable transformational achievement has also been translated into a more equitable income distribution, increased human capital stocks and life expectancy, lower infant mortality, and a modern infrastructure (Subramanian and Roy, 2003). Sugarcane is however still grown on about 90% of the cultivated land area and still accounts for 25% of export earnings (World Factbook, 2006).

Currently, Mauritius has one of the strongest economies in Africa; 2004 GDP at market prices was estimated at USD 6 billion and its PPP adjusted per capita income reached USD 13,500 in 2006 (World Factbook, 2006). Over the past two decades, real output growth averaged just below 6% per year, leading to a more than doubling of per capita income and a marked improvement in social indicators. Economic growth was first driven by sugar, then by textiles and tourism, and more recently by financial services (particularly offshore companies). The information and communications technology (ICT) sector is now emerging as the fifth pillar of the economy, following massive investment by government in the last three years in related infrastructure and training (the newly built Ebene Cyber City is one example). The growth model we present here captures these aspects of improved public infrastructure, increase in human capital stock and the corresponding productivity growth effects of sectoral shift in its estimation of total factor productivity (TFP) growth.

Data and data sources

After the overview of the Mauritian economic situation and aspirations, we now present the data used to estimate the price and income elasticities needed for carrying out an empirical estimation of its growth potential. The equations to be estimated below are (5.8) and (5.9). These equations hold for both the steady state and the transition path and are thus particularly interesting. These equations will be estimated as a simultaneous system. Once the system is estimated, all parameters can be identified and be used to calculate the various elasticities needed to analyse the imported input model.

In order to estimate the equations, time series data for the savings or investment/GDP ratio, capital, trade partners' income and employment are required. The data for gross fixed capital formation as percentage of GDP are taken from the World Development Indicators and represent investment. For the investment base year, we use gross fixed capital formation as of 1980, because the data series prior to that period show an excessive amount of missing observations and are therefore of little use for the analysis. The values of investment are used instead of the savings ratio in order to account for the portion of investments that is financed by foreign capital, which is not incorporated in this model. The data for capital are constructed by cumulating Gross Domestic Fixed Capital Formation (GDFCF) after subtraction of the data for depreciation. To estimate the initial value of capital stock at the beginning of the year 1980, we first compute the capital growth rate derived from the growth of output and the growth of labour employment for which we have data, assuming constant returns to scale Cobb-Douglass production function with conventional factor shares and using a TFP growth of 0.6 %, such as estimated by Subramanian and Roy (2003) for Mauritius[5]. Writing output $Y = A.K^{\alpha}L^{\beta}$, we can take the natural logarithms and obtain $ln(Y) = ln(A) + \alpha ln(K) + \beta ln(L)$.

[5] Using the growth accounting approach Subramanian and Roy (2003) esimated Mauritian TFP growth to average 0.6% for the period 1982-1990.

By taking the derivatives $dln(Y) = dln(A) + \alpha dln(K) + \beta dln(L)$ and assuming constant returns to scale(i.e.$\alpha + \beta = 1$), we can equate $dln(K)$ to $[dln(Y) - d(lnA) - \beta dln(L)]/(1 - \beta)$:

The growth rate of GDP was 4.56% for the year 1980/1981 according to the World Development Indicators. Using the conventional labour and capital shares (respectively 2/3 and 1/3), a corresponding average labour growth of 3.34% and Subramanian and Roy's (2003) average estimate for Mauritian TFP growth of 0.6%, the growth rate of capital was estimated to be 4.91 %. Once the capital growth rate has been estimated, we then use the data for depreciation (computed from the WDI ratios of fixed capital consumption as a percentage of GNI) and investment (GDFCF) to estimate the initial value of K as follows:

$K_0 = (GDFCF1 - Depreciation_1)/dln(K)$[6]

As Mauritius has been sourcing its capital import from various parts of the world, we chose to use the value in constant local currency units (Mauritian rupee MUR) for the capital stock, deflated by the capital investment index for Mauritius (CSO data) and corrected for the change in terms of trade. With the capital stock constructed in this way, we can determine growth rates as log differences and add the rate of depreciation (determined by the depreciation amount relative to the capital stock at the beginning of each year) to get the dependent variable of equation (5.8).

The employment data were computed by using the Heston-Summers-Aten PWT6.2 dataset on GDP per worker and GDP per capita and the WDI data on population and represent full-time equivalent of formal employment. We also include the data for 2005 and 2006 computed from the WDI labour force and the Bank of Mauritius unemployment rate, despite the adverse employment impact of the phasing out the MFA in 2005, which has seriously affected Mauritian textile export and employment (see Lal and Peedoly, 2007). By dividing GDP per capita by GDP per worker, we determined the rate of worker per population, which, when multiplied by total population, yields the total employment head count in the country. However, as recalled by Lamusse (1980), the labour in the sugar cane plantations has been characterised by a strong seasonality and part-time employment. We therefore applied a correction

[6] The initial capital growth $dln(K) = ln(K_1) - ln(K_0)$ is approximately equal to $(K_1 - K_0)/K_0$. Since K_1 is obtained by adding to the initial capital stock K_0 the capital formation in the first period and subtracting the corresponding depreciation charge, K_1 can be written as: $K_1 = K_0 + GDFCF_1 - Depreciation_1$ so that $dln(K) = (K_0 + GDFCF_1 - Depreciation_1 - K_0)/K0$. By a simple arithmetic manipulation, we obtain $dln(K) * K_0 = (GDFCF_1 - Depreciation_1)$. From here, the initial capital stock can be derived as $K_0 = (GDFCF_1 - Depreciation_1)/dln(K)$

factor to account for this by estimating the full-time equivalent factor of around 70% in the years 1980-through halfway the 1990s (when sugar was still dominant in the economy), which we increased to 90% for the years afterwards (when the clothing and apparel industry had taken over as the major export product) to reflect the larger intensity of employment and labour shortage in that period (see also Subramanian and Roy, 2003). The time series starts in 1980 and covers the period through 2006. Trade partners' income is taken to be the trade-share weighted average income (in constant international dollars at 2000 prices) of the European Union, the US and the United Arab Emirates, the three major export markets for Mauritian products. The terms of trade were calculated as 'exports as capacity to import' divided by 'exports of goods and services', both in terms of constant 1998 local currency units.

5.3.4 Estimation methods and results

Econometric method

Before discussing the methods, we check whether the time series follow unit root processes and determine the order of integration of the variables. Econometric methods have indeed been developed traditionally either for stationary variables and more recently for variables being integrated of order one, I(1). Our testing for unit roots will suffer from the fact that these tests have been designed for a large number of observations over long time periods, whereas we deal with only a few observations covering only a 20 year period. Hence, the test results that we obtain here have only limited explanatory power. However, while bearing in mind their low explanatory power for the case at hand with shorter series, we nonetheless note that our augmented Dickey-Fuller (ADF) test results fail to reject the unit root hypothesis for the variables lnZ and lnL. The presence of unit root in these variables would mean that they are not covariance stationary, thus that they appear to be a random walk with a stochastic drift (Greene, 2003: p. 780-781). In that case, the autocorrelation function of this random walk is persistent as the sample time span increases, and standard inferences based on least squares and the familiar test statistics would no longer be valid (Baltagi, 2008: p. 361).

In the case of multivariate time series where only some of the independent variables seem to display unit root processes, Verbeek (2004: p. 314) suggests that adding lagged regressors of variables that seem not to be stationary would suffice to render OLS estimates consistent. However, it is also important to recall that unit root tests suffer from the fact that they often are unable to discriminate between unit rood processes and borderline stationary processes (Baltagi, 2008: p. 362). In the data of our estimated regressions, $ln(Z)$ has obviously a trend but may not have a unit root. $Ln(L)$ seems to have a unit root, which can partly be attributed to the fact that it was constructed from various data series. However, it is not a random variable but rather a constructed series to which unit root theory does not apply. In any case, our estimated regressions do not indicate any persistent autocorrelation.

Furthermore, the system to be estimated has three important aspects to be taken into account in choosing the estimation method. The first one has to do with constraints on the coefficients, which imply a non-linear estimation problem. We have one constraint per regressor in equations (5.8) and (5.9), except for the intercept and the trade partners' income variable, which has the same coefficient in both equations. The second aspect refers to the random terms from the production function and the export function in both equations of the system and has as a consequence that the residuals of the two equations will not be independent. These two properties together suggest using the seemingly unrelated regression (SUR) method. The seemingly unrelated regression method, also known as the multivariate regression, or Zellner's method, estimates the parameters of the system, accounting for heteroskedasticity and contemporaneous correlation in the errors across equations. The third aspect comes from the differential equation properties of equation (5.8) which imply residuals have an impact on all future variables of capital. It also implies that the regressor in the first equation is not exogenous although it is predetermined (see also Davidson and Mackinnon, 2004). Moreover, the saving rate might also vary with the accumulated capital, rendering it not strictly exogenous.

As this would render OLS estimates biased, we use the generalized method of moments (GMM) with heteroskedasticity and autocorrelation correction (HAC) of the coefficient standard deviations, in which we include the lagged saving rates and lagged variables of capital as instruments. GMM estimation is based upon the assumption that the disturbances in the equations are uncorrelated with a set of instrumental variables and is thus a robust estimation method in that it does not require information of the exact distribution of the disturbances. Table 5.4 reports the estimates of the various estimation methods and allows to compare the OLS results to the SUR and GMM estimates. The OLS estimates produce elasticity coefficients that yield an unlikely low measure of returns to scale, while the SUR results yield an unlikely high capital product elasticity and therefore a too high measure of returns to scale. As noted above, these estimates are thus biased and inconsistent; they cannot thus be relied upon.

The GMM estimation of the system as specified in equation (5.8) and (5.9) yields coefficients that are significant but also manifestly biased and inconsistent as a result of serial correlation in both equations (DW=0.77 in the first equation and DW=0.64 in the second). To reduce this problem, we add the lagged dependent variables to the system of equations and also add their lagged values as instruments (See Davidson and MacKinnon, 2004). The resulting GMM-HAC estimates with lagged dependent variables in the two equations are reported under regression no 3 of Table 5.4. The DW statistics are now at 2.04 in the first equation and 1.98 in the second, which means that serial correlation has been almost entirely eliminated.

The Hansen test for the validity of over-identifying constraints suggests that the used instruments are valid as can be observed from the product of the J-statistic and the number of observations. Since our system is subject to five restrictions of the parameters, the resulting minimum distance measure (sum of squares) is larger than the unrestricted sum of squares (see Wooldridge, 2002: p. 201 and Greene, 2003: p. 549). The overidentifying restrictions of the system are chi-square distributed with 13 degrees of freedom (total count of instruments minus the number of coefficient to be estimated). Large values of this statistic imply the rejection of the null hypothesis (Baltagi, 2008: p. 270). Our J-statistic of 0.32 implying a value of nJ of about 7.5 is very low and thus an indication that the system overidentifying restrictions are significant[7].

However, as Roodman (2007) cautions, this statistic may become downward biased as the instrument count increases and thereby fail to reject the null hypothesis. We therefore refine our estimation by successively allowing a reduction in the instrument count to check how the J-statistic reacts to these changes (Roodman 2007) and the automatic lag selection in the autocovariance matrix, adapted to the data sample size in order to increase the accuracy of the t-tests (Newey and West, 1994) and. By allowing the automatic lag selection in our fourth regression, with a reduced instrument count, we obtain a high significance level for all of our coefficients with a sharp drop in the Hansen J- statistic to 0.10. The fifth regression, which has two more instruments

[7] The probability that values of the chi-square distribution are below nJ=7.5 is at the 10% level for the 13 degrees of freedom. As the Hansen test for the joint validity of instrument is also a test for the validity of the model specification, our J-statistic also suggests that the model specification is valid (Greene, 2003; Roodman, 2007; Baltagi, 2008). All of the estimated coefficients except the one to be used for computing the rate of technical progress are also significant at 1% as indicated by their high t-values.

The value for nJ is about 2.5 for these regressions. The probability that values of the chi-square distribution are below nJ=2.5 is at the 1% level for 12 or 13 degrees of freedom.

than the fourth, displays a slightly higher J-statistic of 0.11, which, in accordance with Roodman (2007), means that our instrument count does not bias the J statistic downward and gives therefore a confirmation of the validity of our instruments.

Results

We can thus use the above GMM results to compute the various elasticities according to the relationships indicated in the first column of table 5.4: we therefore use the results of the last regression to compute the elasticities, which can be interpreted with reasonable assurance. The labour product elasticity $\alpha$is estimated at 0.66, while the capital product elasticity β is computed to be 0.36. This regression yields thus coefficients that display minor increasing returns to scale as the sum of both factors' elasticity is slightly above 1. The resulting income elasticity of export demand is now at about 2.86 while the estimation for export price elasticity yields -1.6. These results produce an estimated rate of technical progress of about 1.38% per annum, which implies an annual rate of labour augmenting technical change of about 2% over the considered period, given the elasticity of labour productivity of 0.66. This relatively strong[8] rate of technical change reflects, as explained by Rodrik (2003), not only the gradual increase in technical efficiency, but also the advantage of allocative efficiency resulting from a sectoral shift from sugar to more value-added industries in the export apparel and ICT sectors. It also reflects the increased utilisation of the human capital content of the labour force and the increasing technological content of imported machinery and equipment in the textile and ICT sector of the EPZ, where Mauritius deploys a more productive labour force and production technologies almost matching the world best practices (Wingnaraja, 2001). Indeed, the remarkably strong investment in human capital accumulation and the good quality of its bilingual (French and English) labour force have been crucial determinants of Mauritian industrial transformation.

5.3.5 Steady-state growth rates, engine and handmaiden effects and dynamic gains from trade

So far, we have estimated the model for its non-steady-state version. For long-run predictions, the theory gives us the steady-state formulas for growth rates of expected values. In this section, we calculate the steady-state growth rates of equations (5.10)

[8] In comparison, the OECD countries had an average of 1,7% labour augmenting technical change over similar periods

TABLE 5.4. OLS, SUR and GMM-HAC regression results for the system of equations

Method	Reg.1: OLS		Reg 2: SUR		Reg.3: GMM*		Reg.4: GMM**		Reg5: GMM***	
Variable/Coefficient	Coeff	(Std err)	Coeff	(Std err)	Coeff	(Std err)	Coeff	(Std err	Coeff	(Std err
Constant C_1	-21.697	(6.564)	21.042	(4.736)	24.935	(3.314)	29.678	(1.242)	25.573	(1.798)
Constant C_7	-32.537	(12.05)	18.844	(6.982)	32.515	(4.723)	36.245	(1.575)	33.620	(2.958)
lnS: $C_2 = (\eta+1)/\eta$	0.435	(0.128)	0.593	(0.082)	0.391	(0.061)	0.314	(0.018)	0.376	(0.036)
t: $C_3 = b^*(\eta+1)/\eta$	0.010	(0.011)	-0.004	(0.014)	0.005	(0.004)	0.003	(0.001)	0.005	(0.002)
lnK: C_4:$(\beta\eta+\beta-\eta)/\eta$	-0.882	(0.252)	-0.509	(0.305)	-0.848	(0.090)	-0.864	(0.028)	-0.862	(0.048)
lnL: $C_5 = \alpha^*(\eta+1)/\eta$	0.271	(0.086)	0.321	(0.065)	0.256	(0.033)	0.204	(0.013)	0.249	(0.019)
lnZ: $C_6 = -\rho/\eta$	1.639	(0.366)	1.209	(0.239)	1.745	(0.172)	1.979	(0.053)	1.788	(0.104)
$\ln(\hat{K}+\delta)_{t-1} : C_8$	0.870	(0.106)	0.964	(0.127)	0.801	(0.062)	0.859	(0.032)	0.809	(0.033)
$\ln p_{t-1} : C_9$	1.084	(0.231)	0.905	(0.129)	1.095	(0.088)	1.109	(0.035)	1.105	(0.053)
$\ln p_{t-2} : C_{10}$	-0.406	(0.115)	-0.531	(0.127)	-0.329	(0.066)	-0.361	(0.035)	-0.337	(0.033)
Implied elasticities										
Lab prod elast α	0.623		0.541		0.656		0.648		0.663	
Capprod. elasti β	0.271		0.828		0.388		0.433		0.365	
TFP growth b	0.023		-0.006		0.013		0.011		0.014	
Export inc. elast ρ	9.904		2.968		2.866		2.888		2.868	
Ex price elast η	-1.771		-2.455		-1.642		-1.459		-1.604	
Init prod level A	$5.10E^{+4}$		$1.11E^{-1}$		$1.96E^{+3}$		$7.17E^{+3}$		$3.12E^{+3}$	
Export const. B	$4.75E^{-21}$		$4.75E^{-21}$		$1.26E^{-20}$		$7.64E^{-21}$		$1.18E^{-20}$	
Regression fit	eq1	(eq2)	eq1	(eq2)	eq1	(eq2)	eq1	(eq2)	eq1	(eq2)
R-sq	0.963	(0.861)	0.957	(0.899)	0.911	(0.758)	0.941	(0.723)	0.912	(0.750)
Adj. R-sq	0.948	(0.816)	0.939	(0.867)	0.867	(0.668)	0.913	(0.619)	0.867	(0.657)
DW-stat	2.177	(1.928)	2.174	(2.008)	2.043	(1.981)	2.232	(1.884)	2.079	(1.967)
J-statistic					0.321		0.109		0.114	
No.Obs	25	(26)	23	(23)	22	(23)	23	(23)	22	(23)
nJ					7.065	(7.386)	2.521	(2.521)	5.519	(2.633)

*Fixed N-W bandwidth. 23 instruments: equation 1: c, lnS(-1), t, lnK(-1) , lnK(-2) lnK(-3) lnK(-4) lnK(-5), ln(L), lnZ $\ln(\widehat{K}+\delta)$(-1)and $\ln(\widehat{K}+\delta)$(-2). Equation 2: c, lnS(-1), t, lnK(-2), lnK(-3), lnk(-4), ln(L), lnZ, lnp(-1) and lnp(-2) lnp(-3)

**Variable N-W bandwidth.. 21 instruments: equation 1: c, lnS(-1), t, lnK(-2) , lnK(-3), , lnK(-4), ln(L), lnZ and $\ln(\widehat{K}+\delta)$(-1) to $\ln(\widehat{K}+\delta)$(-2). Equation. 2: c, lnS(-1), t, lnK(-1), lnK(-2), lnk(-3), lnk(-4), ln(L),lnZ lnp(-2) and lnp(-3)

*** Variable N-W bandwidth. 22 instruments: equation 1: c, lnS, t, lnK(-2), lnK(-3), lnK(-4), lnK(-5), ln(L),lnZ $\ln(\widehat{K}+\delta)$(-2) and $\ln(\widehat{K}+\delta)$(-3). Equation. 2: c, lnS, t, lnK(-2), lnk(-3),lnK(-4) ln(L),lnZ, lnp(-1) lnp(-2) and lnp(-3) to (5.12) numerically so as to specify the long-run predictions of the estimated models. We calculate the engine (g) handmaiden (m) and scale(s) effects as defined below, in order to compare them to each other and in order to assess the effects of export growth rates on GDP per capita growth rates in the long run. Finally, we define and calculate the dynamic gains from trade as the difference between the predicted growth of the present model and that of the corresponding Solow model. The derivative of equation (5.12) with respect to $dln(Z)$ is the engine effect g, with repect to b is the handmaiden effect m, and with respect to $dln(L)$ is the scale effect s to the extent that it would drop out if there were constant returns to scale.

$$g = \frac{\beta\rho}{\beta(\eta+1)-\eta} \tag{5.13}$$

$$m = \frac{-\eta}{\beta(\eta+1)-\eta} \tag{5.14}$$

$$s = \frac{-\eta(\alpha+\beta-1)}{\beta(\eta+1)-\eta} \tag{5.15}$$

Next, x represents the corresponding growth rate of the Solow model, assuming that its parameters are identical to those of our estimates.

$$x = \frac{b+(\alpha+\beta-1)\varepsilon}{\beta(\eta+1)-\eta} \tag{5.16}$$

Finally, the difference in the growth rates of our model according to equation (12), $dln(y)$, and the corresponding Solow model, denoted t, is defined as the dynamic steady-state gains from trade.

$$t = d\ln(y) - x \tag{5.17}$$

In Table 5.5, we report the steady-state results for the growth rates of k, p and $y$as well as the engine, handmaiden and scale effects the Solow growth rate x, and the difference, t, of our model with the latter.

All calculations are done under the assumption that the driving trade partners income will continue to grow at 2,49%. Finally, we need an assumption for the growth rate of employment. Our best estimate about employment growth is derived from the analysis of the employment behaviour in Mauritius in the past. Here, it is not superfluous to recall the adverse employment effects of the expiry of the MFA at the beginning of 2005. Indeed, the most direct effect of the dismantling of the MFA has been that a significant number of locally based large foreign textile firms, in particular those from Hong-Kong that have been supplying the US market from Mauritius have

SOURCE: Graph plotted by author with Mauritian CSO data

FIGURE 5.8. *Employment growth in Mauritius, 1998-2006*

relocated to cheaper production location in Asia or elsewhere in Africa, leading to massive employment loss on the island (Lal and Peedoly, 2007). Over the 15 years preceding the MFA dismantling, employment growth has been positive but oscillating, averaging around 1.8% per annum as illustrated on figure 5.8. We assume this rate to be maintained in the long run and use it for our steady state estimation besides alternative scenarios using values in the range of 0-5% for employment growth.

We use the elasticities calculated in the last regression in Table 5.4 and find the following results: The steady-state growth rates of capital per worker are positive for all values of employment growth from 0 to 5%. This rate of employment growth corresponds to per capita income steady state growth rate of about 2.35%. For the assumed average employment growth of around 1.8%, capital per worker grows at 4.49%, while the steady-state per capita income grows at about 3%. Lower values of steady state employment growth yield a better growth of capital stock per worker and thus a slightly better per capita income growth rate (respectively 5.4% and almost 3.4% if employment grows with 0.5%). This is due to the relatively high income elasticity of export demand and the technical progress implied by b=1.4%. The presence of some scale effects, be they small, tends to reinforce the effects of technical change. The terms of trade will only fall if employment grows rapidly, i.e. above 4,5%, and will evolve positively for values of employment growth below this rate.

In our Mauritian case, terms of trade growth remains positive because of the growth of the export demand , as illustrated by the income elasticity of 2.86. For values

TABLE 5.5. Steady state engine, handmaiden and scale effects for alternative employment growth rates

Assumed employ growth	5%	4.5%	4%	2%	1.8%	1.5%	1%	0.5%	0%
Capital growth	0.0221	0.0257	0.0292	0.0434	0.0449	0.0470	0.0506	0.0541	0.0577
dlnp	-0.0013	0.0011	0.0035	0.0130	0.0140	0.0154	0.0178	0.0202	0.0226
dlny	0.0235	0.0246	0.0258	0.0304	0.0309	0.0316	0.0327	0.0339	0.0350
g	0.7577	0.7577	0.7577	0.7577	0.7577	0.7577	0.7577	0.7577	0.7577
m	1.1596	1.1596	1.1596	1.1596	1.1596	1.1596	1.1596	1.1596	1.1596
s	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
x	0.0111	0.0110	0.0109	0.0105	0.0105	0.0104	0.0103	0.0102	0.0101
t	0.0124	0.0136	0.0149	0.0199	0.0204	0.0212	0.0224	0.0237	0.0249
g*(ρ*dln(Z)-dln(L))/ρ	0.0162	0.0199	0.0237	0.0389	0.0404	0.0427	0.0465	0.0503	0.0540
$m * b$	0.0162	0.0162	0.0162	0.0162	0.0162	0.0162	0.0162	0.0162	0.0162
$s * dln(L)$	0.0017	0.0015	0.0013	0.0007	0.0006	0.0005	0.0003	0.0002	0.0000
$dln(Z)$	0.0249	0.0249	0.0249	0.0249	0.0249	0.0249	0.0249	0.0249	0.0249
b	0.0140	0.0140	0.0140	0.0140	0.0140	0.0140	0.0140	0.0140	0.0140
β	0.3654	0.3654	0.3654	0.3654	0.3654	0.3654	0.3654	0.3654	0.3654
η	-1.6040	-1.6040	-1.6040	-1.6040	-1.6040	-1.6040	-1.6040	-1.6040	-1.6040
α	1.6632	1.6632	1.6632	1.6632	1.6632	1.6632	1.6632	1.6632	1.6632
ρ	2.8681	2.8681	2.8681	2.8681	2.8681	2.8681	2.8681	2.8681	2.8681

where the supply effects of employment and technical change are larger than that of the demand force, trade partners income growth multiplied by the income elasticity, terms of trade will fall. For values of employment growth of 4.5% and below , demand side factors dominate and terms of trade will improve. The handmaiden effect of technical progress multiplied by the rate of technical change, $m * b = 0.016$, is smaller than the engine effect multiplied by the difference between trade partners' income growth rate and population growth rate, $g * (\rho dln(Z) - dln(L))/\rho$ for lower values of employment growth and larger than the scale effect, $(s * dlnL)$ again because of the relatively high income elasticity of export demand and the relatively low measure of returns to scale. With lower labour employment growth, this engine effect becomes stronger than the handmaiden effect, while the scale effect gradually vanishes (see last two columns of Table 5.5).

The steady-state part of the dynamic gains from trade, t, is positive for the presented values of employment growth and increases with lower values of employment growth rates. As illustrated by Lewer and van den Berg (2003), dynamic gains from trade are large when export growth rates are high in the transition after taking policy measures. Therefore, static gains from trade and the gains during transition may be larger than those in the steady state.

5.3.6 *Concluding comments*

The growth model outlined in this section shows that the size of a country's income and price elasticities of export demand are an important determinant of its growth and development path, unless the price elasticity is minus infinity. According to our estimates, income elasticity of export demand is relatively high for Mauritius and the price elasticity is minus –1.6 and as a consequence, the engine-of-growth effects are strong as well. As the income elasticity here is high, foreign growth will be translated into more than proportional domestic export growth. A high income elasticity in combination with technical progress will lead to a positive evolution of terms of trade in the steady state, giving rise to a relaxation of the balance of payments constraint.

In particular, given the estimated income demand elasticity of 2.86, the steady state engine effects will be positive for employment growth rates below 5 % and will remain important for the assumed foreign income growth rate and the average employment growth rate of 1.8%. At this rate of employment growth, the positive engine effects will lead to gradual catching up. Engine effects are thus very important because long-run per capita income growth may be larger than the sum of the rate of technical change the rate of increasing returns to scale. The effect of increasing returns is to act in favour of higher growth in this case and employment growth works in the same direction as technical progress but this effect is very low for Mauritius.

The model allows for positive growth rates of the terms and trade and per capita income through imported capital goods, positive dynamic gains from trade and increasing returns. According to our estimates, the income elasticity is relatively large, and if Mauritius continues to take advantage of the preferential access to the US textile markets through the Africa Growth and Opportunities Act (AGOA), this may mean a growth engine without driving down the terms of trade, in line with the expectations. However, the effect may become weakened due to a relatively high price elasticity of export demand, which can translates the positive evolution of terms of trade into a lower export demand. This relatively high price elasticity can be traced to Mauritius' strategy of positioning itself at the differentiated high end of the textile, apparel and tourism sectors. Both arguments interact and are quantitatively relevant. According to our model, neither of the two can be dismissed because technical change matters on the supply side and exports are important determinants on the demand side.

Finally, as the literature on devaluations emphasizes the effects of devaluations for explaining the terms of trade movements, our finding of a price elasticity of about -1,6 implies that devaluations inducing a real fall in export prices would be followed by higher growth rates, since nominal devaluations have real effects (Bahmani-Oskooee and Miteza, 2002).

The steady-state part of dynamic gains from international trade is also dependent on the level of employment growth: high employment growth could yield negative dynamic gains from trade in the steady state, whereas low employment growth brings about positive gains from trade. The impact of employment growth on steady-state output growth is less negative under increasing returns than under constant returns. Moreover, due to the relatively high price elasticity, steady-state growth will not be hampered by employment when its growth does not exceed its values of the past. It is obvious that price movements matter for the value of exports: the current results clearly demonstrate that income and price elasticities of export demand may be important explanations for the growth of Mauritius in the examined period.

As labour force growth slows down, increasing dynamic gains from trade can be generated by trade partners income growth, which translates into higher demand for exports and thus in higher domestic growth for Mauritius. Given the current conjuncture that forces Mauritius to seek other strategic growth sectors than textile, it is obvious that continued dynamic gains from the current trade patterns could translate into linkages supporting other production technologies, which will also affect the values of export demand and price elasticities in the future, and thereby co-determine the new growth prospects of the island.

5.4 Chapter Summary and Conclusions

This chapter has reviewed the Mauritian capabilities, incentives system and institutional setting from the SID point of view, in order to analyse how they may affect the accumulation process and the diversification choices followed by the country. Mauritius has been leading the African continent in terms of human capital accumulation and is well endowed with a competent bilingual labour force. The investment in education has been a deliberate political priority as evidenced by the substantial share of budget allocated to it. The rate of investment in physical capital and public infrastructure has also been substantial and the country is well equipped for industrial development in various sectors. The indicators of technological effort are still at relatively low levels as can be observed from both the input and output measures. The production technologies in the textile sector, though they meet leading edge standards, are still concentrated in the low-tech segment characterised by relatively labour-intensive production methods (Wingnaraja, 2001; Lal and Peedoly 2006). However, this may be changing in the future as the country moves along its development trajectory.

The incentive system, on which we come back in chapter 6, has been characterised by an unusually attractive investment climate and a stable, market-friendly macroeconomic management, owing to a competent and well paid bureaucracy. Outward orientation is apparent in the creation of EPZ to encourage export-based growth as early as 1970, or only two years after independence. However, as we will see later in chapter 6, this relative trade openness has coexisted with a substantial degree of trade restrictions and state intervention to strengthen the import-competing sector during much of the growth period. Competent, relatively cheep labour force for the EPZ sector and well developed credit and equity markets are other incentives that helped the Mautitian industrialisation, although the absorption of unemployment has gradually led to some degree of labour shortage and wage increase.

As for the institutional quality, the country has been characterised by a stable market friendly democracy with low business risk, where trade and investments have been encouraged. Mauritius' scores on conventional measures of institutional quality have been fairly good by any international standards. As a result, the country has been able to attract large foreign investment in the EPZ and banking sector, and managed to convert the income growth generated by its export partners into domestic growth, as illustrated by the GMM estimates of the growth model outlined in the last part of this chapter.

Chapter 6

BOTSWANA AND MAURITIUS IN COMPARATIVE ANALYSIS

6.1 Introduction

In this chapter we compare the growth experiences of Mauritius and Botswana and attempt to contrast their diversification outcomes on the basis of capabilities, incentives and institutional factors. Carroll and Carroll (1997) identify Botswana and Mauritius as two among a handful of developing countries that have achieved growth while maintaining democratic institutions and procedures. They attribute this to three common factors: firstly, the personal commitment of talented political leaders to democratic government and economic development, secondly, a competent and politically independent state bureaucracy that is meritocratic but broadly representative in its composition, and thirdly, a public realm in which there are some modest checks on the actions of the state, in which there is a balance between universalistic and paternalistic norms, and in which the importance of tribal and/or ethnic roles and institutions is recognised.

The various studies that have been devoted to these two countries have advanced similar arguments as being the explaining factors for the growth performance. They include invariably the outward orientation, prudent and far sighted macroeconomic policies, the institutions of property rights and a competent bureaucracy. For the two countries, the emphasis has been put on institutional factors in the most prominent studies (Hope, 1998; Leith, 1999 and Acemoglu et al, 2003 for Botswana; Greenaway and Lamusse, 1999 and Subramanian and Roy, 2003 for Mauritius). Moreover, even though Szirmai (2008) rightly questions the validity of the institutional argument of property rights, free market and low corruption in the light of the impressive growth in China, Acemoglu et al. (2004) convincingly argue that institutional factors matter the most because they determine the accumulation choices of the other factors that affect growth. For the purpose of comparison between Botswana and Mauritius we will therefore put less emphasis on the capabilities indicators as they are relatively low and largely similar in both countries. Moreover capabilities are more likely to be, not only the cause of the accumulation process, but also its consequence to a larger degree. We emphasise instead the incentives and institutional differences.

While Botswana and Mauritius are often cited in one and the same breath as the two success stories of Africa, the two countries display highly contrasting characteristics and developmental outcomes. Botswana owes much of its economic achievements to a fortunate discovery of large diamond reserves shortly after independence, whereas Mauritian growth has mainly been driven by preferential access the EU sugar market before it developed a competitive EPZ-based textile industry. Moreover, whereas sugar production has experienced adverse shocks as a result of a series of cyclones and droughts in the 1990s and its share in total export value has been overtaken by clothing and apparel, Botswana's diamond production has been steadily growing as evidenced by its relatively stable share of a GDP that has been growing at spectacular rates. Botswana's economy remains thus largely based on its impressive diamonds deposits whose value is largely intrinsic to the natural resource, whereas Mauritius has managed to develop a strong textile/apparel industry and a relatively diversified economy, whose value-added is largely the result of human labour and hard work. Additionally, Mauritian social and human development indicators such as life expectancy and relatively egalitarian income distribution contrast sharply with a relatively lower degree of human development characterised by high inequalities and low life expectancy prevailing in Botswana.

This chapter reviews Botswana's and Mauritius' growth and development experiences since their independence in late 1960s, in a comparative perspective. We first present the evolution of Botswana's economic achievements and its corresponding implications for human development. Then we discuss the changing sectoral composition of Botswana's economy and the extent to which the country was able to diversify its economy beyond the diamond sector. In the third section we review the Mauritian economy in historical perspective from its dependence on sugar export to the current diversified structure. We also identify some of the factors explaining this evolution. Finally, Mauritius' development experience is discussed in terms of its success in human development and in income distribution terms. The last section contrast the experiences of the two countries and draws conclusion.

6.2 Overview of Botswana's Growth and Development Experience

Botswana's economic growth has gone hand in hand with the export performance of its two main export products: beef and diamonds. Botswana started to pursue export oriented strategy during the colonial era, when the country was a British protectorate. In that time, export consisted mainly of game meat, game skins and beef. Later, beef exports to the European Union (then European Economic Community) became the country's main engine of growth until the early 1970s, when De Beers had discovered large diamond deposits in the Orapa region. In addition to diamonds, there was coal and copper/nickel, which, together with beef, constitute the country's main exports. These account for more than 90 percent of the country's total export earnings. Diamonds are by far the dominant export product as they alone still account for more than 75 percent of total export earnings.

Botswana's growth prospects depends thus mainly on its ability to manage mineral resources revenues. Botswana's exports of primary commodities have significantly contributed to the country's economic growth. To illustrate this, we can see from Table 4.13 that the main export products of the economy, namely, beef and minerals accounted for about 44 percent of GDP in 1980. By 2004, their share had declined only marginally and was still about 36 percent. Moreover, these products generate the lion share of foreign exchange of the country through their export value. More importantly, the revenues from export of these primary commodities contributed to more than 60 percent of government revenues, enabling the Botswana Government to finance both recurrent and development expenditures as well as the financial assistance policy (FAP) which was meant to initiate industrial development (Sentsho, 2002). They also allowed the country to accumulate foreign exchange reserves of well over 36 months of import coverage.

The accumulation of foreign exchange permitted a good economic management, enabling the government to smooth growth between years of export booms and years of meagre revenues. Indeed, in years of economic booms, when exports revenues were high, the surplus export earnings were converted into foreign reserves to avoid overheating the economy, while in years of low export revenues, which may have led to negative growth rates, government has usually drawn from the reserves to finance economic growth and development. As a result, economic growth has been relatively high over the whole range. This shows that when properly managed, export revenues from the primary sector can lead to sustained economic growth.

6.2.1 GDP Historical Background

At independence from Britain in 1966, Botswana was among the twenty-five poorest nations in the world, but the country's economy has ever since been steadily growing thanks to the discovery of large diamond deposits in Orapa by De Beers in 1967. Between 1966 and 1989, it was the world's fastest growing economy. Botswana's real Gross Domestic Product (GDP) grew at an average of 13.9 percent per annum between 1965 and 1980, at an average of 11.3 percent between 1980 and 1989, and at an average of 4.75 percent between 1990 and 1998 (The World Bank, 1991; 1998; and 2001).

The Bank of Botswana's data shown in figure 6.1 indicate that nominal GDP has constantly been growing at double digit rates except in 1999 when it fell to 6.8%. By 1989, the country was ranked as a lower-middle income economy and in 2004, income per capita had reached USD 9,200 (PPP adjusted) and Botswana was already considered an upper-middle income economy (World Factbook, 2006). The adjusted per capita income has since grown to over USD 14,000 in 2006 (Economist Intelligence Unit, 2008). General political stability and freedom from corruption has facilitated sustained development. Export of diamond and other minerals was the main contributor to the growth in Botswana's economy and still accounted for around 36% of GDP in 2004. The contribution of Diamond and Copper-Nickel to total export varied between 70 and 90 percent in the 1980s and is still the most important source of government revenue today.

The discovery of diamonds in 1967 in the Orapa region was a turning point in Botswana's economic development. There are three main diamond mines, Jwaneng in the southern Kalahari, and Orapa and Letlhakane in the central Kalahari, whose combined earnings have accounted for 77% of the total export earnings and 45% of the GDP. More recently, a small new diamond mine in Damtshaa, 20 km east of the existing Orapa mine and also operated by Debswana, started production in 2002 (Economist Intelligence Unit, 2008). These mines are jointly owned by the DeBeers mining company and the Botswana government. The initial agreement with DeBeers over the Orapa diamond mining project was made when the Botswana government

TABLE 6.1. Botswana growth performance 1993-2003

	GDP at current market prices	GDP growth excluding mining	GDP growth at const 1993 prices	Growth at const prices excl. mining
1993	20.1	17.4	4.0	3.5
1994	11.1	14.6	3.2	5.8
1995	15.8	15.9	5.5	6.1
1996	24.9	15.2	5.6	5.5
1997	13.7	15.4	8.1	7.3
1998	6.8	18.7	4.1	7.8
1999	15.9	11.6	6.6	4.0
2000	14.8	12.1	8.6	4.1
2001	11.5	11.5	2.1	5.1
2002	13.8	14.6	6.7	4.8

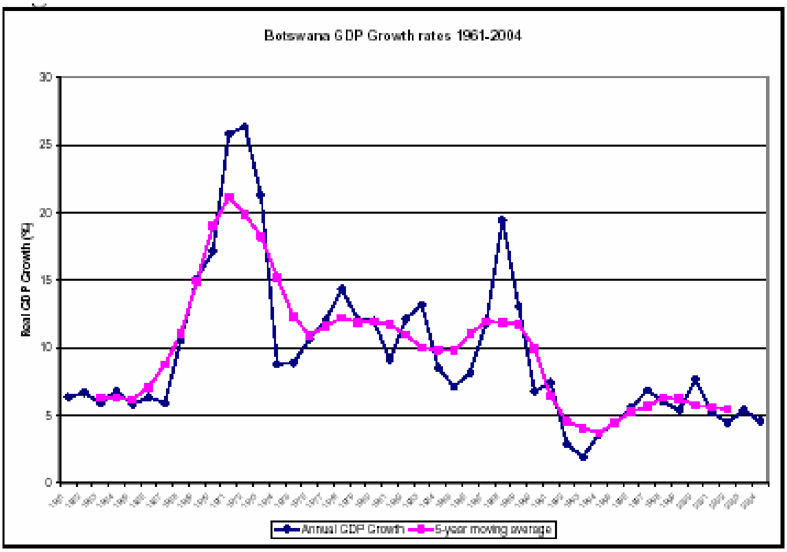
Source Bank of Botswana

was in a relatively weak bargaining position in the face of the South African diamond and gold giant and granted to the Botswana government only 15 percent shareholding and dividends, a 10 percent royalty over sales, and 35 percent company tax on profits of the DeBeers Botswana Mining Company[1]. This agreement was renegotiated by the Botswana government in 1975 to give a 50|50 shareholding in a jointly held company, later renamed Debswana, with the government getting an estimated 75-80 percent of profits. By value of diamonds, Botswana is the world biggest producer, and second only to Australia in terms of diamond volume, with an annual output of 15 million carats, reaching 15.5 million carats in 1994 and 33 million carats in 2006 (Debswana Annual Report, 2005, EIU 2008).

6.2.2 Economic Growth and Human Development

As already illustrated in Table 6.1, Botswana achieved high average real GDP growth rates since the discovery of diamonds in the years that followed its independence. Growth accelerated significantly after independence, and was at its highest in the decade of the 1970's. It peaked in the early 1970's, with annual real GDP growth rates of about 26% in 1971 and 1972. The exceptionally high growth rates of the 1970's in which annual growth was in double digits in eight years of the decade, are particularly striking in the light of the general world slowdown in growth relative

[1] This was the name of Debswana before 1991.



Sources: World Development Indicators and Botswana CSO

FIGURE 6.1. *Botswana's annual growth rates and 5-year moving average 1961-2004*

to the 1960's. As can be read from Figure 6.1 which plots the yearly growth rates and the 5-year moving averages, growth remained high in the 1980's, with the lowest annual growth rate during any year of the decade being 7.13%. Growth however slowed significantly from the 1990's until the present.

Moreover, as Tregenna (2006) remarks, whereas Botswana's economic success has been mainly characterised by spectacular growth rates, its developmental record has been less impressive. The 2005 Botswana Human Development Report notes that employment generation has not kept pace with economic growth: while real GDP grew by 5% per annum between 1991 and 1999, formal sector employment grew by only 1.6% per annum from 222 800 people in 1991 to 255 607 in 1999, representing a poor growth to employment conversion rate of 3.1 percentage points of GDP growth to one percentage point increase in employment. Formal sector employment grew at 4.9% per annum between 1997 and 2001, declining to 1.8% between 1999 and 2002. Additionally, Botswana is amongst the most unequal countries in the world and more than 50% of the population was still living under 2 USD per day in 2004 (UNDP 2005). The ratio of the share of income or consumption of the richest to the poorest decile is 77.6%, the fourth highest of the 123 countries for which data is available.

Despite well known reports of this success story, consensus seems to have emerged that Botswana's problems of poverty and unemployment are ultimately structural. One of the frequently cited reasons for this is that outside mining, Botswana's resource endowment is factually very poor. In particular, the climate and the soil are not suited to the small-scale agricultural methods such as those used in Botswana. Moreover, with 1.7 million people, the market is too small to support employment creation on the scale required to make rapid progress against poverty and unemployment. The small market size limits the nature and size of firms setting up in Botswana and so influences Foreign Direct Investment (FDI) inflows, technology transfer and growth. Botswana is landlocked, which creates high export and import costs because road haulage and air transport are considerably more expensive than shipping. Finally, the size of the country and sparse distribution of the population make service provision to this fragmented market difficult and costly.

Another serious challenge to Botswana's development is the worsening infant mortality and life expectancy as a result of high incidence of the HIV/AIDS pandemic. According to UNDP (HDR, 2005), life expectancy in Botswana has declined to 36.3 years, which is just a little more than half of the mean life expectancy for middle income countries. Life expectancy in Botswana is predicted to fall further below 30 years by 2010, by which time two out of five children are expected to be AIDS orphans (IMF, 2001).

Several explanations have been offered for the relatively poor development records that sharply contrast with good growth statistics. For example Good (2005) attributes it to the relative neglect of rural development by the political elite after independence, who preferred to emphasise mineral development and postponed rural development. This has led to a considerable decline of the condition of arable agriculture and a worsening of the condition of the rural poor. Meisenhelder (1994) argues that the income gap between rich and poor grew along with economic growth. He cites several studies from the 1980's demonstrating the neglect of the poorest: the rural areas received only one third of development spending[2] despite having eighty percent of the population. He argues further that government economic policies have enriched state officials and the cattle elite, served the interests of South African capital, and reinforced dependency in Botswana. According to him, the benefits of the diamond bonanza for the majority of the population have been limited.

[2] For Botswana, development spending in the national budget comprises investments and spending on social services (including investments on education, health facilities and services, housing & urban infrastructure and poverty alleviation programs) and spending on economic services, such as public infrastructure and utilities(roads, railways, electricity and water), agriculture development, industry promotion and other economic development projects.

Jefferis and Kelly (1999) also point to several reasons as to why Botswana's rapid economic growth has not reduced poverty more effectively. As a first explanation, they indicate that the mineral-led nature of this growth has led to little direct job creation and an inadequate diversification of the economy. The second factor is the lack of adequate income for the agricultural sector. The third reason is the fact that the formal sector has been unable to absorb labour market entrants as well as those leaving traditional agriculture. For his part, Hope (1998) explains poverty in Botswana in terms of grossly skewed distribution of income and the lack of potential for income generation, particularly deriving from high rates of unemployment. Additional sources of poverty that are often pointed out include the unequal distribution of access to and control over assets; low capabilities both as a cause and a consequence of poverty; high population growth; the low population density and remoteness of many communities; government policies and spending decisions that favour certain groups (such as cattle farmers) over others (such as rural female-headed households); and certain social organisations, beliefs and practices such as patriarchy, fatalistic cultural beliefs, extended family obligations and discriminatory attitudes against some ethnic minorities.

Further, the scale of the pandemic is also a questioning of Botswana's institutional character and quality. As discussed earlier in this chapter, some authors (including Acemoglu et al., 2003) have been eager to give credit to Botswana's institutions for its growth performance, yet these much-vaunted institutions have been unable to deal in time with perhaps the greatest crisis that has faced the country. It was only from around 1998 onwards that the country began to deal systematically with the HIV/AIDS issue (there is currently a comprehensive programme in place, including provision of anti-retroviral medication). However, the fact that infection rates were allowed to escalate to their current levels does suggest that Botswana's institutions may not be as conducive to success as they are often portrayed to be (see Tregenna, 2006).

6.2.3 Sectoral Diversification

Given the central position taken by mineral wealth in Botswana's success, it is relevant to ask to what extent Botswana has managed to diversify its economy over time and to integrate the mining sector with the rest of the economy. This is relevant both in terms of the sustainability of Botswana's growth, and in terms of the pervasiveness of this growth. The Botswana experience also represents a challenge to the "resource curse" and Dutch disease literature.

The Botswana government has deliberately attempted to promote diversification, both through sector specific and general economic policies, such as a concessionary tax rate and various incentives such as wage subsidies. The Botswana's Industrial Development Policy (IDP) published in 1984 was intended to advance economic growth and independence, diversify the economy away from minerals and cattle, and promote social justice just like many other National Development Plans in various countries. Yet, there has not been substantive diversification beyond mining and services, with the manufacturing and agricultural sectors actually shrinking further in recent years. Further, the mining sector is not well integrated with the rest of the economy through forward or backward linkages although the government is encouraging downstream activities in the diamond sector (see sub-section 6.2.5).

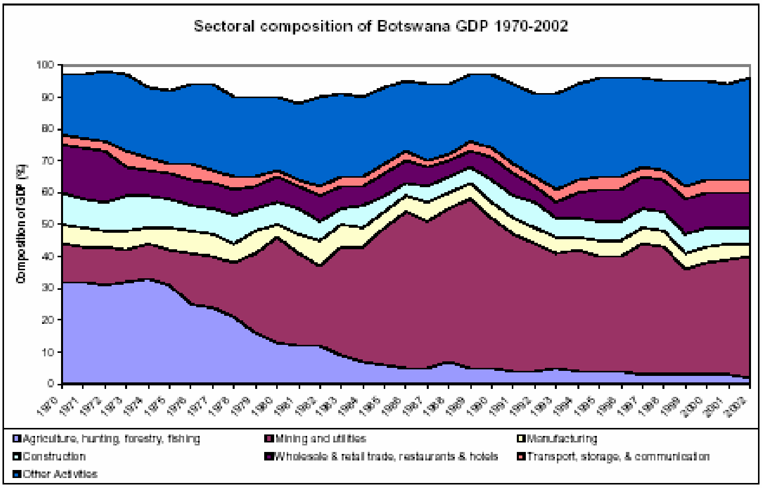
Figure 6.1 shows the evolution of sectoral composition of Botswana's GDP in the post-independence period. Several observations can be made from the displayed numbers. The most striking feature is the declining share of agricultural output, from 42% of GDP in 1966 to 5.6 % in the 1980s and further to just 2.4% in 2004/2005. Although the real value-added by agriculture almost tripled between 1966 and 2005, its relative contribution to the total GDP has been reduced to insignificant proportions. Secondly, the phenomenal growth of the mining share in the economy, which came to dominate the country's GDP since 1966 to present. From a share of GDP of 0 % in 1966, the share of mining activities went to a peak of about 49 % in 1988, and is currently at about 40%. Debswana, the diamond company owned in equal parts by the Government of Botswana and South African De Beers, currently produces more than 75% of Botswana's export earnings, 36% of GDP and 50% of government revenue, and is the largest employer outside the public sector.

The share of manufacturing is consistently low and has actually been declining somewhat. From a relative share of 5.7 % of GDP in 1966, manufacturing contribution to GDP has come down to just under 4% in 2004 and 2005. Although in absolute terms the value added of manufacturing grew about 27- fold in real terms from 1966 to 2005, this consistently low and falling share of GDP is a critical issue, since it underscores the country's difficulties to diversify the economy. Finally, the share of services is exceptionally high and rising, reflecting among other things the development of the tourism industry. The share of agriculture in GDP has thus completely collapsed since independence, while the share of manufacturing never really became significant (although both sectors did grow significantly in real terms). By 2004 the combined share of agriculture and manufacturing value-added in GDP was a tiny 6.6%.

TABLE 6.2. Repeated table 4.1:Botswana GDP decomposition per economic activity in selected years

GDP by economic activity in selected years					
Economic activity	1966	1975/76	1985/86	2000/01	2004/05
Agriculture	42%	20.7%	5.6%	2.6%	2.4%
Mining	-	17.5%	48.9%	36.5%	35.9%
Manufacturing	5.7%	7.6%	3.9%	4.1%	3.9%
Water& Electricity	0.6%	2.3%	2.0%	2.4%	2.5%
Construction	7.8%	12.8%	4.6%	5.8%	5.6%
Hotel, restaurant & Trade	9.0%	8.6%	6.3%	10.3%	10.5%
Transport	4.3%	1.1%	2.5%	3.8%	3.5%
Bank, insur.& bus services	20.1%	4.7%	6.4%	10.9%	10.9%
Central Government	9.8%	14.7%	12.8%	16.0%	16.4%
Social and personal services	-	2.8%	2.5%	4.0%	4.0%
Tot. GDP at const. pr (mln P)	908.6	2,083.5	5,708.2	16,524.4	19,661.2
GDP excl mining (mln Pula)	908.6	1,718.1	2,917.3	10,497.1	12,607.3
GDP per capita (Pula)	1682.5	2,861.9	5,175.0	9,793.4	11,112.6
Real GDP growth	-	18.4	7.7%	8.4%	5.6%
GDP growth excl. mining	-	11.8	11.6%	4.0%	4.3%

Source: Central Statistics Office



Source: Central Statistics Office, Botswana.

FIGURE 6.2. *Botswana's sectoral diversification 1970-2002*

Overall, in terms of shares of GDP, we thus see a low and declining manufacturing sector, a surge of the services, but essentially a plummeting of the shares of agriculture and the dominance of mining. Although Botswana's agricultural activities might be expected to be relatively low given its adverse climactic conditions, it has traditionally had a very strong livestock sector and agriculture's current contribution to GDP value added of just 2.36% is very low in both absolute and comparative terms.

6.2.4 Economic and Institutional Explanations of Botswana's Growth

Bonanza Development to Beat the Resource Curse

Most of those who studied Botswana's development experience have ascribed its diamond-fuelled economic success to the particular features of the country's institutions. For example, Acemoglu, Johnson and Robinson (2003) give an extended explanation for Botswana's economic success and emphasise institutional factors that they trace back to historical times characterised by leadership accountability and participation in the decision making by the constituencies through the so-called Kgotla or popular assemblies. Hope (1998) also advances what he considers to be the key explanations of Botswana's success as lessons of development, in particular for the transition economies of sub-Saharan Africa. First, he stresses the importance of "good governance": political accountability, bureaucratic transparency, the exercise of legitimate power, political freedom and human rights, sound fiscal management and public

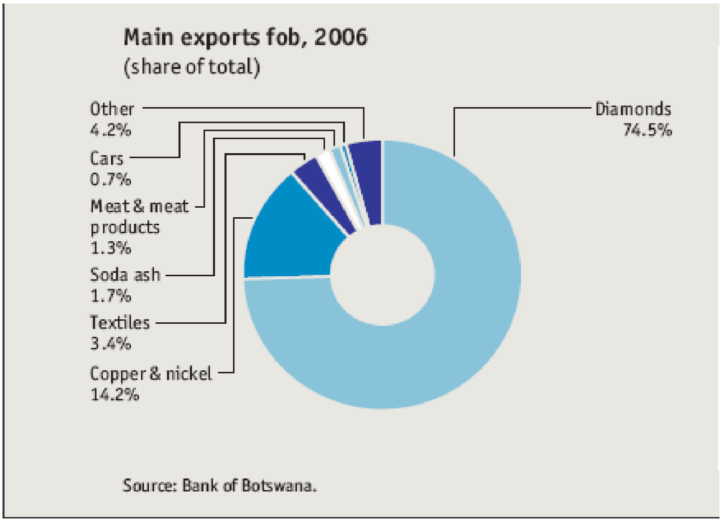


FIGURE 6.3. *Botswana's export composition, 2006*

financial accountability, respect for the rule of law and a predictable legal framework, an active legislature, enhanced opportunities for the development of pluralistic forces, and capacity building and checked down corruption and rent seeking activities. Further, he underscores the importance of institutional development and capacity building, so that the state has effective implementation capacity and can control and manage external debt within the national capacity to service such debt. Finally, Hope argues that the Botswana experience underscores the importance of high rates of domestic saving and investment and the need for outward-oriented export promotion and economic diversification strategies. As for Meisenhelder (1994), he explains Botswana's growth by Becker's (1983) theory of "bonanza development", in which a "new bourgeoisie" of managers and technical specialists, a class that is potentially hegemonic, emerges and rises to dominance of the economic power and articulates the national and international political economies in a non-dependent fashion. The Bonanza development strategy features thus the use of state power and entrepreneurship to tie the export sector to the rest of the economy, and of state export-derived revenues to provide co-optative benefits to mobilized popular groups. Becker's bonanza development theory suggests that mining sector makes a major contribution to foreign exchange earnings and to capital accumulation, particularly for financing industrial development as well as financing the required political co-optation to keep the regime in power. According to this theory, the presence of natural resource bonanza in a country gives rise to the emergence of new elites of modern entrepreneurs who spearhead the country's development (Kay, 1989).

Meisenhelder points to several aspects of Botswana's trajectory consistent with the bonanza development theory: the centrality of diamond exports to Botswana's economy; there was a conscious strategy to maximise surplus from mining from which state revenues are derived and cautiously used; and the active solicitation of foreign investment by Multinational companies in mining. Further, bonanza development allowed the state to productively use a portion of the surplus from mining as a substitute for direct linkages between mining and other sectors, resulting in some diversification and employment creation, and the emergence of a working class.

Meisenhelder (1994) then suggests that other characteristics of Botswana's development are more consistent with the thesis of dependent development, given the persistence of inequality in Botswana and its continued dependence on South African capital. This is reinforced by Botswana's policy emphasis of promoting foreign investment and mineral exporting as the primary machines of economic growth. He thus characterises Botswana's trajectory of bonanza development as featuring both growth and dependency, with the growth itself being conditioned by the country's dependency as manifested in increasing inequality. He argues that the economy remains "disarticulated" in that diamond mining produces little employment and is not well integrated with the rest of the economy. Botswana's vulnerability to price fluctuations in the diamond market makes it potentially less self-sufficient and thus bound to maintain dependency links.

Viewed in the context of the Dutch disease literature, Botswana would at first sight appear to be a recipe for economic disaster: a single natural resource, whose exploitation is capital-intensive and virtually exclusively for export, with little actual or potential up- or down-stream linkages with the rest of the domestic economy, with domestic ownership both absolutely concentrated and in state hands. From the Dutch Disease and resource curse literature, this could be expected to have effects such as an overvalued exchange rate, political mismanagement and corruption, wasteful and non-sustainable investment projects, diversion of existing human resources into the minerals sector and underinvestment in broader human capital formation, and a squeezing and constraining of the manufacturing sector; all of which would depress growth rates.

Botswana appears to have avoided some of these effects, and it has certainly avoided the growth impeding ones. Sarraf and Jiwanji (2001) examined Botswana's policies in the light of the resource curse literature and suggest explanations as to how Botswana has managed to “beat” the resource curse. According to Sarraf and Jiwanji, the country avoided the effects of resource curse by managing the nominal exchange rate to avoid real currency appreciation and by accumulating international reserves and running budget surpluses during boom periods for use during lean periods, which reduced inflationary pressures and also meant that government could avoid radically cutting expenditure during downturns. The authors argue that these policies enabled Botswana to avoid the problems typically associated with export booms, and hence to sustain high growth rates.

A synoptic review of the various factors presented in the literature to explain Botswana’ success allows to identify, in addition to the mineral wealth that makes up the lion share of the country’s revenues, five main aspects as alternative explanations of growth and development: the lack of full-fledged colonisation, inflows of foreign aid and investments, political and institutional climate and finally the proximity and interactions with South Africa. We briefly discuss each of these factors in turn.

Soft Colonisation and Smooth Transition to Independence

For Acemoglu et al. (2003), the relative “benign neglect” of the Botswana territory by the British colonists resulted in a limited extent of colonisation that allowed the country to avoid devastating effects of colonial exploitation and placed it in a stronger position for growth relative to other SSA countries at independence. As indicated by Tregenna (2006) colonisation tended to distort the entire production and distribution structure of the colonies to meet the requirements of the coloniser. For example, transport networks in other colonised SSA countries were geared towards exporting the raw materials of the colony to be shipped to the colonial metropolis. These distortions usually tend to persist after independence, thereby hindering the country’s ability to pursue their own autonomous national development paths (Acemoglu et al., 2004). The absence of such distortions meant that, upon independence, Botswana was in a relatively better position relative to other countries that emerged from their colonial experiences handicapped for subsequent economic development.

In the first place, Botswana largely avoided the destruction of its social fabric as occurred under colonialism in other areas. The country was therefore able to retain its natural resources without their being stolen by the coloniser. Moreover the country was not fully converted into an export market for the coloniser, with implications for the domestic market after independence. More importantly, unlike most other countries on the continent, Botswana did not undergo a liberation struggle to free itself from colonialism. Such struggles were extremely costly to those countries where they took place, both in terms of loss of human life and destruction of infrastructure and the means of production. Further, the fallout from and repressive responses to liberation struggles were destructive in terms of social relationships and cohesion, especially in cases of large-scale displacement, break-up of communities and the like (Tregenna 2006). Botswana's independence was granted by Britain without a period of intense political or military conflict. This arguably spared Botswana from many of the negative destructive and divisive effects of such struggle. Botswana also did not undergo a national liberation struggle from minority rule as in some other Southern African countries like South Africa or Zimbabwe. The absence of such upheavals in the case of Botswana allowed for the political and economic stability conducive for growth.

Additionally, the inexistence of revolutionary traditions in Botswana can also partly explain the relative absence of political turmoil after independence. This arguably allowed the state to foster the political stability conducive to attracting foreign investment and enabled it to pursue a relatively elitist accumulation path without facing strong opposition and mobilisation of the population. Further, the absence of a fully-fledged anti-colonial or national liberation movement in Botswana has possibly influenced the pro-western, pro-market orientation of the policies adopted after independence. Indeed as a consequence of the smooth transition to independence, there was neither a body of intellectual thought nor a mass mobilisation in favour of socialism, as in a number of other African countries emerging from colonisation or minority rule, or even necessarily a strong commitment to "social justice" in some progressive sense. This might have contributed to the rather elitist character of accumulation in Botswana, as still appears in the high levels of inequality and failure to share the gains of high growth more broadly. These factors would suggest that Botswana's gaining of independence without undergoing a liberation struggle both contributed to its subsequent high growth, as well as influencing the nature of that growth trajectory.

Aid and Foreign Investment

Botswana's growth has also greatly benefited from large inflows of foreign aid and investment funds. This can be partly explained by the fact that it was highly receptive to foreign aid and investment, whereas some other countries were more sceptical. Botswana was an attractive destination for donors and investors due to its political stability and pro-market, pro-Western outlook. Further, it attracted donor funds initially as the only non-racial liberal democracy surrounded by minority ruled states in Southern Africa. Particularly in its early stages of development, Botswana was highly dependent on large inflows of both donor aid and foreign direct investment. These were critical in getting the economy started and in the initial investments to start the mining operations.

The aid that Botswana received was relatively high as a percentage of GDP until the late 1980's. Although having declined from a peak at just 30% in the year of independence was still a multiple of the rate other country received. As a percentage of gross capital formation, aid was high even though declining in the 1960's, until 1980's it was still high relative to low and middle income countries and to Sub-Saharan Africa, and only declined to a level of just 1.45% of gross capital formation by 2003. Moreover, as discussed above, even in its receptiveness to foreign aid and investment Botswana was careful to retain some influence and autonomy for example, in requiring donor projects to fit into its own national development plans. Donors are obliged to channel their funds into projects that have already been identified as national priorities in the plan. This arguably allowed Botswana to capture some of the benefits of these flows while minimising their negative distortionary and autonomy undermining effects.

Role of the State

The analysis of the policies pursued by the government of Botswana clearly shows the central role of the state in its growth performance. Maundeni (2001) attributes Botswana's success to what he terms an "indigenous initiator state culture" that endured through the protectorate stage and was inherited by the post-colonial state elites[3]. This facilitated an indigenous developmental state in which "executive" state powers were promoted. The leading role the state played in the accumulation strategies can be considered as one of the central factors explaining Botswana's high growth rates. It seems thus clear that without an active, decisive, and growth-oriented state, Botswana could not have attained the growth rates that it has been able to achieve.

Throughout its economic growth record, the Botswana government was highly active in economic planning. At independence, the government nationalised what was virtually the only form of industry, the single abattoir at Lobatse. The Ministries of Finance and of Development Planning were combined and located at the centre of state power. The strength and competence of the bureaucracy gave the state a high

[3] The emergence of the political elite in Botswana, from the colonial period until the modern times is extensively discussed by among others Meisenhelder (1994), Maundeni (2001) and Acemoglu, Johnson and Robinson (2003). Recent information about political elites and the political situation can be obtained from the Economist Intelligence Unit.

implementation capacity. In the planning system Central targets and ceilings for the public sector were set around skilled labour, recurrent expenditure, and development expenditure. Describing Botswana's growth as a free-market success story would simply be ignoring the reality of Government interventions and its central role in the whole development process. Even Acemoglu et al. (2003) who stress the importance of institutions, note that there was "massive government intervention in the economy, detailed planning, and central government expenditure... well above the African average" (Acemoglu et al., 2003, p. 4).

Further, in 1972 the Government adopted the National Policy on Incomes, Employment, Prices and Profits. One of the aspects of this policy was to establish government as the wage and salary leader in the economy, in terms of both the structure and level of wages. The resulting pro-business labour conditions may have contributed to Botswana's growth rate by maintaining low wages and enhancing profitability, as well as increasing the attractiveness of Botswana for foreign investment relative to some of its neighbours. To some extent a parallel can be drawn between these labour conditions and those in the East Asian Tigers during their rapid growth phase. However, in the latter countries, the benefits of growth were much more widely shared, with growth being relatively egalitarian and associated with rising wages and living standards. In the case of Botswana, however, labour conditions seem to have been associated with a relatively elitist growth path.

Another aspect of Botswana's active industrial policies regards the strict rules allowing only approved companies to bid for government contracts. Although Botswana's fiscal policy is generally characterised as conservative, the rate of increase in public spending has consistently outstripped economic growth. Since 1990, when Botswana has shifted to a more market-oriented strategy, growth rates have actually slowed down. While this is not enough to suggest a causal relationship, it shows at least that the shift to a less central role by the state has not increased growth. Nevertheless, Botswana continues to plan in a fairly comprehensive fashion. The ninth National Development Plan sets out detailed reviews from the NDP8 and plans for the period 2003 to 2009 in economic policy, human resource development, science and technology, the public sector, finance and banking, trade and industry, works, transport, communications, energy agriculture, mineral development, water resources, national parks and tourism, education, health, land management, housing, culture and social services, and various other areas.

Botswana's Relationship with South Africa

Given the strong interwovennes between Botswana's and South African Economies it is worth considering to what extent and in what ways Botswana's political and economic relationship with South Africa, and it geographic proximity, affected Botswana's growth trajectory(see also Habiyaremye, 2007 for the effects of South African trade and investments on Botswana's growth and diversification). Particularly in its early stages of growth, Botswana was dependent on South Africa in various ways. Until 1976, Botswana's monetary policies were directly controlled by the South African government through Botswana's membership of the Rand Monetary Area. Until today, the strong presence of South African Banks in Botswana's financial sector is highly visible. It can also be suggested that one of the reasons for the stunting of Botswana's manufacturing sector was the dominance of South African exports within the Southern African Customs Union (SACU). The manner in which Botswana managed its relations with the foreign private sector in mining was also advantageous.

Notable is also that it was mainly South African companies that extracted Botswana's mineral reserves. As mentioned in section 6.2 the initial agreement with De Beers over the Orapa diamond mining project, made when the Botswana government was in a relatively weak bargaining position, gave the latter 15 percent shareholding and dividends, a 10 percent royalty over sales, and 35 percent company tax on profits of the De Beers Botswana Mining Company (which was later renamed Debswana in 1991) and was renegotiated by the Botswana government in 1975 to give a 50|50 shareholding in a jointly held company, Debswana with the government getting an estimated 75-80 percent of profits. This could be thought of as a negotiated "nationalisation" of part of the operations, and certainly enhanced the benefits of Botswana's mineral resources for its economic growth.

Politically, Botswana opposed the Apartheid system in South Africa and did suffer some destabilisation as a direct result of this (for example cross-border attacks on ANC cadres based in Botswana). However, Botswana did not provide a similar level of support nor suffer anything near the scale of destruction and destabilisation as other countries in the region. This probably contributed to its attainment of comparatively higher growth rates. Although Botswana disagreed fundamentally with the racist policies of the then Apartheid South Africa, South West Africa and Rhodesia, trade and business relations were maintained.

A remarkable feature in these relationships is that Botswana was able to achieve growth rates far outstripping South Africa's, to such an extent that Botswana currently has a higher per capita GDP as well as better development indicators than does South Africa. The explanation to this arguably lies in the particular accumulation trajectory followed by Botswana. As argued above Botswana elites were able to pursue a narrow based growth path in which they may well have derived benefits from Botswana's semi-dependent relationship with South Africa, even though the relationship was not of benefit to the people of Botswana as a whole. Over time, and as it has built up its economic strength, Botswana has to a large extent emerged from the semi dependence relationship with South Africa.

6.2.5 Beyond Diamonds: Alternative Areas for Growth

Manufacturing

Because of the small size of the domestic market, manufacturing activity in Botswana depends to a large extent on the country's access to the South African market through its membership of the Southern African Customs Union, although more recently the textile and garment-making industry has developed through exporting to the US under the provisions of the African Growth and Opportunity Act (AGOA). During the 1990s, the establishment of an assembly plant for Hyundai cars encouraged expectations that a vehicle industry could be developed to supply the region. As a result, vehicles became Botswana's second largest source of export revenue from 1994 to 1999. However, production stopped in early 2000, when the South African group that ran the operation went into bankruptcy. Similarly, Volvo set up an assembly plant for vans and lorries in 2000, but had to close it in 2005, transferring the operations to Durban in South Africa, closer to the port of arrival of manufactured parts from Sweden and to its end customers.

Both the Botswana Export Development and Investment Authority (BEDIA) and the Botswana Development Corporation (BDC) assist manufacturing, and a concessional rate of 15% company tax for qualifying manufacturing companies provides a further incentive. However, a shortage of serviced land, high rents, utility and transport costs, and relatively low labour productivity are barriers to expansion, and local economists have questioned Botswana's potential to develop a sustainable competitive advantage in manufacturing, especially when competing against countries with plentiful cheap labour. The Pula devaluation in May 2005 was explicitly aimed at helping manufacturing, among other sectors, and the government continues to emphasise the potential for manufacturing development.

Among other areas that Botswana is most actively looking to develop, are those where the country has a clear comparative advantage: downstream diamond industry in cutting and polishing, tannery and leather products (which are by-products of the beef industry) as well as glass and jewellery manufacturing. In addition, the country is hoping to give a boost to its textile and garment industry, continues to nurture its tourism industry and get the information technology sector on track.

Processing Diamonds

The downstream diamond industry is being developed further too, in order to bring more value added of this product to the country. Botswana's Diamonds are marketed exclusively by De Beer's Diamond Trading Company (DTC), which is currently based in London. However, under the terms of the May 2006 agreement, the firm will move to Botswana, where the diamonds will be sorted and valued once the new headquarters currently under construction are completed. The establishment of DTC Botswana is a particularly significant step in the development of downstream diamond-related businesses in the country, which will also include a large "diamond park" that will concentrate in one place all the country's diamond-processing operations including cutting and polishing. The park is to be located close to both the new DTC headquarters and the Sir Seretse Khama Airport near the capital Gaborone, and construction was also expected to be completed by 2008. A major attraction for international diamond firms considering basing their operations in Botswana will be the security of supply from DTC Botswana. A number of prominent companies have already announced that they will open polishing and cutting plants at the diamond park. This brings the total number of firms licensed to process diamonds in Botswana to 15, with four factories currently in operation.

Textile Industry

Although the government has periodically tried to encourage the development of the textile industry, this is more because it is seen as a means of large-scale job creation than due to any obvious competitive advantage that the country may have in this industry. In fact, wages in Botswana are relatively high and all raw materials have to be imported so that production costs are not really advantageous. Currently, there are high hopes of further benefits from AGOA, which allows duty-free access for textiles, among other products, to the US market. In August 2002 AGOA was amended to grant Botswana a special dispensation to source raw materials from third countries, because of its small domestic resource base, and subsequently textile exports have grown very rapidly, albeit from a very small base. According to the Economist Intelligence Unit's estimation, the ending of quotas on cheaper Asian producers in early

2005 did not have an immediate negative impact on Botswana's textile production, since textile exports actually increased by 80% that year as production expanded, helped by the 12 percent currency devaluation. But the impact appears merely to have been delayed, and in 2006 textile exports fell by around 25 percent.

Services: Tourism and ICT Sector

Tourism: The government has identified environmentally sensitive, low-volume, high-price tourism as a potential source of growth, employment and economic diversification. Botswana's main tourist attraction is the unique wetland environment of the Okavango Delta, as well as three national parks and five game reserves that feature abundant wildlife. In January 2004, the industry received a boost when a report in the Washington Post newspaper ranked Botswana third in the top ten tourist destinations, citing its unspoiled wildlife.

Facilities throughout Botswana are generally of a high standard. There is a range of high-quality hotels, casinos and conference centres in Gaborone. Accommodation in the rest of the country is divided between hotels in the towns and tourist lodges and camps in the wildlife areas. The number of accommodation facilities including lodges, bed and breakfast but also self-service apartments, has grown rapidly, in large part owing to concessional loan finance provided by the Citizen Entrepreneur Development Agency. The development of tourism is however a sensitive issue because of extensive foreign ownership in the sector.

ICT: Given the government's intention to make Botswana the best location to do business in the Southern African region, it has outlined the objective of developing an adequate ICT sector to supply the necessary business services. The ICT sector is relatively young in the country, but the expectation is that the number of IT companies in Botswana is destined to increase significantly. In order to achieve this objective, the country has taken the initiative to build a second university in the most central part of Botswana (Serowe - Palapye area) devoted to strengthening the ICT capabilities in order to alleviate skill's shortage in the country. The ICT University will be a tertiary institute offering both formal and generic ICT courses at certificate, diploma and degree and masters level.

6.3 Mauritius' Growth Experience

6.3.1 Historical Background

Arab and Malay sailors knew of Mauritius as early as the 10th century AD, but the island was first discovered by the Portuguese in 1505 and first colonised in 1638 by the Dutch, who named it in honour of Prince Maurits of Orange. Mauritius was a strategic base for the VOC in the trade with East Asia and India, and was populated over the next few centuries by waves of traders, planters and their slaves, indentured laborers, merchants, and artisans. As the colony of Cape (in modern South Africa) began to grow in importance, the strategic value of Mauritius decreased and the Dutch abandoned the colony in 1710.

In 1715, Mauritius was claimed by the French who renamed it Ile de France. It became a prosperous colony under the French East India Company, and its current capital, Port Louis, was established and named in honour of King Louis XV, great-grandson and successor of the famous Louis XIV. The French Government took control in 1767, and the island served as a naval and privateer base during the Napoleonic wars. In 1810, Mauritius was captured by the British, whose possession of the island was confirmed 4 years later by the Treaty of Paris. French institutions however, including the Napoleonic code of law, were maintained. Even today, the French language is still more widely used than English.

The Mautitian population consists mainly of Indo-Mauritians (76%) creoles (18%), Fronco-Mauritians (5%) and sino-mauritians (4%). Mauritian creoles trace their origins back to the plantation owners and slaves who were brought to work in the sugar fields. Indo-Mauritians are descended from Indian immigrants who arrived in the 19th century to work as indentured labourers after slavery was abolished in 1835. The Indo-Mauritian community includes Muslims (about 17% of the population) from the Indian subcontinent. Franco-Mauritians control nearly all of the large sugar estates and are active in business and banking.

6.3.2 Growth Performance and Economic Accomplishments

As already mentioned in the introduction to chapter 4, Mauritius has accomplished an industrial performance defying even the most optimistic expectations, despite a host of unfavourable initial conditions. Its successful diversification strategy and pro-growth institutions enabled it to be resilient to economic shocks and become the SSA leader in terms of transition from commodity dependence to industrialisation.

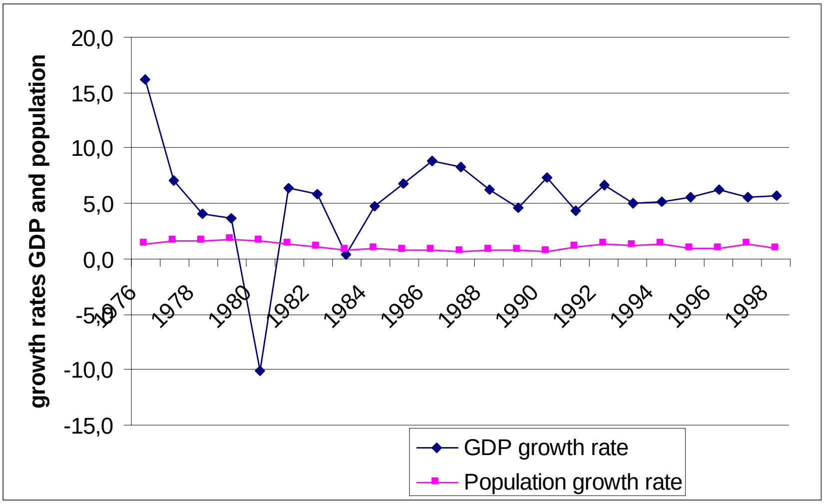


FIGURE 6.4. *GDP and population growth rates in Mauritius, 1976-1998*

Mauritian growth experience has been very spectacular in comparison to its African neighbours. Mauritius grew at an average rate of 5.9% per annum between 1973 and 1999. The transition from low growth to high growth rates occurred in the 1970 and early 1980s and high growth records were maintained throughout the 1990s. This transition was mainly driven by the creation of Export Processing Zone (EPZ) in 1970, which had as purpose the diversification of export into manufacturing. This EPZ came to be dominated by the textile and clothing industry and has been in for much of the export growth performance of the country.

The growth in the 1970 was mainly intensive and occurred as a result of input factor increase with employment rate increasing by almost 36% while the investment was growing at almost 3% and the number of firms in the EPZ from 8 to 45 between 1970 and 1976 (Subramanian and Roy, 2003). Technological change and outsourcing were the main drivers of growth throughout the 1980s. This has led to an impressive growth rate of exports, reaching 32.4 percent in real terms at the end of the decade and employment reaching 90,000 units while the number of firms had gone to an all times high, surpassing the 400 mark. The accompanying sharp decline in unemployment rate has led to labour shortages and increases in wage rates during the 1990, which induced some of the Mauritian textile firms to seek cheaper labour cost locations in Madagascar and on the continent.

After the period of intensive growth in the 1970 and 80s, in which employment grew by about 5.2 percent per annum, growth has been principally driven in the

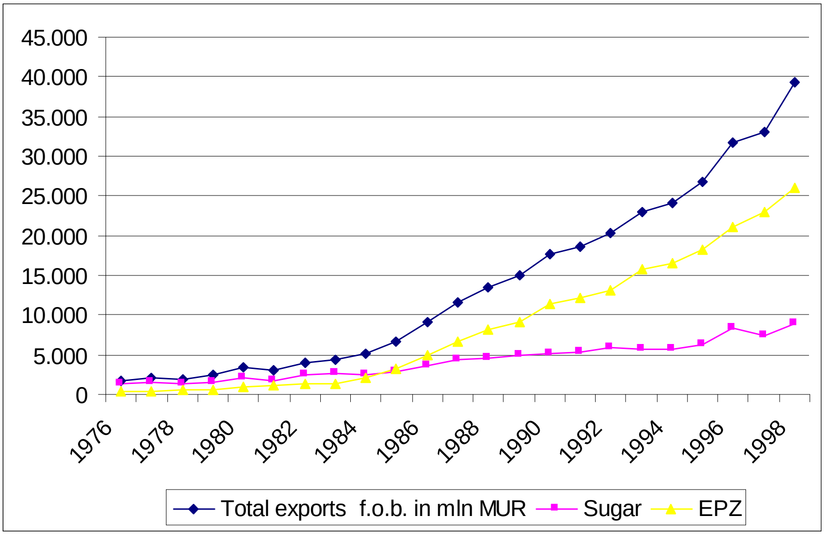


FIGURE 6.5. *Contribution of EPZ to export growth 1976-1998*

1990s by productivity improvement as a rational response to the rising wage level. Efficiency and high quality have thus been the trademarks of the Mauritian textile industry since that period. Moreover what distinguishes Mauritius from the rest of Africa is that this growth has led to appreciable improvements in human development indicators. Human capital accumulation through education has led to achieving universal primary education and high rates of enrolment in the secondary schools. Life expectancy at birth has increased from 62 years at independence to almost 73 years in 2004, the female life expectancy being even somewhat higher at 77 years in 2006 (World Factbook, 2007; see also figure 6.6 on the next page).

More importantly, the way growth has been shared is admirable. Inequality has tremendously declined as can be indicated from a reduction of the Gini coefficient from 0.50 in 1962 to 0.34 in the 1990 and further to 0.3 in 2005. This is partly due to the spectacular job creation in the EPZ textile sector which absorbed unemployment from early 1880s and reduced it from almost 20 percent in to less than 4 percent at the end of the decade. At the same time, Mauritius has been able to provide a level of social protection comparable to that of developed countries, comprising generous social security to civil servants and the elderly.

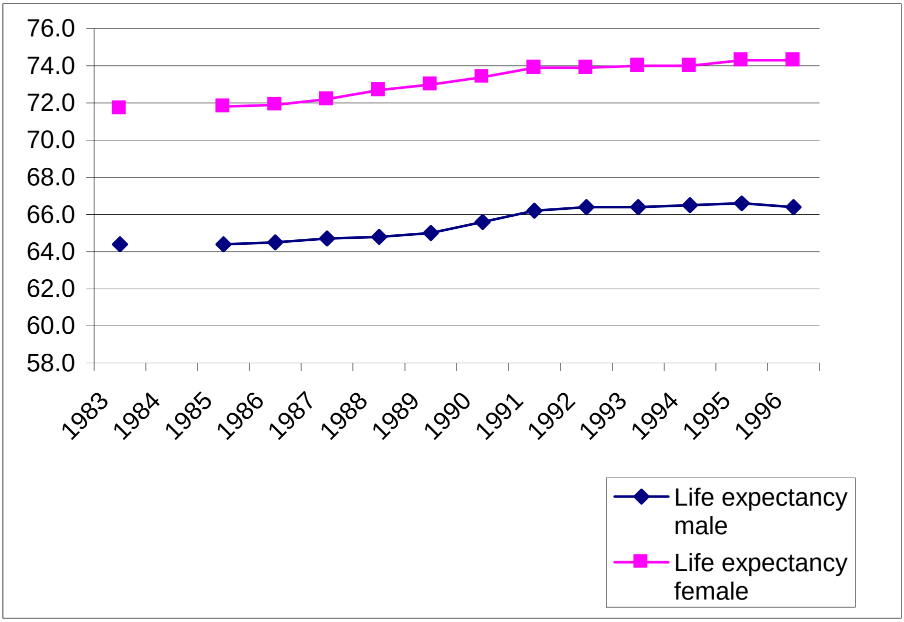
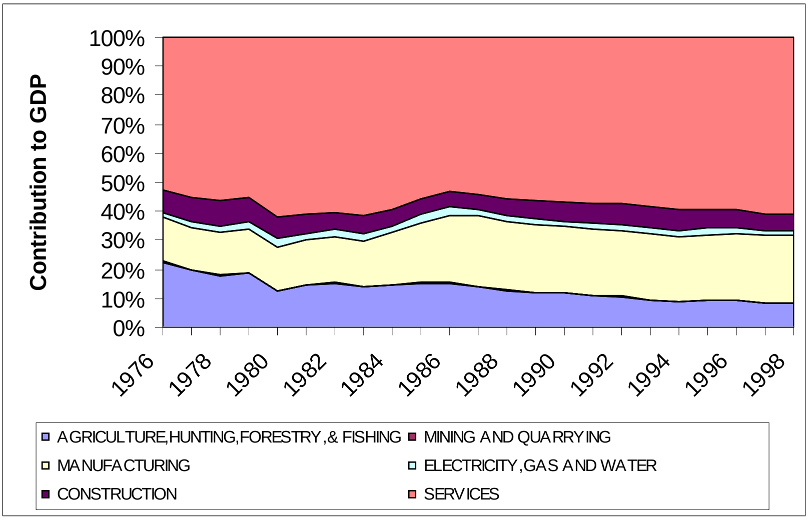


FIGURE 6.6. *Life expectancy for Mauritian men and women, 1976-1998*

6.3.3 *Sectoral Diversification*

As one can read from the Mauritian growth statistics and figure **??** above, the economy, once dependent on sugar plantations, received a diversification boost in early 1980s with the implementation of the EPZ act of the 1970s that attracted many textile and apparel companies to implant their activities on the island with favourable tax conditions. Indeed the textiles and apparel industry came to dominate the EPZ activities and accounts for 80% of investment and 90% of employment (Subramanian et al., 2003). The diversification process was pursued proactively by the government with the encouragement of investment in tourism and the financial service sector.

Notable characteristic of the evolution of sectoral composition is the gradual decline of the share of agriculture in the GDP compensated by a steadily increase in the share of manufacturing. In contrast to Botswana's reduction of the agriculture to insignificant proportions, however, the agriculture sector remains strong at about 9 percent, because as we will see below, Mauritius has continued to nurture its sugar industry, whose sugarcane plantations still cover 90 percent of arable land. The growth of the manufacturing and the service industries underscores Mauritian successful diversification, even though the EPZ industries have remained dominated by textile and clothing



Source: Mauritian Central Statistics Office data

FIGURE 6.7. *Mauritian sectoral composition of GDP, 1976-1998*

firms. The other constituents of the manufacturing sector are analysed in sub-section 6.3.6 in light of the effect of the phasing out of the MFA from the beginning of 2005.

6.3.4 Export composition

The strength of the manufacturing sector has resulted in a diversified export composition as presented in Table 6.3. Textiles and clothing have by far overtaken sugar as the main export product. The recovery of the EPZ sector begun in 2006 after the 2005 contraction, together with the EU sugar reform is likely to strengthen this trend[4] (Economist Intelligence Unit, 2008). Fishery and seafood products are another growing export area Mauritius has recently developed.These three product categories account for more than 50 % of export revenues as illustrated in Figure 6.8.

6.3.5 Economic Explanations of Mauritian Growth Success

As noted by Subramanian and Roy (2003), rents from sugar production have been crucial for Mauritius' development because they contributed to a sizable level of domestic savings. The authors estimate that rents from preferential access to the EU

[4] The EU sugar reform implies among other things a progressive reduction of the guaranteed price and will therefore affect the value of Mauritian sugar export revenues.

TABLE 6.3. Mauritius'export composition: 2004-2007

Year	2004	2005	2006[a]	2007[b]	*%change*
Export (fob, MUR mln)	54,905	63,219	74,037	69,482	-6.2
Domestic export	43,676	42,104	47,638	50,289	5.6
-Sugar	9,631	10,536	11,198	9,269	-17.2
-Clothing	23,386	19,534	21,999	24,794	12.7
-Fish	2,250	3,168	5,016	6,104	21.7
Re-export	9,028	16,661	21,328	13,753	-35.5
-Machinery & transp eqpt	2,338	9,194	11,937	3,905	-67.3
-Ships stored & bunkering	2,201	4,124	5,071	5,440	7.3

a: revised values; b: provisional values

Source: Central Statistics Office, Mauritius

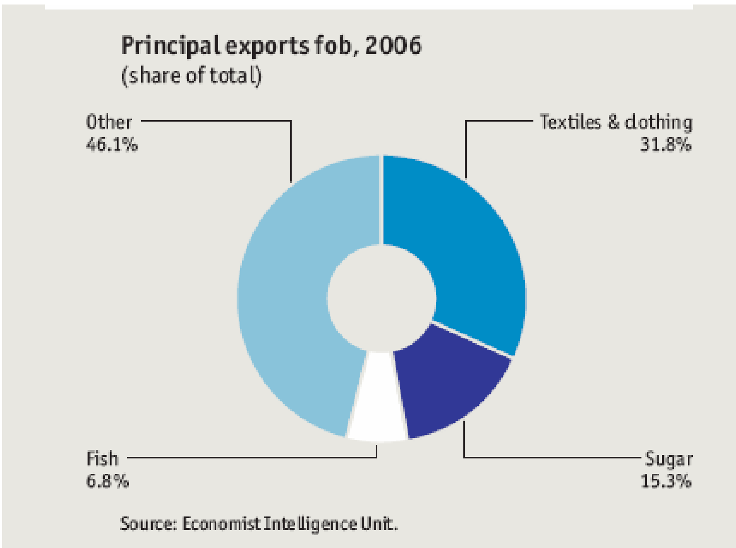


FIGURE 6.8. *Mauritius' export composition, 2006*

sugar market and to the clothing market have together amounted to 7 percent of GDP in the 1980s and 4.5 percent of GDP in the 1990s. As a result, these rents enabled Mauritius to maintain a high level of domestic investments, in such a way that in the periods of growth booms, domestic rather than foreign savings financed industrial expansion. In addition, sugar barons were the main investors in the EPZ sector where they own the majority of firms either directly or through a complex web of businesses, reminiscent of the Keiretsu or chaebol structure. The wealthy owners of the sugar industry (Franco-Mauritians) have used their privileged position and corporate links with commercial banks to raise credit funds to finance both the EPZ and the tourism sectors.

Moreover, Mauritius has benefited from international business network links and co-ethnicity derived from its small Chinese minority, which played an important role in attracting the first wave of foreign investment flows from Hong Kong into the textile industry. Overseas Chinese are a well-known example of the role of ethnic network in trade and international investment through their informal and formal societies to facilitate information flows and enforcement of contracts (Head et al., 1997). Likewise, the offshore banking and financial services sector owes much of its buoyancy to the co-ethnicity with India and the large presence of Indian diaspora on the island. This has been particularly relevant to such an extent that Mauritius has now become the major foreign investor in India.

Even though Mauritian growth was undoubtedly fuelled by its EPZ industries in the 1980s and 1990s, Mauritius has not had an open trade regime by conventional measures; as reminded by Subramanian and Roy (2003), it had a highly restrictive trade regime throughout much of its growth period. According to Rodrik (1999), Mauritian growth is mainly attributable to a policy of heterodox opening that ensured the returns to the export sector were high, and shielded this sector from the rest of economy to prevent the effects of restrictive trade regime to spill over to it. This heterodox approach had as a result that the returns to the export sector were high enough to avoid other domestic resources being diverted to its inefficient import competing sector. This was achieved mainly through the creation of EPZ with duty free access to all inputs, tax incentives to subsidise exports and the enactment of pro-business labour market conditions in the EPZ sector that gave employers a greater flexibility in discharging workers.

Through the lower wages that prevailed in this sector as a result of its high share of women employees (with lower minimum wages rate as compared to somewhat higher minimum wage for their male counterparts), the EPZ received an additional advantage, which has meant in practice that export could prosper without lifting the restrictions imposed to the trade regime. Indeed, the differential in wage rates between the EPZ sector and the rest of the economy remained high throughout the 1980s, with EPZ wages being 36 to 40 percent lower than in the rest of the labour market, and the gap narrowing to between 7 and 20 percent in the 1990s (Subramanian and Roy, 2003). The creation of EPZ by consequence generated new opportunities for trade and employment, but without taking the protection away from the import substitution sector.

Mauritian growth has thus been driven by separate incentives to both the import-competing and the export sector and was achieved through a high dose of state intervention on both sectors (Rodrik 1999). In that sense, Mauritius seems to have followed the *dirigisme* approach of Korea, Taiwan and Japan rather than the Washington consensus (Subramanian and Roy, 2003). This has been possible because of favourable and preferential access to US and European markets. These two markets have been essential to Mauritian development because they affected the two main export product Mauritius, namely textiles and sugar, accounting together for over 90% of the country's export.

6.3.6 Institutional Explanations

The role of institutional quality in the Mauritian growth experience seems to also have been substantial. For example, while the creation of EPZ in other African countries led to many failures as a result of the high opportunity of rent seeking offered by the high degree of selective intervention in this sector, the Mauritian EPZ has been an engine of growth because the well paid bureaucracy contributed to lower level of corruption, and hence, to lower transaction cost of doing business in Mauritius[5]. The good institutional quality is also credited for having enabled Mauritius to overcome its imbalances of the early 1980s because a culture of transparency and participatory politics (see Table 5.3) have ensured that early warning signals and feedback mechanisms were in place, allowing emerging economic problem to be tackled early (Gulhati and Nallari,1990). Able macroeconomic stabilisation policy allowed to keep inflation in check, reducing it from double digits levels at the end of the 1970s to a controllable level of around

[5]Subramanian and Roy (2003) explain how the instauration of a large, well-paid civil service staffed predominantly by the majority ethnic Indians, was achieved as as part of the political bargain between the political and economic elites which were mainly Franco-Mauritian owners of the sugar sector.

7% at the end of the 1999. This, together with a good management of the exchange rate, has enabled Mauritius to overcome the shocks to its economy provoked by sharp declines in sugar production as a result of a series of cyclones and drought damages.

Thanks to the appeal of its institutional setting, Mauritius has attracted more than 9,000 offshore entities, many aimed at commerce in India and South Africa, and investment in the banking sector alone has reached over USD1 billion. Mauritius, with its strong textile sector, has been well poised to take advantage of the Africa Growth and Opportunities Act. Five key public institutions form the core of the institutional support system for the Mauritian SID: the Mauritius Export Development and Investment Authority (MEDIA) which provides overseas marketing support, the Export Processing Zone Development Authority (EPZDA), which provides consultancy, training and information services for EPZ firms, the Industrial and Vocational Training Board which also provides Training services, and the Development Bank of Mauritius (DBM) which provides concessionary finance and the Small and Medium Industry Development Organisation (SMIDO) which provides extension services to SMEs. The five institutions differ considerably in terms of purpose, age and size and financial resource base.

The Mauritian Chamber of Commerce and Industry (MCCI) plays a fundamental role in meeting the challenges arising from the twin movements of globalisation and regionalisation. It is and will remain a crucial actor in keeping the Mauritian business community abreast of the numerous changes and developments on the international scene as the new global setting for industry and trade takes shape. It remains also essential in helping Mauritian businesses to rise to the challenge of meeting the full implications of such changes. For so doing, it closely cooperates with Mauritius' official representatives in achieving the most favourable interpretation and implementation of the WTO rules and in securing the appropriate terms and conditions for a fruitful new relationship with the European Union and other trade partners, in the highest interests of the country.

Through its long-standing experience and credibility in Mauritius, the MCCI's increased role in the Eastern and Southern African regions aims at the further development of the range and scope of its functions and services, and in fully meeting its objectives in years to come. As a core private sector institution on the Mauritian business scene since 1850, it is determined to pursue its mission in favour of free enterprise, enhanced standards of living and economic democracy.

The Small Enterprises and Handicraft Development Authority (SEHDA) was created following the merger of the SMIDO and the National Handicraft Promotion

Agency (NHPA). The aim of the merger is to rationalise and optimise the use of resources dedicated to the small business sector in Mauritius. SEHDA provide the following services to enterprises to facilitate various aspects of their business activities:

- Business Counselling and Facilitation serve for counselling both potential and existing entrepreneurs to identify problems and opportunities and appropriate solutions and strategies and assisting them in selecting a business idea that best suit them;
- Skills Development Programme is aimed at improving skills and knowledge of entrepreneurs in selected areas while entrepreneurship development programmes encourage potential entrepreneurs, including graduates, to start businesses;
- Infomediary Services to facilitate access to databases;
- SEHDA Awards aim at enhancing export, innovatory, technological and ICT capabilities of Small Enterprises. Awards, Prizes and Prestige are available for best Small Enterprises to identify best practices and communicating them to other Small Enterprises;
- Business Forums to allow local entrepreneurs to meet foreign businessmen and develop links, to improve the terms of sourcing of raw materials, semi-finished goods and accessories and to encourage joint ventures and alliances optimising complementary resources and competences;
- Marketing Assistance to enable handicraft operators to test, launch and market their products.

6.3.7 Mauritian Textile Industry After MFA

The garment industry has made a major contribution to the economic development of Mauritius. Currently, more than 75,000 of the overall working population of 549,000 are employed in the clothing sector. The development of the Mauritian textile sector is mainly a product of the island's Chinese population and investors from Hong Kong, who used the Mauritian export processing zone (EPZ) to build the new industry in the 1980s.

Equipped with a highly skilled labour force and efficient management practices, Mauritius manufactures products of excellence like Boss, Ralph Lauren, apparels for export towards the EU and USA. Great emphasis has been laid on producing high quality textile products. Mauritian textile industry enjoys a good reputation among professional textile buyers. Famous textile distributors and retailers like 3 Suisses, Galeries Lafayette, Harrods, Selfridges, Mast and the Gap source out their products from Mauritius. To face the present economic situation, investments are being made in new technology with an aim of making Mauritius a centre for capital-intensive activities such as spinning, weaving, design, marketing and logistics. The country has gradually moved away from "bottom of the range" products towards those with a higher added value, so as to increase stability, retain comparatively high wages and compensate for the shortage of local skilled labour. However, since the expiry of the Multi Fibre Arrangement (MFA) as from January 1st, 2005, the world's textile and clothing has experienced a revolution as the global quota system was abolished. China is gradually conquering most of the previously existing quotas, which have given countries like Mauritius a chance to industrialise.

As the expiry of the MFA was nearing, there has been a succession of company closures in Mauritius, which already have seriously affected the unemployment rate. Several Hong Kong-owned groups already have left the country, and Mauritius has learned to fear the growing power of countries with lower wages like China. These textile groups had come to Mauritius largely for the quotas, and now the latter are disappearing as a result of the expiry of the MFA. Mauritius' long distance from the USA, compared to Asia, does not do it any favours either.

The Mauritian government has responded to the difficulties generated by the new trade regime in the garment industry providing training in tourism and other alternative sectors to textiles, in order to re-deploy some of the workers sacked by the companies in the export processing zone. In order to help the textile companies move up the product range and increase its efficiency, the Mauritian government encouraged a wide-reaching application of IT in the sector. Computer Aided Design and Computer Assisted Manufacturing (CAD/CAM) are important applications of IT in the textile industry. This technology enables companies to cope with complex designs, increasing number of styles and with rapid changes in the market trends.

Computer aided design (CAD) has emerged as an essential technology in the textile garment industry, due to the various facilities that it offers: the minimisation of losses in fabrics (about 10% saving is achievable), the significant reduction in the time required (about 65% of time saving is possible) to produce designs and cut plans for the new style garment. With help from the World Bank the government has also started taking measures to restructure and renovate the whole EPZ and develop new areas of growth in the manufacturing sector.

6.3.8 Alternative Areas of Growth in the Services and Manufacturing Sector

The massive employment loss generated by the closure of textile companies in the wake of the MFA expiry have prompted the Mauritian government shift its priority to developing alternative areas of growth. Incentives packages have been reserved for the priority areas, including offshore banking and financial services, information technology, printing and publishing medical products and electronics. As part of its new development and diversification strategy, Mauritius seeks to position itself as a growing regional offshore financial centre.

Offshore financial services: The Mauritian government is promoting offshore activities that will not only set Mauritius on its way to become the regional financial centre but also an international financial and business centre. Various types of offshore activities have already been identified, including offshore fund management, holding companies, operational headquarters, offshore captive insurance, foreign security companies, ship management, financial services and consultancy, shipping, aircraft financing and leasing, and trading. Most of these types of offshore activities can already be conducted in Mauritius.

To boost this sector, the island provides an environment for banks, insurance and reinsurance companies, captive insurance managers, trading companies, ship owners or managers, fund managers and professionals, to conduct their international business. The current structure offers the following incentives:

•Exemption from compliance with the Exchange Control Act;

•Freedom to conduct all legitimate banking and other financial business with non residents;

•Exemption from credit, interest rates and other restrictions normally applied to business of domestic banks;

•Low income tax rate of 5% on all offshore profits;

•Free repatriation of profits without further taxation;

•Exemption from stamp duty on documents relating to offshore business transactions;

•Exemption from custom duty on imported office equipment;

•No withholding tax on interest payable on deposits raised from non-residents by offshore banks;

•Double taxation avoidance treaties with the United Kingdom, France, Germany, Malaysia, Sweden, India, Italy, and Zimbabwe. Similar agreements are being negotiated with other countries;

•Expatriate staff are subject to a concessionary personal income tax rate, i.e. half the normal personal tax rates;

•No estate duty or inheritance tax is payable on the inheritance of shares in an offshore entity;

•No capital gains tax.

Information Technology: The information technology sector in Mauritius has experienced a steady growth during the last three years. Several companies from USA, UK, France, Belgium, South Africa, Singapore and India have already opted for Mauritius to conduct the following operations to cut down their operation costs and find new markets: software development; pre-press activities; high value-added data processing; CD-ROM and Internet publishing; development of multimedia applications; and, translation.

The manufacturing sector also continues to offer good prospects to potential investors in the following areas: information technology, printing and publishing, electronics, precision engineering, jewellery, pharmaceuticals and health care, and agro-based industry in addition to high quality textiles and apparel.

Printing and Publishing: The Mauritian printing houses have made significant investments in state-of-the-art technology to achieve higher output and quality prints. The industry has advanced equipment such as high-end colour scanners, large format image setters, sheeted and web-fed colour offset presses and a variety of automatic binding and finishing machines. To promote the expansion and modernisation of printing activities, concessionary loans are provided by the Development Bank of Mauritius.

Light Engineering: The light engineering and high precision plastics sectors feature prominently in the government's industrial strategy. Support services to these sectors are being actively encouraged and government is committed to consolidate and build up an efficient manufacturing base in these sectors. Products which can be manufactured in Mauritius for the regional and international markets include: injection moulded plastic components; automotive parts and components (e.g. gasket sets, shock absorbers, filters, radiators); household appliances, electric fans, air conditioners and water pumps; equipment for the construction industry; brass locks, padlocks, door knobs; - Parts and components for motorcycles and bicycles; and plastic casing for TV, video, fax machines, and telephones and PABX systems.

Electronics: According to a comparative cost analysis conducted by experts of international reputation, the following products can be competitively manufactured in Mauritius: printed circuit boards, security devices and systems; smart (IC) cards, modular power converters, magnetic and decoding boxes for modems and satellite TVs. Products that can be assembled in Mauritius for the regional market include: audio and video equipment, household electrical appliances, telecommunication equipment and computers.

Jewellery: Out of 300 jewellery manufacturers, some 20 companies are now operating in the EPZ and undertake a range of manufacturing processes such as casting, stone setting, metal plating, stamping, manufacture of mechanical chains and hollow jewellery.

Pharmaceuticals and Health care: The health care industry includes the manufacture of pharmaceuticals and the development of medical equipment and instruments. Products such as gelatine capsules, bulk drugs, medicines, disposable syringes, perfusers and diffusers are presently being manufactured in Mauritius for export.

Agro-based industry: The agro-based industry involves the processing of local raw materials, including the by-products of the sugar industry. Products that are being manufactured are bakers' yeast, perfumes, citric acid, confectionery, cut flowers and pot plants, hydroponics, seaweed and seaweed products.

6.4 A Tale of Two Crystals: Sugar versus Diamonds

In this chapter, we have analysed Botswana's and Mauritian growth performance in the light of their capabilities, incentive system and institutional quality. Botswana's spectacular growth performance, mainly attributable to the prudent management of diamond revenues, was also fostered by a remarkably good institutional setting based on pro-business and pro-western property rights and investor protection regime. The fact that the main driver of the economy, diamond mining, is in the hands of the government (i.e. for the 50 percent share in Debswana that belong to the country), has also meant a predominant role of the state in the economy as the largest employer by far. The role of the state has been decisive in the countries growth and its accumulation of human and physical capital has been substantial. The historical integration with the South African economy has also been beneficial to the country's development.

However, we have noted that human development has lagged behind the impressive growth records. Life expectancy at birth, instead of improving has tended to deteriorate and infant mortality has remained relatively high (about four times higher than the rate in Mauritius), both as a result of a high incidence of HIV/AIDS pandemic. According to the Washington-based Progressive Policy Institute, Botswana's life expectancy at birth has fallen from 64 years to 35 between 1990 and 2004. While life expectancy at birth was still estimated to be 39 years on average in 2002, it was projected by USAID to drop further to 27 by 2010 as a result of AIDS, while infant mortality is projected to lead to negative population growth, with AIDS being the primary cause of mortality. Another compelling feature of Botswana's economy is that growth has been accompanied by unusually high levels of income inequality, which means that high growth records have translated in the coexistence of opulence with large levels of poverty in broad layers of the population. Additionally, the predominance of the diamond mining industry, which is largely capital intensive has not enabled the country to absorb the large levels of unemployment. Unemployment officially was 23.8% in 2004, but unofficial estimates place it closer to 40%. Furthermore, the lack of integration and linkages between the diamond sector and the rest of the economy has also meant the absence of technological spillovers to the economy. Although this lack of integration does not appear to have slowed Botswana's growth, it could undermine the long-term sustainability of high growth rates as well as limit the diversification potential.

The collapse of its agricultural share in GDP also means that employment in that sector is not likely to pick up soon. Despite substantial efforts aimed at boosting diversification and expanding the manufacturing sector, manufacturing value-added has remained a tiny 4% of GDP and its export potential remain relatively low. Results of chapter 4 had already indicated that manufactured export at this stage could only grow by draining resources from other sectors of the economy.

Like in Botswana and many other African countries, dependence on primary commodity has been very high in Mauritius in the years after independence. For a long time, Mauritius has been dependent on sugar production and owes much of its current prosperity to the rents generated by this sector. However, unlike Botswana, Mauritius has been successful in converting the rents of a primary commodity into a thriving, internationally competitive manufacturing industry, namely the textile and apparel production. The key difference between Mauritius and the other African countries is that Mauritius timely understood that it had to nurture its agriculture sector and sugar industry rather than tax it (Subramanian and Roy, 2003). This way, the rents from sugar were high enough to finance the expansion of the EPZ textile sector as well as develop a high-end thriving tourism sector. This was achieved through a policy of intensive state intervention by a meritocratic, competent and well paid bureaucracy, which allowed shielding the EPZ sector from the effects of a restrictive trade policy aimed at protecting the import competing industries.

The institutional quality reached as a result of the government-business nexus and Mauritian population diversity, has exemplified the success of the optimal rent sharing strategy, in which political and economic elites have worked symbiotically to the success of the country. Unlike Botswana, Mauritius' spectacular economic performance has resulted in shared prosperity and the labour intensive nature of the EPZ industries that developed on Mauritius has helped absorb all unemployment to the extent that the country experienced labour shortages in the 1990s. The resulting increases in wages have forced the industry to rationalise and upgrade their technologies and growth has then been mainly driven by productivity increase. Although the level of technological effort (in terms of research funding, research intensity, and patent applications) remains relatively low compared to advanced economies, Mauritius' other indicators of capabilities are fairly good as evidenced by the competence of its healthy, long-lived bilingual labour force and its modern infrastructure. This provides a potential for growth in the various sectors that the government seeks to develop as a response to the adverse employment effect of the phasing out of the MFA arrangement.

The puzzling question that remains is why the two countries, both credited for good institutional frameworks, and both starting from doom scenario conditions at independence[6], the one blessed with diamonds the other relying on hard work in sugar plantations and factories arrived to such similar high growth performances, but so sharply contrasting development outcomes. State intervention has been high in both countries but whereas the Botswana government remained the principal economic player, Mauritian economy was dominated by separate elite that had to strike compromise deals with political elites. Proponents of the privatisation could see in that the source of the better human development observed in Mauritius.

While Botswana was endowed with precious diamond with steadily increasing revenues and a homogeneous population composition, Mauritius started with sugarcane and was exposed to the threats of intermittent cyclones and droughts, its population diversity forming a potential source of tensions. One could argue that for comparable institutional quality, Botswana had the better trumps. But sugar has proved to bring

[6] Remember James Meade's prediction of a recipe for failure in the report to the government of Maritius: Mauritian remoteness from developed markets,its tropical climate with frequent cyclones and droughts, as well as the lack of natural resources and its ethnic composition were perceived to present poor prospects for growth and development (Meade et al.,1961). As for Botswana, at independence it was one of the poorest countries in the world and agriculture on its arid land could hardly be expected to prosper without the diamonds that were discovered only after independence.

more prosperity as it was partly at the basis of the success of the EPZ, while ethnic diversity proved to be a source of business connection for Mauritius, attracting investors from Hong Kong into the textile industry. In our view, sugar outperformed diamonds because the value of export product in Mauritius was mainly the result of productive effort, while productive effort remains a fairly low share of exported diamond value[7]. Seneca would find here an illustrative example of Ovid's poetic description of August's palace referred to in chapter 1, as well as a confirmation of the Lacedaemonian virtue and of his own assertion that the endurance of hard work is a God's blessing to fortify good men[8]. The sugar industry generated linkages to the economy which meant that the managerial skills and production capabilities developed in the sugar industry as well as the monetary rents generated by it, have been essential in the success of the EPZ sector.

[7] Jomo. K.S. (2002) draws a similar difference between North-East Asia (Japan, Korea and Taiwan) and South-East Asia (Singapore, Malaysia, Thailand and Indonesia). For Jom KS, North-East Asia, endowed with much fewer natural resources, has managed to build stronger domestic capabilities and has depended less on foreign capital, while South-East Asian growth has depended to a large extent on foreign investments.

[8] See Cicero's Tusculanae Disputationes, Book V: 98: "Labor in venatu, sudor, cursus ad Eurotam, fames, sitis: his enim rebus Lacedaemoniorum epulae condiuntur". See also Seneca: «Operibus, inquit, doloribus damnis exagitentur ut verum colligant robur » in: *Qua re incommoda bonis viris accidant cum providentia sit.* Compare also with footnotes 8 and 9 in Chapter 1

Chapter 7

GENERAL CONCLUSION

7.1 Summary of Findings

Growth in SSA has been impeded in general by the marginalisation of Africa in the world trade, by dependence on a few primary commodities and by the decline of its terms of trade since the mid-1980s. The combined effects of these factors have been devastating for the African population, whose poor living conditions have turned into poverty traps characterised by too low saving rates, too low capital stocks and a too low level of human capital to spur growth. In this study, we have explored how this seemingly inextricable situation of poverty traps can be overcome by shifting the attention on the utilisation of imported technologies. These technologies, however, can only be successfully acquired, utilised and diffused if the acquiring country has developed sufficient absorptive capacity in the form of human capital, physical infrastructure and institutions organised in systems of innovation for development. Analysing SSA poverty and dependence on primary commodities within such a framework has allowed us to identify the main issues to be addressed by SSA governments and their donors in their development strategies.

From the time homo habilis started using the first rudimentary tools to facilitate his work, technological knowledge has been the principal determinant of human survival and became later the main driver of his economic development. Technology differences have thus rightly been identified by economic theories as the principal factor responsible for productivity and income differences. In this dissertation, it has been argued that foreign technology adoption by developing countries can enable them to widen the range of productive activities they can engage in and thereby positively affect their productivity and income growth.

The review of dualism, growth and trade literature has brought to the fore the quasi unanimous recognition of the primordial importance of technological knowledge generation and diffusion in determining the capital accumulation and growth pace. Although theories may differ in their explanations of incentives and costs for technological innovation and diffusion, the main lesson derived from their analysis is that developing countries seeking to reduce their dependence on primary commodities and to increase their levels of productivity must find means to acquire and master technologies developed in advanced countries.

The review of the catch-up theories unveiled the limitations in the ability of backward countries to automatically converge to high levels of productivity as predicted by the neoclassical growth and trade frameworks. The limiting factor for this ability being the absorptive capacity (see e.g. Verspagen, 1991 or Rogers, 2004), the objective of this study has been to analyse its relationship to economic diversification and its critical masses that enable backward countries to adopt foreign technologies. This has been done using the SID approach, a developing country version of the National Innovation System approach, which emphasises capabilities, incentives and institutions as the essential ingredients for a successful acquisition and assimilation of foreign technologies necessary for productivity and income convergence.

We have conceptualised absorptive capacity in terms of its indicators of physical infrastructure, human capital and capital investments, in order to test our hypothesis of threshold levels of absorptive capacity for diversification. To that end, we used an econometric framework developed from the production function perspective. Our estimation produced the following results:

- Human capital stocks, infrastructure and population size significantly explain part of the cross-country differences in export diversification, while the endowment in natural resources constitutes a strong impediment to diversification across all countries. Overall, the rate of investment in physical capital accumulation does not seem to significantly explain the observed differences: if anything, capital accumulation seems to go in hand with the exploitation of primary commodities in Sub-Saharan Africa.
- Comparing SSA countries with the rest of the world, we found that for human capital and infrastructure to lead to more diversification, some threshold levels in their indicators must be in place. Many SSA countries have levels of infrastructure

and human capital stock that are below or around these thresholds, implying that their absorptive capacity is still too low to materially influence export diversification.

- Although the density of infrastructure matters in explaining diversification differences among SSA countries, infrastructure and investments are often associated with the exploitation of primary commodities, therefore sometimes barely benefiting the other sectors of the economy.

The low level of basic infrastructure and human capital stock seems thus to be one of the reasons why SSA has continuously been falling behind the rest of world by all standards of economic, social and technological development.

Based on these results, we have analysed the reduction of primary commodity dependence in two of the most economically successful African countries. First, we analysed the technological capabilities, the incentive system and institutional framework of Botswana, a successful diamond exporter with high records of economic growth. Technology adoption and diversification in Botswana were analysed with firm level data collected during the field research. This analysis was articulated on the matching between the imported capital equipment and the manufacturing industries using them in order to estimate the effects of capital goods import on productivity growth and on the manufacturing sector expansion. Our results in this analysis showed that for Botswana's manufacturing industry, the importation of capital that embody foreign technologies and the growth in proportion of skilled labour are the most important factors associated with productivity increase and industry expansion. Moreover, we have assessed the effects of the change in export composition on growth. Rather than being generated by manufacturing productivity increase, the growth of manufactured export was found to be mainly driven by draining resources from other sectors of the economy, as also evidenced by strong tax incentives offered for the development of the manufacturing industry.

For Mauritius, whose growth has mainly been fuelled by its preferential access to developed countries' markets, we have mainly paid attention to the rate at which the export partners' income growth has been translated into domestic growth. This was done by estimating the price and income elasticity of export demand in a growth model, which also allowed us to simultaneously estimate export driven productivity growth and dynamic gains from trade. We found that the accumulation of imported capital goods has helped Mauritius to convert the growth of its export partners' income into domestic per worker productivity growth.

The comparison of the growth and development experiences of the two countries on the basis of their incentive systems and institutional factors has revealed the sharp contrasts between them and has unveiled the relative advantage of hard work over high intrinsic value of the natural resources. Productivity-based performance indeed has a higher developmental pervasiveness as compared to mineral-based growth, because the share of value added by humans in the total value of the exported product is relatively higher in the former case. While both countries have been lauded for their institutional qualities, the analysis of their developmental records has brought to light important differences. The elitist, mineral-based and government-dominated accumulation path of Botswana resulted in a dualistic society in which Lucullan opulence coexists with poverty and high unemployment rates, while the effort-based, business-dominated labour intensive industrialisation resulted in a more egalitarian society, with relatively high levels of life expectancy human capital, low infant mortality and good scores on other indicators of human development.

If development is also measured by the ability of a nation to offer decent living conditions to all of its members, as put forward by Sen (1988) in his definition of the development concept, the comparison between Botswana and Mauritius shows that the small sugar crystal produced with a lot of human effort can outperform the much more coveted diamond crystal (rents from the sugar industry have also been at the basis of the emergence of the EPZ-based textile industries). The institutional implication of this is that optimal rent-sharing agreement between political elites and economic elites is more likely to lead to a more dynamic and pervasive development outcomes as compared to the concentration of political and economic powers in the hands of the same elites, although counterexamples like Singapore can be found to object to that.

7.2 Policy Implications

The precondition for any policy recommendation is obviously the existence of a propitious climate of peace and security as well as an unconditional freedom for honest citizens to engage various productive and business activities that give appropriate rewards for their efforts. As already underscored in the introduction, without these basic conditions, no individuals will be willing to invest in capital accumulation and future production. The successes of Botswana and Mauritius have largely depended in part on the continuous existence of politically and economically stable environment where entrepreneurial spirit could flourish.

As recollected by Tregenna (2006), the various rebellious and civil wars that were fought on the African continent after independence were mainly proxy wars for the interests of non-African countries. Capital accumulation, technological catch up and prosperity in African countries is only possible when Africans come to realise that there is only one war worth fighting: the war against the ignorance of what the Japanese, the Europeans, the Americans or the Chinese produce with African minerals and other raw materials. In the spirit of “what people can do and what they cannot do”, we first acknowledge that all policy recommendations involve making choice on the use of costly resources that may often not be available. Since the policy targets cannot be achieved at the same time, what is important is to choose priorities and establish targets, and then design performance measures and incentive systems capable of mobilising the suboptimally used human and physical resources to gradually put in place critical masses of each of the pillars of the strategy to win this war against the ignorance and insidious illusions of static comparative advantage in “selling the fortuitous gifts of nature to others”. Such pillars comprise imperatively at least three components: human capital, infrastructure and the mobilisation of financial resources.

- The training of human capital must produce sufficient levels with the required skills to identify access, negotiate, adopt and assimilate foreign technologies. For the harnessing of foreign technologies to be effective, the technological skills must reach such levels that reverse-engineering of foreign goods is possible in the first place. Human capital must also embody the organisational capabilities needed to coordinate technological efforts and implement the SID strategic objectives.

- The second pillar rests on the development of adequate infrastructure necessary to facilitate the flows of skills, goods and services, which are the vehicles of technology diffusion. Infrastructure is also necessary to reduce the transaction costs and facilitate the functioning of firms that eventually have the ultimate responsibility of internalising technologies. Especially, development of rail traffic can considerably reduce transportation costs for land-locked countries and unlock them. This often necessitates coordination with neighbouring countries: regional integration with free movement of citizens, goods and services (such as the East African Community) is one of the ways through which such coordination can take place. The high costs of infrastructure are often invoked to justify the low level of infrastructure in SSA countries. However, the amount of railways that were constructed during the colonial period with local resources prove that there are more than enough local resources to build adequate infrastructure, provided that a good coordination is in place.

- The third pillar is the mobilisation of financial resources to make all this happen. As proposed by Gerschenkron (1962) and Akamatsu (1962), the state has an important role to play in boosting savings and channelling the financial resources to finance technologic catch up. The money that is often squandered or diverted to foreign banks could be productively invested in the training of human resources and the construction of infrastructure if the owner of these financial resources can expect reasonable returns to their investment in their own countries. A stable political climate to motivate long-term investment planning and good functioning financial market are thus of utmost importance in any catch-up strategy. Although foreign aid and foreign investment can also be some of the sources of financing, development planning must emphasize the primordial role of generation and better mobilisation of domestic finance through a more efficient management of available resources and higher productive efforts.

Like the fast growing East Asian countries, Botswana and Mauritius were successful because their leaders were capable of optimising their respective counties' human and physical resources by upholding a propitious institutional setting and an incentive system for fostering the accumulation process. Although the trade and industrialisation policy tools used by Mauritius may no longer be available to other African countries in a more globalised economic system, the example of Mauritian industrialisation shows that diversification is possible in Africa, provided that a number of factors are in place. Such factors include a right mix of incentives and institutional quality, capable leaders heading a competent bureaucracy, and a skilled, hard working but honestly rewarded labour force.

However, it is important to keep in mind that dynamic efficiency does not follow automatically from the acquisition of foreign machinery embodying new technology and the accumulation of related operating know-how. Sustained dynamic efficiency depends heavily on domestic capabilities to generate and manage change in technologies used in production. These capabilities are based largely on specialised resources (such as highly skilled labour force) that are neither incorporated in, nor automatically derived from capital goods and technological know-how (Bell and Pavitt, 1993). Capacity-building is thus required at all stages in the process of technology acquisition and assimilation. In the beginning, basic levels of technological capability should be built via the establishment of institutes that provide training in the fundamentals of technology assessment and management.

Capacity for technology assessment and negotiation by African countries at the agreement stage of technology acquisition is crucial in order to overcome the disadvantages of information asymmetry that characterises the technology market. In Sub-Saharan Africa, existing capabilities are unfortunately still weak in almost all technology areas. Many political leaders in SSA have rarely been interested in nurturing the development of the capacity to innovate and to be competitive in international markets. Bilateral and multilateral donors have also shown too little readiness to provide assistance aimed at nurturing the local innovative capabilities. Fundamental change in the export structure can be achieved if African governments set their minds on developing an autonomous capacity to innovate, and to acquire, diffuse and adapt existing technologies.

However, capacity alone is of limited use without the appropriate blend of incentives and institutions to foster technology utilisation and productivity increase. Where efforts to build up technological capabilities have been undertaken, the link between science and technology on one side and the industry on the other, has been minimal, resulting in a brain drain of African scientists and shortages of competent manpower coexisting with unemployed qualified personnel. Should SSA countries succeed in building basic technological capabilities, their recipe for escaping dependence on primary commodity and poverty traps will also have to include the essential ingredients of an increased role for agriculture productivity, political stability, independent competent bureaucracy, expansion of education and finding an engine of growth.

7.3 Devising Development Strategies with the SID Approach

The limitations of traditional approaches justify the need of applying the SID as an alternative analytical framework for SSA development problems. Whereas technology is treated as freely available and applicable in the neoclassical theories, in practice, technology is neither costless nor easy to absorb and utilise. Its acquisition can require substantial investments and its absorption and application often require complex skills and competences that are not always freely available in many developing countries. The use and assimilation of new technologies presuppose the existence of a minimum of technological capabilities in developing countries to choose, acquire, generate, and apply technologies that are suited to their development objectives. Such capabilities on national level eventually determine the rates and patterns of development and industrialisation (Bhalla, 1994). Development strategies in the SSA context need to be measured not only against this dimension but also against other dimensions of the SID and must be continually evaluated on their systemic adequacy. For these reasons, developing countries, and SSA countries in particular must frame their development strategies within robust SID tailored to their development needs and priorities.

7.3.1 Investing in Human Capital

Adequate human capacity is needed to assess, select, import, develop and adapt appropriate technologies. As noted above, there is considerable evidence showing that for any strategy regarding technology acquisition diffusion, adaptation and improvement sufficient levels of human capital are needed. If capabilities for active learning and integrating the new knowledge are deficient, they may result in unsuccessful application of purchased technologies and unforeseen technology adoption problems. Since human capital is essentially accumulated through the channels of education, training, experience and learning by doing, policy aimed at fostering formal education, skills training and other avenues of human capital accumulation are important in building adequate human capabilities. Indeed, research has demonstrated that an economy's absorptive capacity, which forms the basis for successful technology transfer, depend heavily on the level of education and training (Mytelka, 2001).

Dahlman and Nelson (1995) also note that a key input in achieving a successful technology acquisition is a technical human capital base able to assess and decide on technology matters, requiring a well developed level of educational system that lays the necessary foundation at all levels. They distinguish two levels at which investment in human capital should be aimed: the university level and the primary/secondary education level. According to Dahlman and Nelson, while university level forms qualified personnel to assess technology and develop strategy to take advantage of technological changes, the primary/secondary level provides critical components to speed up the diffusion and adoption of new technologies. This means that there is a need for strong scientific, engineering and socio-economic capabilities as a base for policy making as well as for skilled labour force that makes adaptation and improvement of foreign technologies on the shop floor and increase the awareness and ability to take advantage of technological opportunities.

In many SSA countries, there are still large mismatches between the skills produced by the existing education systems and the competences that are needed to factually trigger a sizable industrialisation. This is usually the result of the emphasis on general orientation in educational system, both at secondary and university levels, in which curricula often do not address the formal training needs for specific technical skills required for foreign technology adoption. In light of these mismatches, the education curricula should be geared towards generating and training specialised technical skills that can leverage the existing comparative advantages of the country (like upstream and downstream activities in the main export products) or even create new advantages (for example, large scale solar energy systems in the regions where sunshine is the most abundant). In addition, although the need for general skills such as those of lawyers, psychologists, physicists and other scientists must retain the necessary attention in the curricula choices, the sending of students to foreign universities in industrialised countries should also be better coordinated (and evaluated) and primarily be aimed to serve industrialisation policy objectives by enabling the acquisition of specific industrial skills available in those industrialised countries, in line with the development targets of the sending country.

7.3.2 Acquiring Foreign Technology

African countries can acquire foreign technology in various ways, such as reverse engineering of foreign capital goods, technology transfer through foreign direct investment (FDI) or foreign licensing. As a prominent actor in the technology acquisition process, the government has the responsibility to contribute to the formation of human and social capital needed to evaluate, choose, implement and modify foreign technologies. Since a great deal of technological information is embodied in foreign capital goods, the easiest way for developing countries to acquire technology is by importing those capital goods from developed countries and reverse- engineering them domestically and adapting them to local conditions. However, this type of technology acquisition does not include the transfer of theoretical or practical knowledge; it is therefore of limited use if it takes place without an already existing solid base of human capital capable of filling these skills lacunae.

Obviously, trade and tariffs laws and regulations, as well as intellectual property regimes, are powerful instrument to guide this avenue of acquisition. As Mansfield et al. (1981) suggested, imitation costs can be high where the levels of human capital are low, and the loose intellectual property rights regime that would be needed to maintain such a system might be prohibitively damaging to foreign trade relations. The alternative way of acquiring technologies through FDI is not less sinuous. In many cases the technology remains totally controlled by the foreign investor, but local firms can benefit from the establishment of foreign firms through linkages and spillovers. Here, the government has also a whole host of policy tools to influence technology acquisition. Developing countries might for example regulate the amount of domestic ownership in foreign firms because more local ownership is likely to increase the network and linkages available for spillovers to other domestic firms. However, a too restrictive regulation can discourage foreign investment. A balance must therefore be found between the imperatives of quicker diffusion and those of getting the technology to the country in the first place.

For the acquisition of foreign technologies to work properly, substantial management and engineering skills are required to muster the resources and ensure that technical knowledge is assimilated to a significant extent. This often demands high quality training to facilitate the transfer of expertise applicable to particular products and processes to the personnel of the receiving firms. These kinds of trainings form a crucial phase in technology acquisition and must be part of any technology transfer package. Moreover they need to be deliberately planned as a learning vehicle for the workforce of the recipient firms. Technology transfer should therefore not only be of specific know-how, but also of related systemic knowledge of the relevant technologies so that recipients can add value. As pointed out by Brooks (1995), this is an important consideration for developing countries, because it implies that the workforce must experience continual cumulative learning, both from experience and formal training, in order to be competitive.

As already pointed out by Akamatsu (1962), the acquisition and application of foreign technologies often implies social changes, even social disruptions that can stumble on resistance to change or can be opposed by vested interests. One of the most important functions of a country's SID is therefore to manage technological transition and provide legitimacy for change (see Johnson 2000). The country's authorities in charge of technology policy must also, as actors of the SID, reduce social uncertainly associated with these changes by pre-emptively analysing how people will act and react to them. Countries with a large legitimacy base are likely to enlist the social consensus if the benefits of change are timely and adequately conveyed to the population.

7.3.3 Using and Diffusing Technologies

Nations with a low rate of literacy and weak higher education systems have a great deal of difficulties assimilating and implementing foreign technology, because they lack essential skills in their human capital stocks. Technical competences and skills at the university-education level are needed to monitor and assess international technology development and implement any needed adaptation and changes. Strong education is also necessary at the primary and secondary levels to increase the general literacy level of the population and create a labour force with human skills necessary to understand the working of technology and make improvements on the shop floor.

For developing countries to take full advantage of acquired technology, government needs to enact policies that help domestic firms in using and diffusing these technologies throughout the economy. This can be done by establishing institutions and networks that disseminate the tacit and codified knowledge present in new technological systems. These networks and institutions do not develop by themselves; they need to be initiated and stimulated as an essential part of a nation's social absorptive capacity which is embedded in the national systems of innovation. With the help of government incentives, developing countries can create various formal and informal networks to facilitate the diffusion of the technology. Subcontracting is one of the effective instruments to create such close contacts that support knowledge transfer while conducting business. To ensure that domestic subcontractors produce products of equal or similar quality, it is important to establish an organisation that implements standards, testing and quality control. Standardisation systems require collaboration between public and private sectors and are part of the institutional system of national system of innovation administered by the public sector because of their character of "public goods".

7.3.4 Adapting and Improving Technologies

Transferred technology is typically used by firms to improve upon their productive capabilities. Technology adaptation and improvements take thus place at the firm level. The role of firms' innovations strategies is particularly important in the adaptation and improvement of the transferred technologies. Many of incremental changes in process inputs or equipments that characterise constant technological advance do not occur in formal R&D labs but rather on the shop floor. The ability to absorb and use new technology effectively by firms in developing countries also improves their capability to develop innovations themselves.

However, if international competitiveness is the goal, then local research and development becomes indispensable and research labs are necessary to conduct reverse engineering or adapt technologies to fit specific needs of customers or simply to keep up with the international industry trends. Developing countries should concentrate their efforts on the industrial R&D expenditures that focus on the support for the acquisition, assimilation and improvement of foreign technology that complement the existing knowledge and technological base (Dahlman and Nelson, 1995). Fundamental change requires thus an autonomous capacity to, acquire and adapt technologies or even develop new ones.

7.3.5 Improving and Strengthening the Position of Agriculture

The example of Mauritius in the previous chapter illustrates how the nurturing of a dynamic agricultural sector can become an engine of growth. As we have seen in chapter 3, for industrialisation to be fuelled by the dynamics of the agriculture, output and productivity must rise in the agriculture sector. Such increase can be achieved through a variety of factors including better irrigation techniques, application of fertilisers and the use of high yield and pest resistant seeds varieties. For a majority of countries, increasing food production implies expansion of arable land and an increase in the intensity with which the available arable land is utilised, for example by shortening the fallowing period or by multi-cropping (see Szirmai, 2005). Application of fertilisers, use of high-yield, disease resistant seeds varieties and mechanisation serve to increase the harvest per land area. In many parts of Sub-Saharan African countries, subsistence agriculture remains the most dominant economic sector and occupies the majority of the population. This often results in underutilised labour and persistent low productivity level as labour is used excessively with too low level of capital. A better labour reallocation as in developed countries could ensure that a much smaller proportion of the population produces enough agricultural output for the needs of the entire economy, while the rest of the labour force cold be assigned to other activities in the manufacturing or service sector.

According to the Soil Fertility Initiative (SFI) of the World Bank, CGIAR and FAO, soil fertility decline is the major limiting factor for agricultural production and economic growth in Sub-Saharan Africa. Soil fertility depletion is the fundamental root cause of declining per capita food production in Africa. No matter how effectively other conditions are remedied, food production will continue to decrease unless soil fertility depletion is addressed. Soil fertility replenishment should thus be considered as an investment in natural resource capital and only fertiliser application is likely to generate the increase in food productivity required to keep up with population growth and food demand (Yanggen, 1998).

If broader structural constraints are reformed, African farmers can produce more and their efforts can further be enhanced by more participatory decentralised form of crop breeding and by support for agro-ecological alternatives (De Grassi and Rosset, 2002). The idea that more conventional research and extension by national and international agricultural research centre will produce new high yielding drought and disease-resistant crop varieties that will boost the productivity of African agriculture by replacing old low yielding varieties is a myth as explained by De Grassi and Rosset (2002). Likewise, conventional expectations that stepping up funding for the public research sector to guarantee the availability of public goods and the assumption that the strong evolving synergies with the private sector will ensure that varieties will be developed and distributed more efficiently to the farmers in the future are tentamount to ignoring the hard lessons of the reality. These expectations fail to recognise that poorer African farmer utilise crops with multiple, interlinked characteristics to suit their complex, diverse and changing priorities. In such a process, the state has an important role to play, by stimulating agricultural entrepreneurship and facilitating market exchange. Indeed, it is this transformation, together with the introduction of better crop varieties, which permitted East Asian countries to achieve the green revolution in the 1970s.

Although the agricultural sector's share of GDP and employment has become increasingly small in developed countries, agriculture remains the most vital sector of the economy in every country, with perhaps the exception of some city states. For example, being the largest world economy, the United States is also the country with the largest agricultural production (FAO Production Yearbook 2004) and the European Union has for long devoted 50% of its budget to the common agricultural policy (CAP). Agriculture is thus an essential sector in developed countries as it is crucial to the development of other sectors of economic activities in developing countries as well.

7.3.6 Poverty reduction

Even though no unambiguously deterministic (or one-to-one) relationship between growth and poverty reduction has yet been established (see e.g.Bardhan's 1988 and Timmer 1988 discussions on this issue), it is reasonable to state that for a country to be able to reduce the poverty of its population, it must find means to achieve economic growth and put in place policies to use the benefits of economic growth to alleviate poverty. Since the 1970, it has increasingly been accepted that for a country to successfully deal with widespread poverty and hunger, rapid growth with a broad participation of the entire population for sustained periods of time is necessary (Timmer 1988). Nowadays, there is a growing consensus amongst both analysts and African actors themselves that local involvement, in the form of traditional institutions, local organisations and individuals is critical to increasing national capacity and optimising resources available for investing in future growth and poverty reduction. Unfortunately, even the financial assets saved by Africans in most cases migrate to developed countries and are thus not used to invest in activities that could help Africa exit the poverty traps. Collier, Hoeffler and Pattillo have estimated that the proportion of African private wealth held abroad was 40% even back in 1990 and it has not shown any decreasing trend since then (Collier, 2002). The political economy consequence of this mobility is that capital has strong bargaining power relative to the immobile factors such as land and labour. Hence, the burden of poor governance is shifted more or less fully to these immobile factors. Bringing the money home and linking with African diaspora in developed countries for business and technology networks can constitute a valuable trump for overcoming the financial resources constraints.

7.4 Study Limitations and Avenues for Future Research

This study has however a number of limitations, mainly owing to the limited scope of its objectives, the availability of needed data and the generalisability of the results due to the relative small size of the two countries covered in the case studies. The scope of this study, as delineated in the study objectives is limited to the analysis of the role of absorptive capacity components and technology adoption in the diversification process. The thesis therefore does not cover the areas of the generation of technologies nor the field of technology market and actual technology transfer between countries and diffusion among domestic firms within countries. For such aspects, the reader is referred to works such as Mansfield (1968), Mansfield et al. (1981), or Fransman (1986). Since the acquisition, utilisation and further adaptation of foreign technologies takes place within firms, the thesis concedes further that technological capabilities can better be analysed on sectoral or firm level in order to enable a better assessment of their effects on economic performance and competitiveness. Such an approach on firm level has been used by Biggs, Shah and Srivastava (1995) for a number of African countries and provides a wealth of information about technological learning in Sub Saharan African firms . Extension of their methodology to the case of Botswana and Mauritius would provide valuable micro-level evidence for our case studies but was deemed unfeasible because prohibitively costly.

In addition, although we recognise the importance of the institutions in shaping the climate for technology adoption and diversification, this thesis does not engage in discussions about the effects of political structure and institutions on growth and technology, despite temptations to do so. The reader is referred for these aspects to the relevant literature in the respective fields . The emergence of institutions and their effects on human motivation and accumulation process choices has continually attracted research interest (see for example, North, 1990 or Acemoglu et al., 2004). However, institutions are shaped by complex factors, most of which are externally determined and even good institutions can falter as a result of bad or incompetent leaders. The role of capable and visionary leadership in the accumulation and growth process should be part of the broader field of institutions.

Further, the constraints of data availability allowed analyses covering time series of typically only 20 to 27 years. This data limitation puts a challenge on the statistical validity of the results as the used series are not long enough to infer long-term relationships. Moreover, as a result of the difficulty to obtain data on diversification measures for long periods of time, we were not able to conduct a panel data analysis that would have enabled us to overcome many of the limitations inherent in cross-sectional regression analyses such as the one we used in chapter 3. Further research on the relationship between absorptive capacity components and diversification is therefore needed with panel data, in order to validate the result of chapter 3 in the time dimension. Finally, however successful the two countries of our interest may be, they are relatively small economies (Botswana: about 1.7 million inhabitants, Mauritius: about 1.2 million inhabitants in 2006) and therefore do not share many of the features of typical SSA countries. Applicability of the results of these countries to larger African economies is therefore subject to caveats. Extending case studies to some larger countries like Kenya, Mozambique, Nigeria or Tanzania would generate more generalisable insights in the process of technology adoption and reduction of primary commodity dependence.

-FINIS-

References

[1] Abdulai, A. and P. Jaquet (2000). "Exports and Economic Growth: Cointegration and Causality for Cote d'Ivoire". *Africa Development*, pp. 1-17.

[2] Abramovitz, M. (1956)."Resource and Output Trends in the United States since 1870". *American Economic Review*, 46: pp.1-23.

[3] Abramovitz, M. (1986). "Catching up, forging ahead, and falling behind". *Journal of Economic History*, 46 (2): pp. 385-406.

[4] Acemoglu, D., S. Johnson, and J. Robinson (2003). "An African Success Story: Botswana". In: Rodrik, D. (ed). In Search of Prosperity: Analytic Narratives on Economic Growth. Princeton University Press, Princeton, NJ.

[5] Acemoglu, D., S. Johnson and J. Robinson. (2004a). "Institutions as the Fundamental Cause of Long-Run Growth". Paper Prepared for the Handbook of Economic Growth edited by Philippe Aghion and Steve Durlauf.

[6] Acemoglu, D., S. Johnson and J. Robinson (2004b). Institutional Roots of Prosperity. The MIT Press.

[7] Addison, T., G. Mavrotas and M. McGillivray (2003). "Aid, Alternative Sources of Finance and the Millennium Development Goals". Paper prepared for presentation at the "Development Financing: Global Policy Agenda's session at Development Studies Association Annual Conference, London, November 2004.

[8] Adeoti, J. (2002). “Building Technological Capability in Less developed Countries: The Role of National Systems of Innovation”. Science and Public Policy, April 2002.

[9] African Development Bank (2005). Africa in the Global Trading System. African Development Report 2004. Oxford University Press, Oxford.

[10] African Development Bank (2008). Managing Natural Resources for Sustainable Development. African Development Report 2007. Oxford University Press, Oxford.

[11] Aghion, P. and P. Howitt (1992). “A Model of Growth Through Creative Destruction”. *Econometrica*, 60(2): pp.323-351.

[12] Akamatsu, K. (1956). “The Flying Geese Pattern of the Industrial Development of our Country-The Case of Machine and Tool-making Industries”. *Hitosubashi rongyoo*, 11 (reprinted 1959): pp. 514-526.

[13] Akamatsu, K. (1962). “ A Historical Pattern of Economic Growth in Developing Countries”. *The Developing Economies*, preliminary issue 1962.

[14] Alam M.(1991). “Convergence Tendency: Some Time-Series Results”. *Southern Economic Journal,* 57(3): pp. 841-847.

[15] Alesina, A., S. Ezler, N. Roubini en P. Swagel (1992). “Political Instability and Economic Growth”. NBER Working Paper.

[16] Al-Marhubi, F. (2000). “Export Diversification and Growth: An empirical Investigation”. *Applied Economics Letters*, 7: pp. 559-562.

[17] Alse, J. and Moshe Bahmani-Oskooee (1993). Export Growth and Economic Growth: An Application of Cointegration and Error-Correction Modeling, *Journal of Developing Areas*, 27: pp. 535-642.

[18] Al-Yousif, Y. K. (1997). “Exports and economic growth: Some empirical evidence from the Arab Gulf countries”. *Applied Economics*, 29(6): pp. 693-97.

[19] Amin Guitiérrez de Piñeres, S. and M. J. Ferrantino (2000). *Export Dynamics and Economic Growth in Latin America*, Ashgate Publishing Ltd.

[20] Amsden, A.H. (1989). *Asia's Next Giant: South Korea and Late Industrialisation.* Oxford University Press, New York.

[21] Arrow, K. (1962). “The Economic Implications of Learning by Doing”. *Review of Economic Studies*, 29: pp. 155-173.

[22] Arthur, W.B (1994). *Increasing Returns and Path Dependence in the Economy*, Ann Arbor, Michigan: University of Michigan Press.

[23] Asafu-Adjaye, J. and D. Chakrabarty (1999). "Export-led Growth and Import compression: Further time Series Evidence from LDCs". *Australian Economic Papers,* (June): pp. 164- 174.

[24] Aschauer, D. (1989). "Is Public Investment Productive?". *Journal of Monetary Economics*, 23: pp. 177-200.

[25] Atje, R. and B. Jovanovic (1993). "Stock Markets and Development". *European Economic Review*, 37(2-3): pp. 632-640.

[26] Auty, R. (1990). *Resource-Based Industrialisation: Sowing the Oil in Eight Developing Countries*. Oxford University Press, New York.

[27] Auty, R. (1993). Natural Resources, Development Models and Sustainable Development. International Institute for Environment and Development.

[28] Auty, R. (1994). "Industrial Policy Reform in Six Large Newly Industrialising Countries: The Resource Hypothesis". *World Development*, 22: pp. 11-26.

[29] Auty, R. (2001). *Resource Abundance and Economic Development.* Oxford University Press.

[30] Aw, B. Y. and A. Hwang (1995). "Productivity and the export market: a firm-level analysis". *Journal of Development Economics*, 47: pp. 313–332.

[31] Azariadis, C. and A. Drazen (1990). "Thresholds Externalities in Economic Development". *Quarterly Journal of Economics*, 105(2): pp. 501-526.

[32] Bahmani-Oskooee, M. and M. Miteza (2002). "Do nominal devaluations lead to real devaluations in LDCs?". *Economics Letters*, 74: pp. 385-391.

[33] Bairam, E.I. (1993). "Income Elasticities of Exports and Imports: A Re-Examination of the Empirical Evidence". *Applied Economics*, 25: pp. 71-74.

[34] Balassa, B. (1978). "Exports and economic growth: Further evidence". *Journal of Development Economics*, 5(2): pp. 181-89.

[35] Balassa, B. (1980). "The process of industrial development and alternative development stategies". Princeton Essays in International Finance, N^o 141, December (Princeton, NJ: Princeton University, Department of Economics).

[36] Balassa, B. (1985). “Exports, Policy Choices, and Economic Growth in Developing Countries After the 1973 Oil Shock”. *Journal of Development Economics*, 4(1): pp. 23-35.

[37] Baltagi, B. (2005). *Econometric Analysis of Panel Data*, 3rd edition. John Wiley & Sons Ltd, Chichester.

[38] Baltagi, B. (2008). *Econometrics*, 4th edition. Springer-Verlag, Berlin , Heidelberg.

[39] Bardhan, P. (1988). “Alternative Approaches to Development Economics”. Chapter 3 in Chenery, H. and T.N. Srinivasan (eds). *Handbook of Development Economics*, Vol.1, Elsevier Science Publishers B.V., Amsterdam.

[40] Bardhan, P. and S. Lewis (1970). “Models of Growth with Imported Inputs”. *Economica*, 37(148): pp. 373-385.

[41] Barro, R. (1990). “Government Spending in a Simple Model of Endogenous Growth”. *Journal of Political Economy*, 98: pp. 103-125.

[42] Barro, R. and Lee Jong Wha (2000). “International Data on Education Attainment: Update and Implications”, NBER Working Paper w7911.

[43] Barro, R. and Lee Jong Wha (2001). International Data on Educational Attainment, *Oxford Economic Papers*, 3: pp. 541-563.

[44] Barro, R. and X. Sala-i-Martin (1995). *Economic Growth.* New York: McGraw-Hill.

[45] Barro, R. and X. Sala-i-Martin (2003). *Economic Growth.* The MIT Press.

[46] Beaulier, S. (2003). “Explaining Botswana’s Success: The Critical Role of Post-Colonial Policy”. *Cato Journal* 23 (2): pp. 227-240.

[47] Baumol, W., S. Batey Blackman and E. Wolff (1989). *Productivity and American Leadership: The Long View*, MIT Press.

[48] Beck, N. and J. Katz (1995). “What to do (and not to do) with Time Series Cross-Section Data”. *The American Political Science Review*, 89 (3): pp. 634-647.

[49] Beck, N. (2001). “Time Series Cross-Section Data: What Have We Learned in the Past Few Years?” *Annual Review of Political Sciences*, 4: pp. 271-293.

[50] Beck, T. and R. Levine (2003). “Stock Markets, Banks and Growth: Panel Evidence”. *Journal of Banking and Finance,* 28 (3): pp. 423-442.

[51] Beck, T., R. Levine, and N. Loayza (2000). "Finance and Sources of Growth ". *Journal of Financial Economics*, 58: pp.261-310.

[52] Becker, D.(1983). *The New Bourgeoisie and the Limits of Dependency: Mining, Class, and Power in "Revolutionary" Peru.* Princeton: Princeton University Press.

[53] Begum, S. and A. Shamsuddin (1998). "Exports and economic growth in Bangladesh". *Journal of Development Studies*, 35(1): pp. 89-114.

[54] Behrman, E., S. Machin and J. Bound (1996). "Implictions of Skill-Biased Technological Change: International Evidence". Boston University.

[55] Bell, M. and K. Pavitt (1993). "Technological Change and Industrial Growth Contrasts between Developed and Developing Countries". *Industrial and Corporate Change*, 2(2): pp. 71-88.

[56] Benhabib, J. and M. Spiegel (1994). "The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data". *Journal of Monetary Economics*, 34: pp. 143-173.

[57] Benhabib, J. and M. Spiegel (2002). "Human Capital and Technology Diffusion". Mimeo. Federal Reserve Bank of San Francisco.

[58] Bernard, A., and J. Jensen (1999). "Exceptional Exporter Performance: Cause, Effect or Both?". *Journal of International Economics*, 47(1): pp. 1-25.

[59] Bértola, L., H. Higachi and G. Porcile (2002). "Balance-of-payments-constrained growth in Brazil: a test of Thirlwall's Law, 1890-1973". *Journal of Post-Keynesian Economics*, 25(1): pp. 123-140.

[60] Beynon, J. (2001). "Policy implications for aid allocations of recent research on aid effectiveness and selectivity". Paper presented at the joint Development Centre/DAC experts seminar on "Aid effectiveness", OECD Paris, January 2001.

[61] Bhagwati, J. (1978). Anatomy and Consequences of Exchange Control Regimes: Liberalisation Attempts and Consequences. Cambridge, MA: Ballinger.

[62] Bhalla, G., (ed.) (1994). Economic Liberalisation and Indian Agriculture, New Delhi, Institute for Studies in Industrial Development.

[63] Biggs, T., M. Shah and P. Srivastava (1995). "Technological Capabilities and Learning in African Enterprises". World Bank Technical Paper, no 288. Africa Technical Department Series.

[64] Bigsten, A., P. Collier, S. Dercon, M. Fafchamps, B. Gauthier, J.W. Gunning, A. Isaksson, A. Oduro, and R. Oostendorp (1998). "Rates of return on physical and human capital in Africa's manufacturing sector". The Centre for the Study of African Economies Working Papers Series. Working Paper 76.

[65] Blomstrom, M., R. Lipsey and M. Zejan (1994). "What explains Growth in Developing Countries?" NBER Working Papers 4132.

[66] Bogetic, Z. and J. W. Fedderke (2006). "International Benchmarking of South Africa's Infrastructure Performance". *Journal of Development Perspectives*, 1(2): pp.123-146.

[67] Borensztein, E., J. De Gregorio and J.W. Lee (1998). "How does FDI affect economic growth?". *Journal of International Economics*, 45: p. 115-135.

[68] Bowman, M an C. Anderson (1963). "Concerning the role of education in development ". in: Geertz, C.(ed). Old Societies and New States: In Quest for Medernity in Africa and Asia. The Free Press.

[69] Brooks, J. (1995). *Training and Development Competence: A Practical Guide*. Kogan Page, London.

[70] Brunnschweiler, C. and E. Bulte (2008). "The Resource Curse Revisited and Revised: A Tale of Paradoxes and Red Herrings". *Journal of Environmental Economics and Managemennt*, 55(3): pp.248-264.

[71] Burnside, C., and D. Dollar (2000). "Aid, Policies, and Growth". *American Economic Review*, 90: pp 847-69.

[72] Burnside, C. and D. Dollar (2004). "Aid, Policies, and Growth: Revisiting the Evidence". World Bank Policy Research Working Paper 3251, March 2004.

[73] Calderon, C. and L. Liu (2003). "The Direction of Causality Between Financial Development and Economic Growth". *Journal of Development Economics*, 72: pp. 321-334.

[74] Carroll, W. and T. Carroll (1997). "State and Ethnicity in Botswana and Mauritius: A Democratic Route to Development?". *Journal of Development Studies*, 33(4): pp. 464-86.

[75] Caselli, F. and D.Wilson (2004). "Importing Technology". J*ournal of Monetary Economics*, 51(1): pp. 1-32.

[76] Catão, L. and E. Falcetti. (1999). "Determinants of Argentina's External Trade". International Monetary Fund Working Papers, WO/99/121.

[77] Caves, R. (1974). “Multinational firms, competition and productivity in the host country”, *Economica*, 4: pp. 176-193.

[78] Chakrabarty, M and A. Schmalenbach (2003) "The Representative Agent Hypothesis: An Empirical Test". Royal Economic Society Annual Conference 2003. Royal Economic Society.

[79] Chenery, H. and M. Syrquin (1986). “Typical Patterns of Industrialisation”. In Chenery, H., S. Robinson and M. Syrquin (eds). *Industrialisation and Growth: A Comparative Study*. New York: Oxford Unversity Press.

[80] CIA. World Factbook 2006. CIA Publications, Washington DC.

[81] Clerides, S., S. Lach and J.Tybout (1998). “Is learning-by exporting important?”. *Quarterly Journal of Economics*, 113(3): pp. 903–47.

[82] Coe, D. and E. Helpman (1995). “International R&D Spillovers”. European Economic Review, 39: pp. 859-887.

[83] Coe, D., E. Helpman and A. Hoffmaister (1997). “North-South R&D Spillovers”. *The Economic Journal*, 107(440): pp. 134-149.

[84] Cohen, W. and D. Levinthal (1989). “Innovation and learning: the two faces of R&D”. *The Economic Journal*, 99: pp. 569-596.

[85] Cohen, W. and D. Levinthal (1990). “Absorptive Capacity: A New Perspective on Learning and Innovation”. *Administrative Science Quarterly*, 35: pp.128-52.

[86] Collier, P. (1995). "The Marginalisation of Africa". *International Labour Review*, 134(4-5): pp. 541-557.

[87] Collier, P. (2002). “Primary Commodity Dependence and Africa’s Future” The World Bank. Washington DC.

[88] Collier, P. (2007). *The Bottom Billion.* Oxford University Press, Oxford.

[89] Collier, P. and D. Dollar (2001). “Globalisation, Growth and Poverty”. World Bank. Washington DC.

[90] Collier, P. and J.W. Gunning (1999). “Explaining African Economic Performance”. *Journal of Economic Literature*, 37: pp. 64-111.

[91] Collier, P. and A. Hoeffler (2001). “On the Incidence of Civil War in Africa”. *Journal of Conflict Resolution*, 46(1): pp. 13-28.

[92] Collier, P. and C. Pattillo (eds.)(1998). *Investment and Risk in Africa.* London: Macmillan.

[93] Conlisk, J. (1996). "Why Bounded Rationality?". *Journal of Economic Literature*, 34: pp.669-700.

[94] Criscuolo, P. and R. Narula (2002). "A novel approach to national technological accumulation and absorptive capacity: Aggregating Cohen and Levinthal". MERIT Research Memorandum # 2002-16.

[95] Cummings, R. (1992). "A Historical Perspective on the Lagos Plan of Action". In: Nyang' oro, J. and T. Shaw (eds). *Beyond Structural Adjustment in Africa.* PRAEGER, New York.

[96] Dahlman, C. and R. Nelson (1995). "Social Absorption Capability, National Innovation Systems and Economic Development". In: D.H. Perkins, and B.H. Koo (eds.). *Social Capability and Long-Term Growth.* Basingstoke, Macmillan Press.

[97] Dalgaard, C-J., and H. Hansen (2001). "On aid, Growth and Good policies". *Journal of Development Studies*, 37: 17-41.

[98] David, P. (1985). "Clio and the Economics of QWERTY". *American Economic Review Papers and Proceedings*, 75: pp. 332-337.

[99] David, P. (2000). "Path dependence, its critics and the quest for 'historical economics'". in P. Garrouste and S. Ioannides (eds). *Evolution and Path Dependence in Economic Ideas: Past and Present.* Edward Elgar Publishing, Cheltenham, England.

[100] Davidson, R. and J. MacKinnon (2004). *Econometric Theory and Methods.* Oxford University Press.

[101] Dawson, P. and L. Hubbard (2004). "Exports and Economic Growth in Central and East European countries during transition". *Applied Economics*, 36: pp. 1819-1824.

[102] Dayton-Johnson, J. and J. Hoddinott (2003). "Aid, Policies, and Growth, Redux. Unpublished manuscript, Dalhousie University, April 2003.

[103] De Grassi, A. and P. Rosset (2002). A New Green Revolution for Africa?: Myths and Realities of Agriculture, Technology, and Development. Institute for Food and Development Policy, Oakland, CA, USA (2002). Food First.

[104] De Ferranti, D., G.E. Perry, D. Leerman and W.F. Maloney (2002). "From Natural Resources to the Knowledge Economy". The World Bank, Washington D.C.

[105] Delgado, R.(1994). Failed Revolutions: Social Reform and the Limits of Legal Imagination. Westview Press, 1994.

[106] De Long, J. and L. Summers (1991). “Equipment Investment and Economic Growth”. *Quarterly Journal of Economics*, pp. 445-502.

[107] De Long, J. and L. Summers (1992). “Equipment Investment and Economic Growth: How Strong is the Nexus?”. Brookings Papers on Economic Activity.

[108] Denison, E. (1967). “Why Growth Rates Differ: Postwar Experience in Nine Western Countries”. Washington D.C. Brookings Institution.

[109] Dixit A. and V. Norman (1980). *Theory of International Trade: A Dual, General Equilibrium Approach.* Cambridge University Press, Cambridge.

[110] Dufrénot, G., V. Mignon and A. Péguin Feissolle (2007). “Testing the Finance-Growth Link: Is there a Difference between Developed and Developing Countries?”. CEPII Working Paper no 2007-24.

[111] Dutrénit, G. (2000). *Learning and Knowledge Management in the Firm: From Knowledge Accumulation to Strategic Capabilities.* Cheltenham: Edward Elgar.

[112] Dutrénit G. (2004). “Building Technological Capabilities in Latecomer Firms”. *Science, Technology & Society*, 9(2): p.209. SAGE PUBLICATIONS.

[113] Easterly, W., R. Levine, and D. Roodman (2003). “New Data, New Doubts: A Comment on Burnside and Dollar’s “Aids, Policies and Growth (2000)””. Development Research Institute Working Paper Series No.4, Development Research Institute, New York University, New York.

[114] Easterly, W and S. Rebelo (1993). Fiscal Policy and Economic Growth”. *Journal of Monetary Economics,* 32: pp. 417-458.

[115] Easterly, W. and Servén, L., (2002). The Limits of Stabilisation: Infrastructure, Public Deficits and Growth in Latin America. Stanford University Press and the World Bank.

[116] Eaton, J. and S. Kortum (2001). “Trade in Capital Goods”. *European Economic Review*, 45(7): pp. 1195-1235.

[117] Eaton, J. and S. Kortum (2002). "Technology, Geographyand Trade”. *Econometrica*, 70: pp. 1741-1779.

[118] Edquist, C., (ed.) (1997). Systems of Innov*ation: Technologies, Institutions and Organisation.* London: Cassell Academic.

[119] Edquist C. (2001). “Systems of Innovation for Development”. World Industrial Development Report (WIDR) 2001.

[120] Emery, R. (1967). “The relation of Exports and Economic Growth”. *Kyklos*, 20 (2): pp. 470-86.

[121] Enders, W. (1995). *Applied Econometric Time Series.* John Wiley and Sons, INC.

[122] Enos, J. (1995). *In pursuit of Science and Technology in Sub-Saharan Africa. Impact of Structural Adjustment Programmes.* UNU INTECH Studies in New Technology. Routledge.

[123] Esfahani, H. (1991). “Exports, imports, and economic growth in semi-industrialized countries”. *Journal of Development Economics*, 35: pp. 93-116.

[124] Esfahani, H.and M. Ramirez (2003). “Institutions, infrastructure and economic growth”. *Journal of Development Economics*, 70: pp. 443-477.

[125] Estache, A. (2005). “What Do We Know About Sub-Saharan Africa’s Infrastructure and the Impact of the 1990s Reforms?”. Mimeo, World Bank, Washington DC.

[126] Fagerberg, J. (1987). “A Technology Gap Approach to Why Growth Rates Differ”. *Research Policy*, 16: pp. 87-99.

[127] Fagerberg, J. (1988). “International Competitiveness”. *Economic Journal*, 98: pp. 355-374.

[128] Fagerberg, J. (1994). “Technology and International Differences in Growth Rates”. *Journal of Economic Literature*, 32: pp. 1147-1175.

[129] Feder, G. (1983). “On Exports and Economic Growth”. *Journal of Development Economics*, 12: pp. 59-73.

[130] Fedderke, J. and Z. Bogetic (2006). Infrastructure and Growth in South Africa: Direct and Indirect Productivity Impact of 19 Infrastructure Measures”. World Bank Policy Research Working Paper 2989.

[131] Feinson, S. (2003). “ National Innovation Systems Overview and Country Cases”. Knowledge Flows, Innovation and Learning in Developing Countries. A Project for the Global Inclusion Program of the Rockefeller Foundation.

[132] Ferrantino, M. and S. A. Gutierrez de Pineres. (1997). “Export Diversification and Structural Dynamics in the Growth Process: The Case of Chile”. *Journal of Development Economics*, 52(2): pp. 375-391.

[133] Ferraro, V. (1996) "Dependency Theory: An Introduction". Mount Holyoke College, South Hadley, MA.

[134] Findlay, R. (1978). "Relative Backwardness, Direct Foreign Investment and the Transfer of Technology: A simple Dynamic Model". *Quarterrly Journal of Economics,* 12(1): pp.42-56.

[135] Finger, J. and M. Kreinin (1979). "A Measure of 'Export Similarity' and its Possible Uses". *The Economic Journal*, 89: pp. 905-12.

[136] Fosu, A. (1990). "Export Composition and the Impact of Exports on Economic Growth of Developing Economies". *Economic Letters,* 34: pp. 67-71.

[137] Frank, A.G.(1972). "The Development of Underdevelopment". in James D. Cockcroft, A. G. Frank, and Dale Johnson (eds.). *Dependence and Underdevelopment.* Garden City, New York: Anchor Books, 1972, p. 3.

[138] Fransman, M. (1986). *Technology and Economic Development.* London: Macmillan Press.

[139] Freeman, C. (1987). *Technology Policy and Economic Performance: Lessons from Japan.* London: Francis Pinter.

[140] Fullerton, T. Jr., W. Sawyer and R. Sprinkle (1999). "Latin American Trade Elasticities". *Journal of Economics and Finance*, 23(2): pp. 143-156.

[141] Gachino, G. (2006). *Foreign Direct investment, Spillovers and Innovation.* Ph.D. thesis, Maastricht University.

[142] Galbraith. J.(2007): "Global Inequality and Global Macroeconomics". *Journal of Policy Modeling*, 29: pp. 587-607.

[143] Gelb, A. (1986). "Adjustment to Windfall Gains: a Comparative Analysis of Oil-Exporting Countries," in Neary, J. Peter and Sweder van Wijnbergen (eds.). *Natural Resources and the Macroeconomy.* Oxford, Blackwell.

[144] Gelb, A. (1988). *Oil Windfalls: Blessing or Curse?* Oxford University Press, New York.

[145] Gelb, A., J. Knight and R. Sabot (1991). "Public Sector Employment, Rent Seeking and Economic Growth". *Economic Journal*, 101: pp. 1186-1189.

[146] George, G. and G. Prabhu (2003). “Development Financial Institutions as Technology Policy Instruments: Implication for Innovation and Entrepreneurship in Emerging Economies”. *Research Policy*, 32: pp. 89-108.

[147] Gerschenkron, A. (1962). *Economic Backwardness in Historical Perspective.* Cambridge, Belknap Press of Harvard University Press.

[148] Ghatak, S. and S. Price (1997). “Export Composition and Economic Growth: Cointegration and Causality Evidence for India”. *Weltwirtchaftliches Archiv*, 133(3): pp. 538-553.

[149] Ghatak, S., C. Milner and U. Utkulu (1997). “Exports, Export Composition and Growth: Cointegration and Causality Evidence for Malaysia”. *Applied Economics*, 29: 213-223.

[150] Gomulka, S. (1971). “Inventive Activity, Diffusion and the Stages of Economic Growth”. Skrifter fra Aarhus Universitets Okonomiske Institut, Aarhus.

[151] Good, K. (1992). "Interpreting the Exceptionality of Botswana". *Journal of Modern African Studies,* 30(1): pp. 69-95.

[152] Goodfriend, M. and J. McDermot (1998). “Industrial Development and the Convergence Question”. Federal Reserve Bank of Richmond, Working Paper No. 99-1.

[153] Gordon, R. (1998). Macroeconomics. Adison Wesley Longman, Inc.

[154] Greenaway, D.and R. Lamusse (1999). “Private and public sector responses to the 1972-75 sugar boom in Mauritius”. In: Collier,P and J.W.Gunning (eds). *Trade Shocks in Developing Countries.* Oxford: Clarendon Press.

[155] Greene, W. H. (2000). *Econometric Analysis* (4th edition). NJ: Prentice Hall.

[156] Greenwood, J., and B. Jovanovic (1990). ‘Financial Development, Growth and the Distribution of Income’. *Journal of Political Economy*, 98(5): pp. 1076–1107.

[157] Griliches, Z. (1957). “Hybrid corn: an exploration in the economics of technological change”. *Econometrica*, 25(4): pp. 501-522.

[158] Grier, R. (2003). “The Interaction of Human and Physical Capital Accumulation: Evidence from Sub-Saharan Africa”. Working Paper, University of Oklahoma, Norman, OK.

[159] Grobbelaar, N. and K.Sotetsi (2005). "Africa's First Welfare State:The Experience of South African Firms Doing Business in Botswana". The South African Institute of International Affairs.

[160] Grossman, G. and E. Helpman. (1991). *Innovation and Growth in the Global Economy.* MIT Press.

[161] Gulhati, R. and R. Nallari (1990). "Successful Stabilisation and Recovery Policy in Mauritius". EDI Development Case Series, World Bank, Washington D.C.

[162] Gylfason, T. (2001a). "Natural Resources, Education, and Economic Development". *European Economic Review*, 45: pp. 847-859.

[163] Gylfason, T. (2001b). "Natural Resources and Economic Development: Wht is the Connection". CESifo Working Paper no 530.

[164] Gylfason, T. (2004). "Natural Resources and Economic Growth: From Dependence To Diversification". CEPR Discussion Paper No. 4804, December 2004.

[165] Gylfason, T. and G. Zoega (2001). "Natural Resources and Economic Growth: The Role of Investment". CEPR Discussion Paper No. 2743.

[166] Habiyaremye, A. (2003). "Authoritarianism and Economic Development: the Example of Korea's Park Chung Hee". *Samenhang- Urugwiro*, no3, june 2003.

[167] Habiyaremye, A. (2005). "Dependence on Primary Commodities and Poverty Traps in Sub-Saharan Africa: Devising strategies and building capabilities for diversification". UNU-INTECH Discussion Paper Series, No 2005-09.

[168] Habiyaremye, A. (2008). "Economic Proximity and Technology Flows: South African Trade and Investment Effects on Botswana's Diversification Effort". UNU-WIDER Research Paper no 2008-093 (presented at the UNU-WIDER CIBS Conference on Southern Engines of Global Growth, Helsinki, 7-9 September, 2007).

[169] Habiyaremye, A. and T. Ziesemer (2006). "Absorptive Capacity and Export Diversification in Sub-Saharan Africa". UNU-MERIT Working Paper No 2006-30.

[170] Habiyaremye, A. and T. Ziesemer (2008). "Export Demand Elasticities as Determinants of Growth: Estimates for Mauritius". UNU-MERIT Working Paper No 2008-72.

[171] Hakura, D. and F. Jaumotte (1999)."The Role of Inter-and Intra-industry Trade in Technology Diffusion". IMF Working Paper WP/99/58.

[172] Hanushek, E. (1995). "Interpreting Recent Research on Schooling in Developing Countries". World Bank.

[173] Head, K., J. Ries and D. Wagner (1997). "Immigrant as Trade Catalysts". In: Dobson W. and A.E Safarian (eds). *The People Link: Human Resource Linkages Across the Pacific*. University of Toronto Press.

[174] Helpman E. and P. Krugman (1985). *Market Structure and Foreign Trade*. The MIT Press, Cambridge (Mass).

[175] Hekkert, M., R. Suurs, H. van Lente and S. Kuhlman (2005). "Functions of Innovation Systems: A New Approach for Analysing Socio-economic Transformations". Draft Paper, University of Utrecht.

[176] Herzer, D. (2005). Exportdiversifizierung und Wirtschaftswachstum in Chile: Eine Ökonometrische Analyse. *Jahrbuch für Nationalöconomie und Statistik*. 225: pp.163-180.

[177] Hirsch, S. (1967). *Location of Industry and International Competitiveness*. Oxford; Clarendon.

[178] Hoff, K. and J. Stiglitz (2002). "Obstacles to the Emergence of the Rule of Law in Post-Communist Societies: Coordination Failures and Conflicts of Interest". Mimeo, World Bank, Washington DC.

[179] Hope, K. R. (1998). "Development Policy and Economic Performance in Botswana: Lessons for the Transition Economies in Sub-Saharan Africa". *Journal of International Development*, 10(4): pp. 539-54.

[180] Houthakker, H. and S. Magee (1969). "Income and Price Elasticities in World Trade". *The Review of Economics and Statistics*, 51(2): pp. 111-125.

[181] Howitt, P. and P. Aghion (1998). "Capital Accumulation and Innovation as Complementary Factors in Long-Run Growth". *Journal of Economic Growth*, 3: pp.111-130.

[182] Hulten, C. and R. Schwab (1991), "Public Capital Formation and the Growth of Regional Manufacturing Industries". *National Tax Journal*, 44(4): pp 121-134.

[183] Hunt, J. and J. Tybout (2000). "Does Promoting High-Tech Products Spur Development?". In Rocha, R. and M. Olarreaga (eds). *Competitividad de las Exportaciones en Colombia*. Bogota: Tercer Mundo, 2000.

[184] Isham, J., M. Woolcock, L. Pritchett and G. Busby (2003) “The Varieties of Resource Experience: How Natural Resource Export Structures Affect the Political Economy of Economic Growth”. Middlebury College Economics Discussion Paper 03-08.

[185] Islam, M. (1998). “Export Expansion and Economic Growth: Testing for Cointegration and Causality”. *Applied Economics*, 30: pp. 415-425.

[186] Jacobsson, S. and A. Johnson (2000), The diffusion of Renewable Energy Technology: an analytical framework and key issues for research. *Energy Policy*, 28(9): p. 625- 640.

[187] Jacobsson, S., B. Sanden and L. Bangens(2004). “Transforming the energy system:The evolution of the German technological system for solar cells”. *Technological, Analytical and Strategic Management.* 16(1): pp.3–30.

[188] Jaumotte, F. (1998). «Technology Diffusion and Trade: An Empirical Investigation» Université Catholique de Louvain, Institut de Recherches Economiques et Sociales (IRES) Discussion Paper No 1997021

[189] Jefferis, K. and T. Kelly (1999). “Botswana: Poverty amid Plenty”. *Oxford Development Studies*, 27 (2): pp. 211-31.

[190] Johnson, A. (2001). "Functions in Innovation System Approaches". Paper for DRUID’s Nelson-Winter Conference. 2001. Aalborg, Denmark.

[191] Johnson, A. and S. Jacobsson (2001). “Inducement and Blocking Mechanisms in the Development of a New Industry: The Case of Renewable Energy Technology in Sweden”. In: Coombs, R., K. Green, A. Richards and V. Walsh (eds). *Technology and the Market. Demand, Users and Innovation.*Edwar Elgar Publishing Ltd., Cheltenham (2001), pp. 89–111.

[192] Jomo, K.S. (2002). “Southeast Asia’s Ersatz Miracle”. in Jomo K.S ed.(2002). Southeast Asian Developmental States in Comparative East-Asian Perspective.

[193] Jones, R. (1971). “A Three Factor Model in Theory, Trade and History” in: Bhagwati, J.N. (eds). *Trade, Balance of Payment and Growth. Essays in Honor of C.P. Kindleberger*. Amsterdam.

[194] Jones, C. (1995). “R&D-Based Models of Economic Growth”. *Journal of Political Economy*, 103: pp. 759-784.

[195] Jonkers, E. (1951). *Keur uit de Werken van Cicero*, Tweede druk. E.J Brill, Leiden.

[196] Juma, C., K.Fang, D. Honca, J. Huette-Perez, V. Konde, and S. Lee (2001). “Global Governance of Technology: Meeting the Needs of Developing Countries”. *International Journal of Technology Management.* 22(7): pp.629-655.

[197] Jung, W.(1986). “Financial Development and Economic Growth: International Evidence”. *Economic Development and Cultural Change*, 34: pp. 336-46.

[198] Kaplinsky, R. (2005). *Globalisation, Poverty and Inequality.* Cambridge, Polity Press.

[199] Kasahara S. (2004). “The Flying Geese Paradigm: A Critical study of Its Application to East Asian Regional Development”, UNCTAD, Discussion Paper # 169.

[200] Katz, J. (1994). “Technology, Economics and Late Industrialisation”. Chapter 7 in Salomon, J.-J., F. Sagasti and C. Sachs-Janet, (eds). *The Uncertain Quest: Science, Technology and Development.* UNU Press.

[201] Kay, C. (1989) *Latin American Theories of Development and Underdevelopment.* Routledge, London and New York

[202] Keller, W. (1994). “Absorptive Capacity: Understanding the Creation and Acquisition of Technology in Development”. Yale University

[203] Keller, W. (1995). “Are International R&D Spillovers Trade-Related? Analyzing Spillovers among Randomly Matched Trade Partners.” Department of Economics, University of Wisconsin.

[204] Keller, W. (1997). ‘Trade and the Transmission of Technology”. NBER Working Paper no W6113.

[205] Keller, W. (2004). “ International Technology Diffusion”. *Journal of Economic Literature*, 42(3): pp. 752-782.

[206] Khan, M. and M. Knight (1988). “Import Compression and Export Performance in Developing Countries”. *Review of Economics and Statistics*, 70(2): pp. 315-321.

[207] Khor, M. (2000). “Globalisation and the South: Some Critical Issues”. UNCTAD Discussion Papers, No147, April 2000.

[208] Kim, K. (2000). “An Analysis of Sources of Growth in East Asian Economies and R&D Spillover Effects”. *Journal of the Korean Economy*, Vol. 1.

[209] Kim, L. (1997). *From Imitation to Innovation. The Dynamics of Korea’s Technological Learning.* Boston, MA: Harvard Business School Press.

[210] Kim, L. (2000). 'Korea's Ntional Innovation System in Transition' in: Kim, L and R. R. Nelson (eds.), *Technology, Learning, and Innovation: Experience of Newly Industrializing Economies*, Cambridge University Press.

[211] Kim, L., J. Lee and J. Lee (1987). Korea's Entry into the Computer Industry and its Acquisition of Technological Capability". *Technovation*, 6: pp.277-293.

[212] King, R., and R. Levine (1993a). "Finance, Entrepreneurship and Growth: Theory and Evidence". *Journal of Monetary Economics*, 32 (3): pp.513–42.

[213] King, R., and R. Levine (1993b). "Finance and Growth: Schumpeter Might Be Right"'. *Quarterly Journal of Economics* 108(3): pp. 717-37.

[214] Korhonnen P. (1994). "The Theory of Flying Geese Pattern of Development and its Interpretation". *Journal of Peace Research*, 31(1): pp. 93-108.

[215] Kravis, I.(1970). "Trade as a Handmaiden of Growth". *Economic Journal*, December: pp. 850-872.

[216] Krishna, K., A.Ozyildirim and N. Swanson (2003). "Trade, investment and growth: nexus, analysis and prognosis". *Journal of Development Economics*, 70: pp. 479-499.

[217] Kronenberg, T. (2005). "The Curse of Natural Resources in the Transition Economies". *Economics of Transition*, 12 (3): pp. 399-426.

[218] Krugman, P. (1979). "Increaing Returns, Monopolistic Competititon and International Trade". *Journal of International Economics*, 9: pp.469-479.

[219] Krugman, P. (1981). "Intraindustry specialisation and the gains from trade". *The Journal of Political Economy,* 89(5): pp. 959-973.

[220] Krugman, P. (1987). "The Narrow Moving Band, The Dutch Disease, and the Consequences of Mrs. Thatcher's Notes on Trade in the Presence of Scale Economies". *Journal of Development Economics*, 27: pp.41-55.

[221] Kuznets, S. (1966). *Modern Economic Growth.* New Haven, CT: Yale University Press.

[222] Kuznets, S. (1971). "Modern Economic Growth: Findings and Reflections" Lecture to the Memory of Alfred Nobel, December 11, 1971. Nobel Lectures.

[223] Kwan, C.H. (2002). "The Rise of China and Asia's Flying-Geese Pattern of Economic Development: An Empirical Analysis Based on US Import Statistics". NRI Papers. Nomura Research Institute.

[224] Lal, K. and A. S. Peedoly (2007). "TextilesandClothing Industry and Economic Development: A Global Perspective: A Case Study of Mauritius". UNU-MERIT Working Paper.

[225] Lall, S. (1992a). Technological Capabilities and Industrialisation. *World Development*, 20(2): pp. 165-186.

[226] Lall, S. (1992b). "Structural Problems of African Industry," in: Stewart, F., S. Lall and S. Wangwe (eds). Alternative Development Strategies in Sub-Saharan Africa. London: Macmillan.

[227] Lall, S. (2000). "FDI and Development: Policy and Research Issues in the Emerging Context" QEH Working Paper Series – QEHWPS43, 2000

[228] Lall, S., G. Barba Navaretti, S Teitel and G Wignaraja, 1994. Technology and Enterprise Development: Ghana Under Structural Adjustment. London: Macmillan.

[229] Lamusse, R. (1995). "Mauritius", in Wangwe S. (ed.). *Exporing Africa. Technology, Trade and Industrialisation in Sub-Saharan Africa.* UNU-INTECH Studies in New Technology. Routledge.

[230] Landes, D. (1969). *The Unbound Prometheus.* Cambridge University Press, Capbidge.

[231] Landes, D. (1998). *The Wealth and Poverty of Nations: Why Some Are So Rich and Some So Poor.* W.W. Norton & Co., New York.

[232] La Porta, R., F. Lopez-de-Silanes, A. Shleifer and R. Vishny (199). "Law and Finance". *Journal of Political Economy*, 10(6): pp. 1113-1155.

[233] Lederman, D. and W. Maloney (2003). "Trade Structure and Growth" World Bank Policy Research Working Paper No 3025. World Bank, Washington DC.

[234] Lee, Jong-Wha, (1995). "Capital goods Imports and Long-Run Growth". *Journal of Development Economics*, 48(1): pp. 91-110.

[235] Leeper, E. and B. Gordon (1992). "In search of the liquidity effect". *Journal of Monetary Economics*, 29(3): pp. 341-369.

[236] Leipziger, D., M. Fay, Q. Wodon and T. Yepes (2003). "Achieving the Millennium Development Goals: The Role of Infrastructure", World Bank Policy Research Working Paper 3163.

[237] Leith, J. J.(1999). "Botswana: A Case Study of Economic Policy Prudence and Growth" .The World Bank Publications. The World Bank, Washington DC.

[238] Levine, R. (2005) “Finance and Growth”. Ch. 21 of Aghion, P. and S. N. Durlauf (eds). *Handbook of Economic Growth*, Elsevier, North- Holland.

[239] Levine, R., N. Loayza and T. Beck (2000). “Financial Intermediation and Growth: Causality and Causes”. *Journal of Monetary Economics*, 46(1): pp. 31-77.

[240] Levine, R.and S.Zervos (1998). “Stock Markets, Banks, and Economic Growth”. *American Economic Review*, 88(3): pp. 537-558

[241] Lewer, J. and H. van den Berg (2003). “How Large is International Trade’s Effect on Economic Growth””. *Journal of Economic Surveys*, 17(3): pp. 363-396.

[242] Lewis, W. A. (1954). "Economic Development with Unlimited Supplies of Labour". *The Manchester School*, 22: pp. 105-138.

[243] Lewis, W.A. (1955). *The Theory of Economic Growth*. Homewood, IL: R. D. Irwin.

[244] Lewis, W.A. (1969). *Aspects of Tropical Trade 1883-1965*. Almqvist and Wicksell, Stockholm.

[245] Lewis, W.A. (1978).*The Evolution of the International Economic Order*. Princeton; Princeton University Press.

[246] Liebowitz, S. and S. Margolis (1990). "The Fable of the Keys". *Journal of Law & Economics*, 33: pp. 1-26.

[247] Lipsey, R. and Kravis (1987). "Is the U.S. a Spendthrift Nation?". NBER Working Paper No. W2274.

[248] List, F. (1841). *Das Nationale Systeme der Politischen Ökonomie*. Jena.

[249] Liu, X. and S. White (2001). “Comparing Innovation Systems: a Framework and Application to China’s Transnational Context”. *Research Policy*, 30: pp. 1091-1114.

[250] Lucas, R. (1988). “On the Mechanics of Economic Development”. *Journal of Monetary Economics*, 22(1): pp. 3-42.

[251] Lucas, R. (1993). "Making a Miracle". *Econometrica*, 61(2): 251-272.

[252] Lundvall, B.-Å. (1985). *Product Innovation and User-Producer Interaction.* Aalborg University Press.

[253] Lundvall, B.-Å.(ed). (1992). National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. London: Pinter Publishers, 1992.

[254] Lundvall, B.-Å. (1997). "Information Technology in the Learning Economy". *Communications & Strategies*, 28: pp 117-192, 1997.

[255] Lundvall, B.-Å. (1999). "National Business Systems and National Systems of Innovation". Special Issue on Business Systems, International Studies of Management and Organisation, Summer 1999.

[256] Madsen, J. (1999). "On Errors in Variable Biases in Estimates of Export Price Elasticities". *Economics Letters*, 63(3): pp. 313-319.

[257] Mansfield, E. (1961). "Technical Change and the Rate of Imitation". *Econometrica*, 29: pp. 741-766.

[258] Mansfield, E. (1968). *The Economics of Technological Change.* Norton & Company, New York.

[259] Mansfield, E. (1983). *Technology Transfer, Productivity, and Economic Policy.* Norton & Co Inc, New York.

[260] Mansfield, E., M. Schwartz and S. Wagner (1981). "Imitation Costs and Patent: An Empirical Study". *Economic Journal*, 91: pp. 907-918.

[261] Marwah, K and L. Klein (1996). "Capital Inflow and Economic Growth". *Carleton Economic Papers*, pp. 96-104.

[262] Marwah, K and L. Klein (1998). "Economic Growth and Productivity Gains from Capital Inflow: Some Evidence for India". *Journal of Quantitative Economics*, 14(1): pp. 81-108.

[263] Marwah, K. and A. Takavoli (2004). "The Effect of Foreign Capital and Imports on economic growth: Further evidence from four Asian countries (1970-1998)". *Journal of Asian Economics,* 15: pp 399-413.

[264] Matsuyama, K. (1992). "Agricultural Productivity, Comparative Advantage and Economic Growth". *Journal of Economic Theory*, 58. pp.317-334.

[265] Matsuyama, K. (2005). Structural Change. [in:] Blume L. and S. Durlauf (eds.). *The New Palgrave Dictionary of Economics*, 2nd Edition, Macmillan.

[266] Maundeni, Z. (2001). "State Culture and Development in Botswana and Zimbabwe". *Journal of Modern African Studies*, 40 (1): pp105 - 132.

[267] Mayer, J. (2000). "Globalisation, Technology Transfer and Skill Accumulation in Low-Income Countries". UNCTA D Discussion Papers Series, no 150.

[268] Mazumdar, J. (1999). “Imported Machinery and growth in LDC”. *Journal of Development Economics,* 65(1): pp.209-224.

[269] Mauritian Research Council (2006). Manufacturing Technology. MRC Publications.

[270] Meade, J., H. Houghton, N Lees, R. Marshall, G. Roddan and P. Selwyn. (1961). "The Economics and Social Structure of Mauritius: Report to the Government of Mauritius" . London Methuen.

[271] Medina-Smith, E. (2001). “Is the Export-Led Growth Hypothesis Valid for Developing Countries? A Case Study of Costa Rica”. Policy Issues in International Trade and Commodities Studies Series no 7. UNCTAD, Geneva and New York.

[272] Meier, G. and J. Rauch (2004). *Leading Issues in Economic Development* (8th ed.) Oxford University Press, Oxford.

[273] Meisenhelder, T. (1994). “Bonanza and Dependency in Botswana”. *Studies in Comparative Economic Development*, 29(Spring): pp. 38-49.

[274] Merton, R.C., and Z. Bodie (1995). “A Conceptual Framework for Analysing the Financial Environment”. in: Crane, D.B. et al. (eds). *The Global Financial System, A Functional Perspective.* Harvard Business School Press: Cambridge MA.

[275] Mody, A. and K. Yilmaz. (1997). “Is There Persistence in the Growth of Manufactured Exports? Evidence from Newly Industrializing Countries”. *Journal of Development Economics*, 53(2): pp. 447-470.

[276] Mokyr, J. (1990). The Lever of Riches: Technological Creativity and Economic Progress. New York, Oxford University Press.

[277] Muchie, M. (2005). “Towards AfricanSystems of Innovation: Reframing Development Theory to Provide Real Answer to the African Dilemma”. Paper presented in UNU-INTECH Seminar March 2005.

[278] Muchie M., P. Gammeltoft and B-A. Lundvall (2003). *Putting Africa First: The Making of African Innovation Systems.* Aalborg. Alborg University Press.

[279] Mutz, C. and T. Ziesemer (2008). “Simultaneous Estimation of Income and Price Elasticities of Export Demand, Scale Economies and Total Factor Productivity Growth for Brazil”. *Applied Economics*, 40(22): pp. 2921 - 2937.

[280] Mytelka, L. (2001). "Promoting Scientific and Technological Knowledge for Sustainable Development". UNU- INTECH Working Paper.

[281] Narula, R. (2004). "Understanding absorptive capacities in an “innovation systems” context: consequences for economic and employment growth". MERIT Infonomics Research Memoranda Series.

[282] Navaretti, G. Barba and I. Soloaga (2001). “Weightless Machines and Costless Knowledge: An Empirical Analysis of Trade and Technology Diffusion”. The World Bank , 2001.

[283] Navaretti, G. Barba, I. Soloaga and W. Takacs (2000). “Vintage Technologies and Skill Constraints: Evidence from U.S. Exports of New and Used Machines”. *The World Bank Economic Review*, 14(1): pp. 91-109.

[284] Navaretti, G. Barba and D. Tarr (2000). “International Knowledge Flow and Economic Performance: A review of the Evidence”. The World Bank Economic Review, 14 (1): pp. 1-15.

[285] Neff, T. (1997) “Improving Energy Security in Pacific Asia: Diversification and Risk Reduction for Fossil and Nuclear Fuels” Project Commissioned by the Pacific Asia Regional Energy Security (PARES)". Massachusetts Institute of Technology, Center for International Studies.

[286] Nelson, R. (1993). *National Innovation Systems.* Oxford University Press, New York.

[287] Nelson, R. and E. Phelps (1966). “Investment in Humans, Technological Diffusion, and Economic Growth”. *American Economic Review*, 56: pp. 69-75.

[288] Nelson, R. and S. Winter (1982). *An Evolutionary Theory of Economic Change.* Belknap Press/ Harvard University Press: Cambridge.

[289] Newey, W. and K. West (1994). “Automatic Lag Selection in Covariance Matrix Estimation”. *Review of Economic Studies*, 61: pp. 631-653.

[290] Ng, F. and A. Yeats (1996). “Open Economies Work Better: Did Africa’s Protectionist Policies Cause its Marginalisation in World Trade?” World Bank Policy Research Working Paper no 1636.

[291] North, D. (1990). Institutions, Institutional Change, and Economic Performance, Cambridge University Press, New York.

[292] North, D. and R. Thomas (1973). The Rise of the Western World: A New Economic History, Cambridge University Press, Cambridge UK.

[293] Nyang' oro, J. E. (1992). "The Evolving Role of the African State Under the Structural Adjustment". in Nyang' oro, J. and T. Shaw (eds). *Beyond Structural Adjustment in Africa*. PRAEGER, New York.

[294] OECD (1987). *Structural Adjustment and Economic Performance*. OECD, Paris.

[295] OECD (1999). *Managing Innovation Systems*. OEDC, Paris.

[296] OECD (2005). *Governance of Innovation Systems*, Vol. 2: Case Studies in Innovation Policy, OECD, Paris.

[297] Ovidius Naso, P. .*Metamorphoseon*.

[298] Oxfam (2005). "Hypocritical" international aid system fails world's poorest". Press Release 28 February 2005 also available on: http://www.oxfam.org/eng/pr050228_MDGs_paris.htm accessed last on 06-06-2008.

[299] Pakdaman, N. (1994). "The Story of Development Thinking". in: Salomon, J., F. Sagasti and C. Sachs-Jeantet (eds). *The Uncertain Quest: Science, Technology and Development*. UNU Press.

[300] Parteka, A. and M. Tamberi (2008). "Determinants of Export Diversification: An Empirical Investigation". Quaderni di Ricerca no 327, Universita Politecnica delle Marche.

[301] Pasinetti, L. (1981). *Structural Change and Economic Growth. A Theoretical Essay on the Dynamics of the Wealth of Nations*. Cambridge University Press, Cambridge.

[302] Persson, T. and G. Tabellini (1994). "Is Inequality Harmful for Growth?". *American Economic Review*, 84(3): pp. 600-621.

[303] Petri, P. (1993) "The Lessons of East Asia: Common Foundations of East Asian Success". The World Bank, Washington DC.

[304] Plümper, T., V. Troeger and P. Manow (2005)."Panel data analysis in comparative politics: Linking method to theory". *European Journal of Political Research*, 44(2): 327–354.

[305] Plümper, T. and V. Troeger (2006)." Efficient Estimaton of Time-Invariant and Rarely Changing Variables in finite Sample Panel Analysis with Unit Fixed Effects". Unpublished Working Paper, Max Planck Institute of Economics, Jena.

[306] Posner, M. (1961). International Trade and Technical Change. Oxford Economic Papers, 13: pp.323-341.

[307] Prebisch, R. (1950). “The Economic Development of Latin America and its Principal Problems”. *Economic Bulletin for Latin America*, 7 (1) February 1962 (reprinted): pp.1-22.

[308] Prebisch, R. (1959). “Commercial Policy in the Underdeveloped Countries”. *The American Economic Review*, 49(2): pp. 251-273.

[309] Pritchett, L. (1996). “Where Has all the Education Gone?”. World Bank Policy Research Working Paper #1581.

[310] Prszeworsky, A. and J. R. Vreeland (2000). “The Effect of IMF Programs on Economic Growth”. *Journal of Development Economics*, 62(2): pp. 385-421.

[311] Psacharopoulos, G. (1985). “Returns to education: A Further International Update and Implications”. *Journal of Human Resources*, 20: pp.583-604.

[312] Psacharopoulos, G. (1991). The Economic Impact of Education: Lessons for Policymakers. ICS Press, San Francisco.

[313] Rajan, R. and L. Zingales (1998). “Financial Deepening and Growth”. *American Economic Review*, 88(3): pp. 559-586.

[314] Ramsey, F. (1928). "A mathematical Theory of Saving”. *Economic Journal*, 38: pp.543-559.

[315] Ranis, G. (1988) “Analytics of Development: Dualism”. Chapter 4 in Chenery, H. and T.N. Srinivasan (eds). *Handbook of Development Economics*, Vol.1, Elsevier Science Publishers B.V., Amsterdam.

[316] Rasiah, R. (1998). “The export manufacturing experience of Indonesia, Malaysia and Thailand: Lessons for Africa”. UNCTAD Discussion Papers.

[317] Rebelo, S. (1991). “Long Run Policy Analysis and Long Run Growth”. *Journal of Political Economy*, 98, pp. 500–521.

[318] Ricardo, D. (1817). Principles of Political Economy and Taxation. London.

[319] Rickne, A. (2001). Assessing the Functionality of an Innovation System. Chalmers University of Technology: Goteborg.

[320] Rivera-Batiz, L. and P. Romer (1991). “Economic Integration and Endogenous Growth”. *Quarterly Journal of Economics*, 106: pp. 531-555.

[321] Robinson, J. (1952). *The Rate Interest and Other Essays.* New York: Macmillan.

[322] Robinson, J., R. Thorvik and T Verdier(2005). “Political Foundation of the Resource Curse”. Paper prepared for the conference to celebrate Pranab Bardhan’s tenure as editor of the Journal of Development Economics.

[323] Rodrigues, F. and D. Rodrik (1999). "Trade Policy and Economic Growth: A Skeptic’s Guide to the Cross-National Evidence". NBER Working Paper no: 7081, Cambridge, MA.

[324] Rodrik, D. (1999). *The New Global Economy and Developing Countries: Making Openness Work.* London, Overseas Development Council

[325] Rodrik, D. (2003). Introduction in: Rodrik, D.(ed). *In Search of Prosperity.* Princeton University Press, p.4.

[326] Rogers, M. (2004). “Absorptive Capability and Economic Growth: How Do Countries Catch-up”. *Cambridge Journal of Economics*, 28: pp.577-596.

[327] Romer, P. (1986).” Increasing Returns and Long-Run Growth”. *Journal of Political Economy*, 94: pp.1002-37.

[328] Romer, P. (1990). “Endogenous Technical Change”. *Journal of Political Economy*, 98: pp. 71-102.

[329] Roodman, D. (2007). "A Short Note on the Theme of Too Many Instruments". Center for Global Development Working Paper Nr. 125.

[330] Roubini, N. and X. Sala-I-Martin (1992), “Financial repression and economic growth”. *Journal of Development Economics*, 39: pp. 5-30.

[331] Ruttan, V. (2000). Technology, Growth and Development: An Induced Innovation Perspective. Oxford University Press.

[332] Sachs, J. and A. Warner (1997). “Natural Resources Abundance and Economic Growth”. NBER Working Paper no 5398.

[333] Sachs, J. D. and A. M. Warner (1997). “Natural Resources Abundance and Economic Growth”. Harvard Institute for International Development, November 1997, pp.1-25.

[334] Sachs J., J. McArthur, G. Schmidt-Traub, M. Kruk, C. Bahadur, M. Faye, and G. McCord (2004). "Ending Africa's Poverty Traps". Brookings Papers in Economics.

[335] Sarewitz, D. (2003). "Knowledge Flows and Knowledge Collectives: Understanding The Role of Science and Technology Policies in Development". Knowledge Flows, Innovation and Learning in Developing Countries. A Project for the Global Inclusion Program of the Rockefeller Foundation.

[336] Sarraf, M. and M. Jiwanji (2001). "Beating the Resource Curse: The Case of Botswana". World Bank Publications, The World Bank, Washinton DC, 2001.

[337] Sen, A. (1983). "Development: Which Way Now?". *Economic Journal*, 93: pp. 745-762.

[338] Sen, A. (1988). "The Concept of Development". Chapter 1 in Chenery, H. and T.N. Srinivasan (eds). *Handbook of Development Economics*, Vol.1, Elsevier Science Publishers B.V., Amstrdam.

[339] Seneca, A.L.(around 64-65 AD). "Quare Aliqua Incommoda Bonis Viris Accidant Cum Sit Providentia". De Providentia.

[340] Senhadji, A. and C. Montenegro (1998). "Time Series Analysis of Export Demand Equations: A Cross-Country Analysis". International Monetary Fund Working Papers, WP/98/149.

[341] Sentsho, J. (2000). Export Promotion in a Mineral-Based Economy: The Case of Botswana. PhD Thesis, the University of Strathclyde.

[342] Singh, L. (2004). "Domestic and International Knowledge Spillovers in the South Korean Manufacturing Industries". *Economic and Political Weekly*, 39(5): pp. 498-505.

[343] Silverberg, G. (1984). "Embodied Technical Progress in a Dynamic Economic Model: the Self-Organisation Paradigm", in Goodwin, R., M. Krüger, and A. Vercelli (eds). *Nonlinear Models of Fluctuating Growth: 192-208* . Berlin-Heidelberg-New York: Springer Verlag.

[344] Silverberg, G. (2002). "The discrete charm of the bourgeoisie: quantum and continuous perspectives on innovation and growth". *Research Policy*, 31: pp. 1275-1289.

[345] Silverberg, G. and D. Lehnert (1993). "Long waves and evolutionary chaos in a simple Schumpeterian model of embodied technical change". *Structural Change and Economic Dynamics*, 4: pp. 9–37.

[346] Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations.*

[347] Södersten, B. and G. Reed (1994). *International Economics*. London: Macmillan.

[348] Soete, L. and R. Turner (1984). "Technology Diffusion and the Rate of Technical Change". *Economic Journal*, 94: pp. 612-623.

[349] Solow, R. (1956). "A Contribution to the Theory of Economic Growth". *Quarterly Journal of Economics*, 70(1): pp. 65-94.

[350] Solow, R. (1957). "Technical Change and the Aggregate Production Function". *Review of Economics and Statistics*, 39: pp. 312-320.

[351] Stein, H. (1999). "Globalisation, Adjustment and the Structural Transformation of African Economies: The Role of International Financial Institutions". CSGR Working Paper no 32/99 University of Warwick.

[352] Stewart, J. (2004). "The best of Times or the Worst of Times: Alternative Visions of Africa in the 21st Century". *The Great Lakes Research Journal*, 1(Dec): pp. 1-18.

[353] Stewart, J. (2005). *Introduction to Applied Econometrics*. South-Western College Publishing.

[354] Stokey, N. (1988). "Learning by Doing and the Introduction of New Goods". *Journal of Political Economy*, 96: pp. 701-717.

[355] Stokke, H.(2004). "Technology Adoption and Multiple Growth Paths:An Intertemporal General Equilibrium Analysis of the Catch-up Process in Thailand". Working Paper, Norwegian University of Science and Technology.

[356] Subramanian, A. and D. Roy (2003). "Who Can Explain the Mauritian Miracle? Meade, Romer, Sachs or Rodrik?". in: Rodrik, D.(ed). *In Search of Prosperity*. Princeton University Press: pp. 205-243.

[357] Suh, J. (2000). "Korea's Innovation System: Challenges and New Policy Agenda" Discussion Paper No. 2000-4, Institute for New Technologies, The United Nations University, Maastricht, The Netherlands.

[358] Szirmai, A. (2005). *The Dynamics of Socio-Economic Development*. Cambridge University Press, Cambridge, UK.

[359] Szirmai, A. (2008). "Explaining Success and Failure in Development". Inaugural Lecture held Feb 15, Maastricht University, Maastricht, The Netherlands.

[360] Temple, J. (2001). "Growth effects of Education and Social Capital in the OECD Countries". *OECD Economic Studies*, 3: pp. 57-101.

[361] Temple, J. and H-J. Voth (1998). "Human Capital, Equipment Investment and Industrialisation". *European Economic Review*, 42: pp.1343-1362.

[362] Thangavelu, S. and G. Rajaguru (2004). "Is There an Export or Import-Led Productivity Growth in Rapidly Developing Asian Countries? A Multivariate VAR Analysis". *Applied Economics*, 36: pp. 1083-1093.

[363] Thorrens, R. (1821). *Essay on the External Corn Trade.* London.

[364] Timmer, C.P. (1988). The Agricultur Transformation". Chapter 8 in Chenery, H. and T.N. Srinivasan (eds). *Handbook of Development Economics*, Vol.1, Elsevier Science Publishers B.V., Amsterdam.

[365] Tregenna, F. (2006). "Explaining Botswana's Growth". Policy Library. Carnegie Council Publications.

[366] Tregenna, F. (2007). "Which Sectors Can be Engines of Growth and Employment in South Africa?: An Analysis of Manufacturing and Services". Paper presented at the UNU-WIDER CIBS Conference on Southern Engines of Global Growth, Helsinki, 7-9 September, 2007

[367] Tyler, W. (1981). "Growth and Export Expansion in Developing Countries: some Empirical evidence". *Journal of Development Economics*, 9: pp. 121-130.

[368] Ukpolo, V. (1994). "Export Composition and Growth of Selected Low-Income African Countries: Evidence from Time-Series Data". *Applied Economics*, 26: pp. 445-449.

[369] UNCTAD (2002a). Diversification of Production and Export in Commodity Dependent Countries, Including Single Commodity Exporters for Industrialisation and Development Taking into Account the Special Needs of the LDCs. Background note for expert meeting, Geneva 26-28 June 2002.

[370] UNCTAD (2002b). The Least Developed Countries Report 2002: Escaping the Poverty Trap. United Nations Publication, sales no. E.02.II.D.13, New York and Geneva.

[371] UNCTAD (2004). UNCTAD Handbook of Statistics 2004. UNCTAD, Geneva.

[372] UNCTAD (2005). UNCTAD Handbook of Statistics 2005. UNCTAD, Geneva.

[373] UNCTAD (2008). Trade and Development report 2008: Commodity prices, capital flows and the financing of investments. United Nations, New York and Geneva.

[374] Uzawa, H. (1965). Optimum Technical Change in an Aggregate Model of Economic Growth". *International Economic Review*, 6: pp.18-31.

[375] Verbeek, M. (2004). *A Guide to Modern Econometrics*, second edition. John Wiley & Sons, Chichester.

[376] Vernon. R. (1966). "International Investment and International Trade in the Product Life Cycle". *Quartely Journal of Economics*, 80: pp. 190-207.

[377] Verspagen, B. (1991). "A New Empirical Approach to Catching up or Falling Behind". *Structural Change and Economic Dynamics*, 2: pp.359-380.

[378] Verspagen, B. (1993). Uneven Growth between Interdependent Economies. Avebury, Aldershot.

[379] Verspagen, B. (1995). "R&D and Productivity: A Broad Cross-Section Cross-Country Look". Journal of Productivity Analysis, 6(2): pp. 117-35.

[380] Viotti, E. (2001). "National Learning Systems: A New Approach on Technical Change in Late Industrializing Economiesand Evidences from the Cases of Brazil and South Korea". Science, Technology and Innovation Discussion Paper No. 12, Center for International Development, Harvard University.

[381] Wacziarg, R. (2001). "Measuring the Dynamic Gains from Trade". *World Bank Economic Review*, 15: pp. 393-429.

[382] Wangwe, S. (1995). Introductory chapter in Wangwe S. (ed). *Exporting Africa: Technology, Trade and Industrialisation in Sub-Saharan Africa.* UNU-INTECH Studies in New Technology. Routledge.

[383] Weeks, S.G. (2002). "Pre-vocational Secondary Education in Botswana: A Historical and Comparative Perspective 1966 to 2002". Paper prepared for the Regional Vocational Skills Development Review, Human Development Africa Region, World Bank.

[384] Wignaraja, G.(2001). "Firm size, Technological Capabilities and Market-Oriented Policies in Mauritius". UNU-INTECh Discussion Paper Series.

[385] Wingnaraja, G., M. Lezama and D. Joiner (2004). Small States in Transition: From Vulnerability to Competitiveness. The Commonwealth Secretariat.

[386] Wolf, M. (2001). "Is Today's Globalisation Different from What Has Gone Before?". Manchester Statistical Society.

[387] Wolf, M. (2004). *Why Globalisation Works.* Yale University Press.

[388] Wooldridge J. (2002). *Econometric Analysis of Time Series and Panel Data.* MIT Press.

[389] World Bank (2007). World Development Indicators. Washington DC.

[390] World Bank (1989). Sub-Saharan Africa: From Crisis to Sustainable Development. Washington D.C.: World Bank.

[391] World Bank(1993). The East Asian Miracle. World Bank Publications, Washington DC.

[392] World Bank (1995). Workers in an Integrating World. World Development Report 1995. New York: Oxford University Press.

[393] World Bank(1998). Assessing Aid, The World Bank, Washington DC.

[394] World Bank (1991; 1998; 2001; 2004; 2005). World Development Report.

[395] World Bank (2007). World Development Indicators 2007. Washington DC.

[396] Xu, B. (2000). "Multinational enterprises, technology diffusion, and host country productivity growth". *Journal of Development Economics*, 62: pp. 477-93.

[397] Yanggen, D. (1998). "Incentives for Fertiliser Use in Sub-Saharan Africa: A review of Empirical Evidence on Fertiliser Response and Profitbility". East Lansing MI MSU Department of Agricultural Economics.

[398] Young, A. (1991). "Learning by Doing and the Dynamic Effects of International Trade". *Quarterly Journal of Economics*: pp. 369-405.

[399] Zhang Jun, Wan Guanghua and Jin Yu (2007). "The Financial Deepening–Productivity Nexus in China: 1987–2001". UNU-WIDER Research Paper No. 2007/08.

[400] Ziesemer, T. (1987). *Economic Theories of Underdevelopment.* Transfer Verlag Regensburg.

[401] Ziesemer, T. (1991). "Human capital, Market Structure and Taxation in a Growth Model with Endogenous Technical Progress". *Journal of Macroeconomics*, 13 (1): pp.47-68.

[402] Ziesemer, T. (1995a). "Growth with Imported Capital Goods, Limited Export Demand and Foreign Debt". *Journal of Macroeconomics*, 17 (1): pp. 31-53.

[403] Ziesemer, T. (1995b). "Economic Development and EndogenousTerms-of-Trade Determination : Review and Reinterpretation of the Prebisch-Singer Thesis". *UNCTAD Review 1995*: pp. 17-33.

Summary in Dutch

Samenvatting in Nederlands

Sinds de tijd dat de homo habilis de eerste rudimentaire werktuigen begon te gebruiken om zijn werk te vergemakkelijken, is technologische kennis bepalend geweest voor menselijke overleving en is zelfs later de belangrijkste stuwkracht geworden achter de economische vooruitgang van de mensheid. Zonder de aanwezigheid van deze kennis in een land zou de nationale economie niet in staat zijn om de beschikbare hulpbronnen optimaal te gebruiken. Landen waar deze kennis onvoldoende is, zoals het geval is in de meeste landen in Sub-Saharaanse Afrika (SSA), hoe goed ze ook begiftigd mogen zijn met natuurlijke rijkdommen, blijven desalniettemin economisch achtergesteld omdat zij slechts aangewezen zijn op de verkoop van hun natuurlijke rijkdommen als ruwe grondstoffen, in plaats van ze om te zetten in hoogwaardige eindproducten. Deze rijkdommen komen dus vooral ten goede van buitenlandse ondernemers die ze wel kunnen gebruiken om hoogwaardige goederen en diensten te produceren. Dit leidt vaak tot een patroon van economische afhankelijkheid in de handelsbetrekkingen. Een dergelijke economische verhouding gaat meestal gepaard met economische en sociale achterstand van landen die over overvloedige natuurlijke hulpbronnen beschikken ten opzichte van hun handelspartners die de nodige technologische kennis wel in huis hebben. Wanneer dit patroon van afhankelijkheid aanhoudt, is het dikwijls moeilijk voor het grondstofexporterende land om zich aan verschijnselen van extreme armoede te onttrekken.We betogen in dit proefschrift dat voor landen waar de economie gedomineerd is door de export van ruwe grondstoffen en andere primaire goederen, de verwerving van buitenlandse technologische kennis een onontbeerlijke voorwaarde is om uit deze afhankelijkheidspositie te komen. Alleen door kennis te verwerven kunnen de economieën van deze landen in staat worden gesteld het spectrum van hun productieve activiteiten uit te breiden en hun afhankelijkheid van de export van ruwe grondstoffen terug te dringen.

In het begin van dit proefschrift schetsen wij de achtergrond van de afhankelijkheid van primaire goederenexport en de daarmee samenhangende problemen van extreme armoede in SSA landen. Deze armoede wordt ook in verband gebracht met het zwakke aandeel van Afrika in internationale handel en investeringsgeldstromen, de voortdurende daling van de handelsruilvoet voor ruwe grondstoffen tegen eindprodukten en de technologische achterstand die de grondstoffen- exporterende landen kenmerkt. De gecombineerde gevolgen van deze factoren zijn verwoestend geweest voor de Afrikaanse bevolking, en haar al slechte levensomstandigheden zijn een soort onontknoopbare armoedevalstrik geworden, gekenmerkt door te lage besparingsratios, een te laag investeringskapitaal en een te laag niveau van menselijk kapitaal. Dit proefschift onderzoekt hoe deze schijnbaar uitzichtloze situatie van armoedevallen doorbroken kan worden door de ontwikkelingsinspanning te concentreren op het gebruik van geimporteerde technologieën om zo de afhankelijkheid van primaire goederen te verminderen. Deze technologieën kunnen echter slechts met succes worden verworven, toegepast en verspreid in het verwervende land indien dat land voldoende absorptief vermogen ontwikkeld heeft in de vorm van menselijk kapitaal, fysieke infrastructuur en instellingen die in innovatiesystemen voor ontwikkeling (SID) georganiseerd zijn. Onze hypothese is dat de afhankelijkheid van primaire goederen en het gebrek aan diversificatie te wijten is aan de afwezigheid van een kritieke drempel van absorptief vermogen dat nodig is om buitenlandse technologieën te verwerven, toe te passen en zich eigen te maken.

In hoofdstuk 2 bestuderen wij hoe de afhankelijkheid van primaire goederen vanuit diverse theoretische hoeken wordt verklaard. We nemen de belangrijkste economische theorieën zoals dualisme, de klassieke-, de neoklassieke - en de endogene groeitheorieën, evenals diverse handelsmodellen onder de loep, om hun uiteenlopende verklaringen voor de handelsstructuren en specialisatiepatronen in verband te brengen met de waargenomen problemen van afhankelijkheid van primaire goederen in de context van Sub-Saharaans Afrika. Op die manier zijn we beter in staat om de redenen te begrijpen waarom de SSA landen er niet in geslaagd zijn hun technologische achterstand op gevorderde landen in te lopen. De analyse van dualisme, groei- en handelsliteratuur brengt naar voren de quasi unanieme erkenning van de fundamentele rol van technologische kennisgeneratie en verspreiding in het bepalen van het tempo waarin kapitaalopbouw en productiviteitsgroei plaatsvindt. Hoewel deze theorieën verschillen kunnen vertonen in hun verklaringen van prikkels en kosten voor de adoptie van technologische kennis en de verspreiding daarvan, de belangrijkste les die uit onze analyse wordt afgeleid is dat de ontwikkelingslanden die hun afhankelijkheid van primaire goederen willen verminderen en hun productiviteitsniveaus verhogen, alles in het werk moeten stellen om de in gevorderde landen ontwikkelde technologieën te verwerven, te beheersen en breed toe te passen.

Naast dualisme, groei en handelstheorieën, behandelen wij ook technologische catch-up, theorieën om inzicht te verkrijgen in de factoren die productiviteitsverschillen beïnvloeden en de hindernissen voor kennisoverdracht naar technologisch achtergestelde landen verklaren. De analyse van deze laatste theorieën onthult dat, ondanks de enorme potentie van technologieoverdracht om de productiviteitshiaat tussen technologisch achtergestelde en gevorderde landen te dichten, verscheidene belemmerende factoren beletten dat een automatische inhaalslag ontstaat in productiviteit van ontwikkelingslanden, zoals die voorspeld wordt in de neoklassieke groei- en handelstheorieën. Aangezien de belangrijke belemmerende factor voor deze automatische convergentie de absorptieve capaciteit is, zoals uiteengezet door onder anderen Verspagen (1991) of Rogers (2004), en gezien onze invalshoek in de verklaring van productiviteitsgroei door diversificatie, trachten wij hier het verband aan te wijzen tussen economische diversificatie en het niveau van absorptieve capaciteit dat ontwikkelingslanden in staat zou moeten stellen om zich buitenlandse technologieën eigen te maken. Om dit te bewerkstelligen, gebruiken wij de OESO taxonomie van technologische bekwaamheden voor ontwikkeling. Deze taxonomie verschaft inzichten in de voorwaarden voor het creëren en verruimen van gunstige omstandigheden om de verwerving en de toepassing van buitenlandse technologieën te vergemakkelijken en te bevorderen. Om onze analyse vorm te geven, hebben wij de absorptieve capaciteit uitgedrukt in termen van haar maatstaven van technologische geschiktheid (fysieke infrastructuur, menselijk kapitaal en investeringen in duurzaam kapitaal en technologische inspanning), innovatieprikkels en instellingen. Op die manier hebben wij ons een kwantificeerbaar beeld kunnen vormen dat ons in staat stelt om de hypothese van de verhouding tussen drempelniveaus van absorptieve capaciteit en diversificatie empirisch te kunnen toetsen in hoofdstuk 3.

Ten einde een dergelijke empirische analyse uit te voeren, gebruiken wij in hoofdstuk 3 de SID benadering, een versie van de Nationale Systemen van de Innovatie (NSI) voor ontwikkelingslanden, die de nadruk legt op technologische bekwaamheid, innovatieprikkels en instellingen als essentiële ingrediënten voor een succesvolle verwerving en toepassing van de noodzakelijk buitenlandse technologieën ten behoeve van productiviteits- en inkomensconvergentie. Derhalve hebben wij de componenten van absorptieve capaciteit in kaart gebracht en vervolgens een direct verband gelegd tussen de indicatoren van absorptieve capaciteit en de adoptie van buitenlandse technologieën die nodig zijn om economische diversificatie in gang te zetten, om de afhankelijkheid van primaire goederen en ruwe grondstoffen te verminderen. In datzelfde hoofdstuk onderzoeken wij ook de rol van landbouw en financiële markten in het ondersteunen van de structurele transformatie en de uitbreiding van andere productieve sectoren binnen het SID raamwerk.

Om de effecten van absorptiecapaciteit op diversificatie te kunnen schatten, stellen we een analytich model voor, dat het mogelijk maakt om het verband tussen diverse indicatoren van absorptieve capaciteit en het niveau van diversificatie empirisch te testen. Wij gebruiken een schattingskader dat vanuit het perspectief van de productiefunctie wordt ontwikkeld. Onze schatting geeft de volgende resultaten:

• Het menselijke kapitaal, de infrastructuur en het bevolkingsaantal verklaren een aanzienlijk deel van de interland verschillen in de exportdiversificatie, terwijl de besckikbaarheid van natuurlijke rijkdommen een sterke belemmering vormt voor diversificatie in alle landen. Globaal gezien schijnt de ratio van investering in fysieke kapitaalaccumulatie niet voldoende om de waargenomen verschillen beduidend te kunnen verklaren: In het geval van SSA landen schijnt die kapitaalaccumulatie, tegen de verwachting in, eerder gepaard te gaan met de uitbating van primaire goederen dan met diversificatie.

• Als we SSA landen met de rest van de wereld vergelijken vinden we dat, voordat menselijk kapitaal en infrastructuur tot meer diversificatie te kunnen leiden, bepaalde drempelniveaus in de indicatoren van deze absorptive capaciteit eerst bereikt moeten zijn. Dat komt geheel overeen met de verwachtingen van onze hypothese. Vele SSA landen hebben niveaus van infrastructuur en menselijk kapitaal die onder of rond deze drempels liggen: dit impliceert dat hun absorptieve capaciteit nog te laag is om de exportdiversificatie beduidend te beïnvloeden.

• Verder vinden we dat hoewel de dichtheid van infrastructuur van beduidend belang is in het verklaren van diversificatieverschillen tussen SSA landen; deze infrastructuur en de gerelateerde investeringen gaan vaak hand in hand met de uitbuiting van natuurlijke rijkdommen, en derhalve vaak nauwelijks ten goede komen aan de andere sectoren van de economie.

Kortom, het niveau van basisinfrastructuurvoorziening is dus ontoereikend voor een effectieve diversificatie en de knelpunten in menselijk en fysiek kapitaal blijken zo één van de redenen te zijn waarom SSA landen voortdurend achter de rest van wereld blijven lopen bij alle maatstaven van economische, sociale en technologische ontwikkeling.

Op basis van deze resultaten hebben wij de vermindering van de afhankelijkheid van primaire goederen in twee van de in economisch opzicht succesvolste Afrikaanse landen nader willen bestuderen: 's werelds grootste diamantproducent Botswana en textielnieuwkomer Mauritius. Hoofdstuk 4 bouwt dus voort op de resultaten en inzichten die uit de analyse van hoofdstuk 3 zijn verkregen en onderzoekt meer in detail of de verhoudingen van deze bevindingen in diamant-rijk Botswana waarneembaar zijn. In dat hoofdstuk brengen wij in kaart de mogelijkheden waarover Botswana beschikt om bekwaamheden, innovatieprikkels en marktgerichte instellingen aan te wenden voor de bevordering van de verwerving van buitenlandse technologieën. Daarnaast onderzoeken wij ook de overeenkomstige veranderingen met betrekking tot de afhankelijkheid van natuurlijke rijkdommen. Onze hoofddoelstelling bij deze analyse is de mate in te schatten waarin de verwerving van ingebouwde technologische kennis door kapitaalgoedereninvoer heeft bijgedragen tot de productiviteitsstijging en de uitbreiding van economische activiteiten in de verwerkende sector, om zo de overheersing van diamant in de economie te verminderen. Deze analyse wordt uitgevoerd op twee aggregatieniveaus met gegevens die tijdens het veldonderzoek verzameld werden: de effecten van de technologische inspanningen en andere indicatoren van absorptieve capaciteit op productiviteit en sectoruitbreiding wordt uitgevoerd op sectorniveau, i.e. omvattend alle branches van de verwerkende industrie, terwijl een verfijning van deze analyse wordt gedaan met panel gegevens op brancheniveau. Deze laatste analyse werd gearticuleerd op de gelijkenis in beschrijving tussen de geïmporteerde investeringsgoederen en de verwerkende industrieën die deze kapitaalgoederen gebruiken in hun productie. Wetend welke kapitaalgoederen werden gebruikt in welke branche van de verwerkende industrie, konden wij vrij gemakkelijk schatten wat de effecten waren van de investeringsgoedereninvoer op de productiviteitsgroei in de betreffende branche en op de overeenkomstige brancheuitbreiding in de verwerkende sector. Onze resultaten in deze analyse tonen aan dat voor de verwerkende industrie van Botswana de invoer van buitenlandse kapitaalgoederen met ingebouwde technologische kennis en de proportie van mankracht met beroepsopleiding in de bedrijven, de belangrijkste factoren zijn die productiviteitstoename en de industrieuitbreiding verklaren. Verder analyseerden wij de effecten van de verandering in de exportsamenstelling op de groei. In tegenstelling tot wat in de eerste instantie verwacht kon worden, namelijk dat een uitgebreider exportstructuur tot snellere groei moet leiden, tonen onze resultaten aan dat de groei van de export van vervaardigde producten eerder wordt gekenmerkt door de afvloeiing van financiele middelen uit andere sectoren van de economie, zoals ook te merken is met de forse belastingsubsidies die gegeven worden om de ontwikkeling van de verwerkende industrie te stimuleren.

Na deze uitgebreide analyse van Botswana in hoofdstuk 4, vestigen wij onze aandacht op de absorptieve capaciteit en diversificatie ervaring van Mauritius in hoofdstuk 5. Dat land is als eerste en enige in Sub-Sahara Afrika erin geslaagd om van de afhankelijkheid van het suikerriet af te komen en over te gaan tot voortvarende textiel- en ICT- nijverheid met sterke concurrentiepositie op de wereldmarkt. In dit hoofdstuk brengen wij technologische bekwaamheden en innovatie-prikkelsysteem van Mauritiaanse economie in kaart om hun rol te kunnen bestuderen in de opkomst van de textielindustrie en de indrukwekkende exportprestaties van dat land. Vervolgens onderzoeken wij in dat hoofdstuk hoe de economische groei en de stijgende vraag van Mauritius' handelspartners voor Mauritiaanse export producten de kapitaalaccumulatie en groeiprestatie van het eiland beïnvloeden door middel van inkomens- en prijselasticiteit. Voor de Mauritiaanse economie, waarvan de groei hoofdzakelijk op de preferentiële toegang van haar exportprodukten tot de markten van ontwikkelde landen berust, besteden wij de aandacht voornamelijk aan de manier waarop de economische groei van handelspartners werd omgezet in binnenlandse inkomensgroei. Dit werd gedaan door de prijs en inkomenselasticiteiten van de exportvraag te schatten met behulp van een de groeimodel, dat ons ook in staat stelde om de door export gedreven productiviteitsgroei en dynamische handelsvoordelen gelijktijdig te schatten. Aan de hand van de geschatte prijs-en inkomenselasticiteiten vonden wij dat de accumulatie van technologische kennis, die ingebouwd is in geïmporteerde investeringsgoederen, Mauritius aanzienlijk heeft gebaat in zijn inspanning om inkomensgroei van zijn handelspartenrs te vertalen in binnenlandse productiviteitsgroei.

Na deze parallelle analyses van Botswana en Mauritius besteden wij aandacht in hoofdstuk 6 aan een vergelijkende uiteenzetting van deze de twee landen, die vaak in één en de zelfde adem worden aangehaald als waren ze samen het symbool van het succesverhaal van Afrika, maar waarvan de ervaringen in economische groei verre van gelijkaardig zijn. De vergelijking van de ontwikkelingservaringen van de twee landen op basis van hun prikkelsystemen en institutionele factoren brengt de scherpe contrasten tussen hen aan het licht en onthult het relatieve voordeel van hard werk over hoge intrinsieke waarde van de natuurlijke rijkdommen. In dit hoofdstuk maken we ook een overzicht van de belangrijkste factoren die de institutionele verschillen tussen de twee landen verklaren om een beeld te kunnen schetsen van de rol die deze factoren spelen in de verschillen van hun prestaties inzake capaciteitsopbouw en economische diversificatie. In onze bevindingen hebben de op productiviteit gebaseerde groeiprestaties inderdaad een hogere doordringendheid op ontwikkeling in vergelijking met de op natuurlijke rijkdommen gebaseerde welvaart, omdat het aandeel van toegevoegde waarde door mensenwerk in de totale waarde van het uitgevoerde product veel hoger is in het eerste geval en omdat deze toegevoegde waarde bepalend is voor de doordringenheid van ontwikkeling, zoals ook bepleit door List (1841). Terwijl beide landen voor hun institutionele kwaliteiten worden geprezen, heeft de analyse van hun ontwikkelingsgegevens belangrijke verschillen aan het licht gebracht. Het elitaire, op diamant gebaseerd en overheid-overheerst accumulatietraject van Botswana heeft geleid tot een dualistische maatschappij waarin lucullianse opulentie naast schrijnende armoede en hoge werkloosheidscijfers tentoon wordt gespreid, terwijl de op inspanning en hard werk gebaseerde, bedrijfoverheerste arbeidsintensieve industrialisatie van Mauritius tot een meer egalitaire maatschappij heeft geleid, met vrij hoge niveaus van opleiding, hoge levensverwachting, lage zuigelingsterfte en goede scores op andere indicatoren van menselijke ontwikkeling.

Als de ontwikkelingprestatie van een natie ook wordt gemeten met de capaciteit van de maatschappij om aan elk van haar leden fatsoenlijke levensomstandigheden te verstrekken, dan toont de vergelijking tussen Botswana en Mauritius aan, dat het kleine suikerkristal dat met heel wat menselijke zweet en inspanning wordt geproduceerd een veel effectiever bron van ontwikkeling is dan de begeerde diamantkristal (het bankwezen, toerisme en de textielindustrie van Mauritius werden namelijk ontwikkeld uit de herinvesteringen van suikeropbrengsten). De institutionele implicatie van deze waargenomen verschillen tussen Botswana en Mauritius is dat de "optimal rent-sharing agreement" tussen politieke en economische elites (zoals in het Mauritiaanse geval) eerder tot een dynamischer en doordringender ontwikkelingsresultaat zal leiden dan de concentratie van politieke en economische machten in de handen van dezelfde elites (zoals in het geval van Botswana) leiden, hoewel uitzonderlijke tegenvoorbeelden zoals Singapore kunnen worden gevonden.

Het slothoofdstuk besluit de thesis door sommige nuttige beleidsimplicaties voor technologieaanwinst en industrialisatiestrategieën in andere SSA landen te formuleren. Daarbij erkennen wij dat, aangezien beleidsdoelstellingen niet tegelijkertijd bereikt kunnen worden als gevolg van beperkingen in beschikkbare middelen, wat belangrijk is, is prioriteiten kiezen, aandacht vestigen op de prioritaire doelstellingen, prikkels bedenken die de economie in staat stellen om alle beschikbare middelen te mobiliseren, en dan de prestatiemaatstaven bepalen waarmee de effectiviteit van de gekozen stategie gemeten kan worden. De gekozen strategie moet ervoor zorgen dat alle neuzen de zelfde kant op kijken in de strijd tegen de onwetendheid van wat de andere landen met de Afrikaanse grondstoffen produceren en tegen de insidieuse illusie van rijkdom en statische comparatieve voordelen in natuurlijke rijkdommen.

Een dergelijke strategie omvat minstens drie pijlers:

• menselijk kapitaal met de vereiste vaardigheden om nuttige buitenlandse technologieën te herkennen, te identificeren, te verwerven en zich eigen te maken;

• infrastructuur om transactiekosten te verlagen en het functioneren van bedrijven te vergemakelijken: het zijn immers de bedrijven die de uiteindelijke verantwoordelijkheid dragen voor de verwerving van technologie;

• ten slotte de mobilisatie van financiële en menselijke middelen om dit allemaal te verwezenlijken.

Curriculum vitae

Alexis Habiyaremye was born in Kanombe in Northwestern Rwanda on may 15, 1968. He attendend the science college of Musanze , near Ruhengeri, from 1982 to 1988. He then came to Belgium to study Civil Engineering at the Polytechnics Division of the Royal Military Academy in Brussels from 1988 to 1992. After the Military Academy, he studied International Management at Maastricht University and the National University of Singapore. After graduation in 2000, he worked for 2 years as a lecturer for the department of Accounting and Information Management of Maastricht University before joining the Exel Aviation Group at Maastricht Aachen Airport as a financial control assistant. In 2005, he joined the UNU-MERIT PhD programme "Economics and Policy of Technical Change", which he completed in 2009. After his doctoral studies, Alexis hopes to have more time to devote to his favorite hobbies: latin poetry and ancient history.