

Malthus' revenge

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Malthus' Revenge

Luc Soete

Malthus' Revenge¹



Luc Soete²

UNU-MERIT
University Maastricht

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Abstract:

In this paper, we take inspiration from Thomas Malthus' hypothesis that food shortage and hunger would remain "nature's last most dreadful resource" and that "the power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race". We revise and reinterpret it into a modern and thus global version and we elaborate on such a possible new interpretation and what its policy implications might be. In a first section, and somewhat as a parenthesis, we briefly comment on the financial crisis as it has unfolded over the last four months of 2008 and impacted gradually the real economy. In the second section of the paper we review the different policy responses to past Malthusian challenges: how food production succeeded particularly over the second half of the 20th Century to keep pace with rapid population growth. In a third section, we replace the word "population" in the above cited Malthus' quote with "consumption" and illustrate what this

¹ This paper has been prepared as part of a foresight exercise about "The World in 2025" on the request of the European Commission, Directorate for Science, Economy and Society in close collaboration with the Bureau of Economic Policy Advisors. I'm grateful to comments received from colleagues during presentation before the expert group. Errors remain my own.

² Luc Soete is Professor of International Economic Relations and Director of the Maastricht Economic and social Research and training centre on Innovation and Technology of the United Nations University (UNU-MERIT), University of Maastricht, The Netherlands.

might imply for global world growth and Europe's place in the world in 2025. In a fourth and final section, we then draw some initial policy conclusions. The nature of the Malthusian challenges raised today appears both global and local in nature. On the one hand it raises questions with respect to the need for open, international research collaboration. Imposing national, or regional, boundaries with respect to research participation and funding, certainly appears (with respect to some of the most urgent Malthusian research problems) to be the expression of an outdated and wasteful research nationalism. On the other hand, the growing need for local knowledge re-use, adaptation and embedment in many emerging and developing countries involving efforts at local innovation, is in many ways similar to, and reminiscent of the development of the many innovation policy tools in European countries and regions. The first policy challenge, we refer to as "recherche sans frontières"; the second one as "innovation for local development".

Keywords: Thomas Malthus, economic forecasting, population growth, economic growth, resource scarcity, innovation, globalisation, economic development, regional development.

JEL classification: E17, O11, O13, O21, O33

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Introduction

Quite suddenly, a hypothesis which seemed to be disregarded and rejected for the last 30 years, now appears to get some benefit of the doubt. It is not the original version of Thomas Malthus' hypothesis, that food shortage and hunger would remain "*nature's last most dreadful resource*", but a more sophisticated, revised global version. Once the word "*population*" in the famous Malthus quote that: "*the power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race*" is replaced by consumption, both present, real consumption and future, global consumption aspirations, the old Malthus' quote takes on a new, more intriguing 21st Century meaning.

In this paper, we elaborate on such a possible new interpretation and what its policy implications might be. Written as part of a more technology/economic inspired contribution to a European foresight exercise about what the world might look like in 2025, it seemed natural to start such a brainstorming exercise with the most well-known historical economic attempt at forecasting: the one by Thomas Malthus two hundred years ago, adapted though to modern times.

In a first section, and somewhat as a parenthesis, we briefly comment on the financial crisis as it has unfolded over the last four months of 2008 and impacted gradually the real economy. The financial crisis with its dramatic collapse in demand has undoubtedly softened in the short term some of the Malthusian challenges discussed in this paper. However, it is unlikely to provide any long term breathing space. On the contrary, any scenario of rapid recovery is likely to be quickly confronted with the various Malthusian limits to global growth as described below. In this sense the financial crisis of 2008 might, in an indirect way, be illustrative of the intrinsic sustainable growth bottlenecks global society has increasingly become confronted with.

In the second section of the paper we review the different policy responses to past Malthusian challenges: how food production succeeded particularly over the second half of the 20th Century to keep pace with rapid population growth. There are still many lessons to be learned from this recent past: lessons which appear not to have been picked up in the recent debate about rising food prices. Similarly, whereas world population growth no longer appears to raise major Malthusian concerns today, the huge differences in population growth rates across regions in the world – with the most rapid population growth occurring in regions, such as the Middle East and Northern Africa, least well endowed with arable land, access to fresh water and most subject to further environmental deterioration as a possible consequence of climate change – raise major global migration pressures very much Malthusian in nature and origin.

In a third section, we replace the word "*population*" in the above cited Malthus' quote with "*consumption*" and illustrate what this might imply for global world growth and Europe's place in the world in 2025. Such replacement appears justified following the global diffusion of new digital information and communication technologies over the last thirty years with the uptake of those technologies across the world at a historically unprecedented speed. We suggest that future population growth appears today a more relevant measure of future market opportunities, indicative of unfulfilled consumption aspirations, than current GDP which appears in many ways more of an economic measure of industrial strength of the past.

In a fourth and final section, we then draw some initial policy conclusions. The nature of the Malthusian challenges raised today appears both global and local in nature. On the one hand it raises questions with respect to the need for open, international research collaboration. Imposing national, or regional, boundaries with respect to research participation and funding, certainly appears (with respect to some of the most urgent Malthusian research problems) to be the expression of an outdated and wasteful research nationalism. On the other hand, the growing need for local knowledge re-use, adaptation and embedment in many emerging and developing countries involving efforts at local innovation, is in many ways similar to, and reminiscent of the development of the many innovation policy tools in European countries and regions. The first policy challenge, we refer to as “*recherche sans frontières*”; the second one as “*innovation for local development*”.

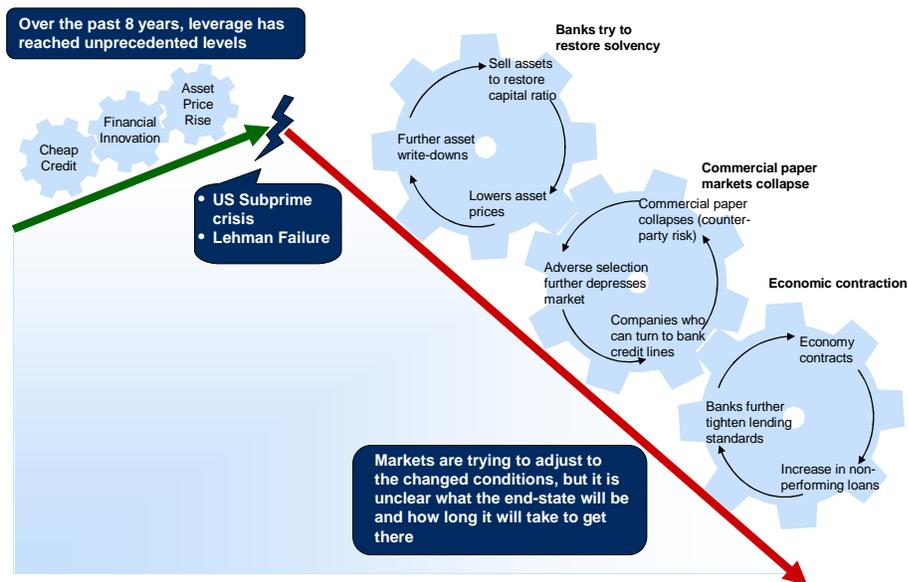
1. Reflections on a unique financial crisis very different from previous downturns

The financial crisis, as it unfolded in 2008, is rapidly starting to affect the real economy across the globe. The collapse in demand appears to spread across many sectors from durable consumer goods such as motor cars to machinery and investment goods. In many sectors, investment decisions have been scrapped or delayed. Unemployment, and not just of temporarily employed labour, is rising rapidly in most countries across the world.

The McKinsey Global Institute describes the unique features of the current crisis along the following four lines. First and most dramatically since September 2008, a more or less systemic failure of credit markets with a large number of such markets coming to a stand still at the same time. Second, high leverage levels in combination with asset write downs have resulted in a further credit contraction that slows GDP as less cash for investments is made easily available. Third, the globally interconnected world of the 21st Century with more countries than ever belonging to the WTO implies that for the first time all large economies and markets across the globe are hit, limiting the possibility of recovery through strong demand or capital injection in one region benefiting other regions. And fourth, the mutually reinforcing effect of the financial crisis and the resulting global economic recession impacts the economy in a variety of different financial and real, local and global ways making outcomes much harder to predict and potentially very negative. The figure below from the MGI illustrates well the mutually reinforcing negative effects of the financial crisis. As the figure highlights, interdependencies in financial assets and the real economy which had been beneficial to the economy over the last decade, became in an unfavourable economic environment detrimental to the economy. Economists have pointed to the dangers of such volatility impacts. Thus as Gallegati *et al.* (2008) noted long before the financial crisis: “private incentives are such that too many linkages are formed with respect to what is socially desirable. The risk of contagion increases the volatility of the outcome and thus reduces the ability of the financial networks to provide risk-sharing.”³ As a result next to the dramatic collapse in final consumer demand, which affected many durable consumer goods sector such as motor cars, there has been a collapse in risk-taking investment with a shift in financial markets’ readiness to provide risk capital. At the same time, the investment opportunities on offer to venture capital and private equity rapidly dried up.

³ Gallegati, Mauro; Greenwald Bruce; Richiardi, Matteo and Joseph Stiglitz (2008), “An Asymmetric Effect of Diffusion Processes: Risk Sharing and Contagion”, *Global Economy Journal*, 8(3)

THE CURRENT CRISIS IS DRIVEN BY MUTUALLY REINFORCING EFFECTS SO MAY LAST LONGER THAN EXPECTED



Source: Morgan Stanley; Federal Reserve; BEA; The Economist; McKinsey analysis

4

One of the reasons why the issue of knowledge investments has played a limited role in the current debate on the financial crisis is the policy need for immediate, short term outcomes of the proposed interventions. Most of the financial interventions appear first and foremost of the “fire fighting” sort, e.g. providing liquidity in the financial system and in a second phase addressing the fire spreading across the initially assumed immune national parts of each country’s financial system, such as the granting of state guarantees for inter-bank loans or the state guarantees of the minimum amount of saving deposits. The next phase in the spreading of the financial crisis is the impact this massive destruction of capital is likely to have on consumer and investment/saving habits of citizens. There are several scenarios. The first one starts from the assumption that citizens will, to the extent possible, try to restore their assets and savings by increasing as rapidly as possible their savings. This can be readily observed in many of the traditionally high-saving European countries, such as Belgium, Germany, the Scandinavian countries or The Netherlands, but even countries such as the US and the UK which had traditionally much lower savings ratio’s. As a result, the high income inequality within developed and emerging countries which had been an engine for the strong consumer-led growth path in the US, Europe and many emerging economies (Russia, Brazil, Latin America, Eastern Europe) no longer induces such strong demand-led global growth impact, filtering through to the rest of the global economy through remittances, and other demand multiplier effects. On the contrary, the high income inequality is now likely to become a major source for high savings, being invested now in secure government bonds. As a result the financial crisis is spreading much more rapidly than expected to the real economy with major global implications.

A different, and to some extent opposite scenario would start from the assumption that precisely because the financial crisis has affected primarily those more well-off having invested funds in high risk products, it is unlikely to have major macro-economic negative growth impacts. Rather it will hasten the decline of individual rich persons or families, allowing for the entry of

newcomers including also emerging economies on the global financial scene. It is interesting from this perspective that China today is keener than ever to position its national currency as a new reserve currency.

So the distributional impact on the real economy of the present financial crisis remains subject to debate. In the meantime, the academic policy debate appears to have shifted to the need for stronger global regulation in the financial sector with proposals for a Bretton Woods 2, for drastic reductions in the financial perks and golden severance payments given to financial CEOs while leaving most of the financial losses with share holders, both private small individual shareholders as well as institutional shareholders. Saving accounts holders are protected at least as long as they invest their savings nationally, while governments have become themselves speculative shareholders using their own state prerogatives to bet on a rise in stock market value. As a European politician put it: *“capitalism for the poor in the US as the origin of the crisis, socialism for the rich in Europe as the solution to the crisis”*.

What can one say about the impact of the financial crisis on knowledge investments? Continuous high knowledge investments particularly in the highly developed countries have been the major factor behind long term welfare growth. That is also the reason why countries, such as the EU ones, have been keen on setting long term targets for increasing such knowledge investments. So leaving aside the nature of such knowledge investment and their geographical scope as discussed below in section 4, the question touches on an essential feature of long term growth and development.

At the micro-economic level, the negative impact of the recession on profitability forces firms in the short term to focus on the most productive segments of their output. Furthermore, the opportunity costs of achieving productivity growth are likely to be lower in recessions, providing incentives to undertake research activities in downturns (Aghion and Saint-Paul, 1998; Canton and Uhlig, 1999). Finally, R&D-personnel will be subject to “labour hoarding”; the most qualified scientists and engineers are kept at the expense of the lower skilled personnel. The internal training of highly skilled R&D personnel requires in some high tech sectors more than ten years, sacking such personnel has generally remained a measure of last resort. This feature also explains why firms during expanding growth phases have often restructured their R&D activities, thereby increasingly calling upon external R&D expertise. As the economic crisis is likely to spread in 2009 in Europe, it can actually be expected that the R&D/GDP ratio of European countries might actually rise.

With respect to innovation, the opposite, cyclical view appears more likely. Innovation or the implementation of new ideas is likely to be postponed in a recession till the boom period (Shleiffer, 1986 and Francois and Lloyd-Ellis, 2003). The old, so-called innovation acceleration hypothesis of Gerhard Mensch (1975) whereby radical innovation would be favoured in recessions/depressions out of despair has been empirically rejected (Clark, Freeman and Soete, 1981). Alongside such cyclical trends there are, however, also more structural factors which might impact directly European research and innovation.

The nature of those structural factors can, at the present moment, only be derived from anecdotal evidence, analytical speculation and historical example. One may start with the uniqueness of the

crisis originating ultimately from within the financial sector⁴ and affecting the real economy under the form of a dramatic change in “risk aversiveness”. As a result private financial institutions which normally play the role of central agents in any counter-cyclical recovery policy have become “dead bodies”. At the same time there is now a widespread lack of trust in future risks with private investors primarily as a result of the huge write-offs over the last year. All this leads to growing distrust in society. As a result the new dominant philosophy of “*Cash is king*” has a direct negative impact on knowledge investments. Within stock listed companies, where the CFO will put pressure on the CEO to distribute as much of the limited profits as dividends – in a recession a crucial differentiating factor signaling solvability and management reputation. In a growing number of non high-tech firms this is likely to prevail over long term R&D investment commitment. Within SMEs as credit is becoming difficult to get, the focus will rather shift to organisational and easy to implement process innovations reducing costs and inventories. New product innovations and renewal investments will be postponed. Finally high-tech starters will postpone the introduction of new product innovations. As a result seed money providers will have difficulties in finding sufficient worthwhile investment proposals. The venture capital market collapses.

In short, the financial crisis has been accompanied by a shift in favour of risk averseness with as most direct impact on the real economy, a move away from investments in risky activities such as R&D and innovation. At the global level though, the crisis is likely to lead to an increased “offshoring” and “outsourcing” of private R&D: a more rapid relocation of certain parts of R&D (in particular development) to cheaper locations in emerging countries with a strong scientific base such as China and India. Furthermore, there is likely to be also increased “national outsourcing” of private R&D from large firms to small firms with increased specialisation and the incumbents’ large private R&D labs playing increasingly a new local role as “open”, more systemic innovation infrastructure. “Open” also to public participation from universities and public research institutes. This development might be particularly beneficial to the developments described in section 4 below. In this sense, it might be argued that the financial crisis provides a new opportunity to reassess the contribution knowledge investments both private and public, will have to make to long term sustainable growth and development so as to overcome the various Malthusian challenges described in the next sections.

⁴ In this we do not follow the fascinating, but in our view as yet unsubstantiated, view of Perez (2009) linking directly the internet bubble of the early 21st century to the present financial crisis.

2. On past Malthusian challenges

Thomas Malthus has of course been most dramatically contradicted by the rapid growth in population over the last Century, and in particular after the Second World War, with world food production keeping well ahead of the world's most rapid growth ever in population.

a) On food production

It is undoubtedly one of the major global achievements of the period of cold-war rapid economic growth: "les trentes glorieuses" in the words of the French economic historian Jean Fourastié⁵, roughly speaking the post-war period between 1950 and 1973, when food production succeeded in keeping up with an exponential growth rate in world population. In saying this, I obviously do not want to underplay the numerous famines as they affected a number of developing countries in the 70's and 80's, but rather belabour the point that such famines were less associated with nature's impossibility to keep up agricultural production than with political and human mismanagement. As Amartya Sen's 1982 classic book on "*Poverty and Famines*" has convincingly argued, there has never been "a famine in any country that has been a democracy with a relatively free press".

However, given the historically unprecedented growth in agricultural production over the post-war period, it is surprising that so little attention is being paid in the current food debate to the characteristics of agricultural production during the early post-war period and in particular to the rich economic literature (Hayami and Ruttan, 1970, and Griliches, 1957) on the nature of technical improvements in agriculture; the particular role of different, so-called agricultural knowledge "extension schemes"; the significant role of publicly funded research in enhancing food productivity; the limited role of intellectual property protection with respect to seeds, fertilizers as well as irrigation and other farming techniques; the dominance of local production over international trade with as a consequence a more limited product variety available to local consumers more closely linked to seasonal production, etc.

All those issues appear at first sight also of particular relevance to the current situation of rapidly rising food prices. We know, as a matter of fact, surprisingly little about the underlying structural causes behind the present rise in food prices. Leaving out possible speculative and other short term effects on food prices, the following questions appear of particular relevance to the current policy debate. To what extent are current food shortages the result of failures to introduce at the global world level, large scale farm production techniques as for instance typified by Europe's Common Agricultural Policy introduced in the 70's and 80's, or rather the opposite: the result of failures to introduce small scale, locally adapted rural agricultural production techniques? Or of more immediate concern: to what extent are present world food shortages the result of recent reforms in European agricultural policy with the structural removal out of agriculture production of large areas of agricultural land? Might such policies at a moment of rapidly rising food demand not have exacerbated the problem of reduced food supply? And at the level of research: to what extent has research on agricultural production shifted from a national priority with the involvement of large public research laboratories to an area with low public and increasing private sector research interest? What have been the implications of such a policy shift on the

⁵ See Fourastié, J., 1979. Les Trente Glorieuses, ou la révolution invisible de 1946 à 1975.

access to, and the diffusion of, soil and agricultural knowledge; farming and irrigation techniques⁶ and; more broadly, environmentally sustainable, agricultural development?

A first relevant policy conclusion might therefore consist of the need to re-prioritize agricultural research as an area, not of “*grand*” but of “*glocal challenge*”: global in nature but local in implementation with particular attention being paid to world regions’ environmental, including fresh water availability, comparative advantage. Such “re-prioritization” will also need to pay particular attention to the growing convergence between food and nutrition research and what it implies in terms of the trade-off between increased intellectual property protection and the resulting international trading of licenses and global access to such knowledge.

b) On population dynamics

With respect to population dynamics, by contrast, world population growth has gradually adjusted downwards over the last thirty years. Any tendency towards a continuous exponential population growth rate has been proven to be false. The present world population of 6.6 billion, increasing at a daily rate of some 200,000 is expected to peak in absolute terms at some 9.5 billion between now and 2025. The exponential growth after 1950 when world population was just 2.5 billion did ultimately evolve in a non-linear, typical s-shape curve.

Certainly with respect to world population demographics, Thomas Malthus appears to have been disproven totally. Actually, and contrary to Malthusian expectations, it is the impact of improved health and sanitation conditions on life expectancy which has, as a second order effect, brought down most significantly population growth. The main reason being of course that those health and sanitation improvements were accompanied by contraception technologies, shifting dramatically the balance between desired procreation and accidental one. In this sense, it can be expected that improvements in world-wide health and sanitation conditions will further reduce child mortality in the least developed countries, reducing in the longer term the way parents want to insure their own future by having large numbers of children. It is in other words, and from a Malthusian perspective somewhat paradoxical, the combination of health improvements and the ensuing reduced mortality rate which is behind the long term decline in population growth and ultimately the more or less expected future stable world population size of around 9,5 billion.

While population growth does not play any longer a direct role in the Malthusian predicament, it remains though an important overall context condition. In Table 1, based on data originally collected by Maddison (2003), the historical share of countries both in population and GDP over the last 200 hundred years is presented for China, India, Brazil and South Africa.

What remains from a historical perspective, particularly striking is how the two largest countries in the world: China and India, saw their population world share and their share of world GDP fall

⁶ One may think here of various digitally controlled drip irrigation techniques when converting desert into farmland producing low water intensive crops. As a recent article in the IHT pointed out, most rapid population growth occurs in regions such as Northern Africa and the Middle East with the least available land with fresh water availability. Whereas in the oil-rich countries in those regions, money can solve the water shortage problem, the solution is obviously not sustainable: “You can bring in money and water and you can make the desert green until either the water runs out or the money”(Martin, Andrew, “Population rises, resources dwindle and there is no easy solution”, International Herald Tribune, July 22nd, 2008).

significantly over the period 1820 till 1973. In 1973, the *imbalance* between the world's concentration of GDP and the world's concentration of population was historically probably the most extreme one ever.

Table 1: China India, Brazil, South Africa and Mexico in the World Economy

Share in world population and world GDP: 1820-2001

Percentage share of world population

Year	China	India	Brazil	South Africa	Mexico	Total
1820	36.6	19.9	0.4	0.1	0.6	57.6
1870	28.1	17.0	0.8	0.2	0.7	46.8
1913	24.4	14.2	1.3	0.3	0.8	41.0
1950	21.7	14.8	2.1	0.5	1.1	40.2
1973	22.5	14.8	2.6	0.6	1.5	42.0
2001	20.7	16.5	2.9	0.7	1.7	42.5
2006	20.2	16.9	2.9	0.7	1.7	42.3

Percentage share of world income

Year	China	India	Brazil	South Africa	Mexico	Total
1820	32.9	16.0	0.4	0.1	0.7	50.1
1870	17.1	12.1	0.6	0.2	0.6	30.6
1913	8.8	7.5	0.7	0.4	0.9	18.3
1950	4.5	4.2	1.7	0.6	1.3	12.3
1973	4.6	3.1	2.5	0.6	1.7	12.5
2001	12.3	5.4	2.7	0.5	1.9	22.8
2006	16.8	6.1	2.4	0.5	1.8	27.4

Source: Deepak Nayyar (2008) based on data from Maddison (2003); Maddison(forthcoming)

Again in the current debate little attention has been paid to the rich, and sometimes controversial literature on such global unequal development paths between the developed OECD countries and the developing world with many debates amongst trade theorists and development economists about, amongst others: unequal exchange, import substitution and the need for infant industry development strategies, the impact of de-colonisation and the many early development attempts in developing countries at self-reliance, etc. Viewed in retrospect all these contributions were first and foremost inspired by concerns about rising global inequality and what appeared at that time to be an intrinsic lack of autonomous growth and development opportunities for many developing countries, just having achieved political independence but by and large still being economically tied to their previous colonial powers⁷.

I would also argue that it is this extreme geographical inequality in world GDP in the 60's and early 70's which has formed the basis for the sheer unilateral focus of social scientists and policy

⁷ It might be noted that while India and China have been expanding their industry at a very fast rate and are undergoing industrial revolutions, the absolute numbers employed in manufacturing as well as the share of manufacturing in total employment has been falling. Many scholars would argue that the two countries should have had their industrial revolutions more than a hundred years ago but that they were thwarted in this endeavour by colonialism including unequal treaties.

makers on strengthening *domestic* competitiveness as the essential feature for a country's future economic growth. As Ulrich Beck and Elisabeth Beck-Gernsheim, discussing the recent phenomenon of globalization, put it a couple of years ago: "The consequences of this for society (and sociology) have been spelt out most clearly in the English-speaking countries, but above all Britain, where it has been forcefully argued that conventional social and political science remains caught up in a national-territorial concept of society. Critics of 'methodological nationalism' have attacked its explicit or implicit premise that the national state is the 'container' of social processes and that the national framework is still the one best suited to measure and analyse major social, economic and political changes." (Beck and Beck-Gernsheim, 2002) This national-territorial obsession of social scientists was particularly reflected in policy makers desire in both developed *and* developing countries alike, to be technologically independent, to create national technology support policies aimed at strengthening the country's technological competitiveness. As a matter of fact, in the 70's the notion of technological independence was quite popular in the development literature⁸.

In many developing countries, poorly endowed with arable land and/or natural resources, peripheral islands or land-locked countries/regions, the old Malthusian concerns about rapid local population growth and limited local opportunities for low cost agricultural production still exist. As a matter of fact lack of development appears still closely associated with population dynamics⁹ with most rapid population growth occurring in regions, such as the Middle East and Northern Africa, least well endowed with arable land and access to fresh water. Furthermore, those regions appear often the most fragile and most subject to further environmental deterioration following climate change. The historical Malthusian solution, large foreign emigration is still today the clearest manifestation of the local validity in many regions in the world of Malthus' predicament.

⁸

See in particular Soete (1981)

⁹ As Sen (1998) pointed out the ability of countries to reduce their mortality can be seen as a test of their economic performance.

3. The new Malthusian 21st Century challenge: “global” consumer aspirations

The advent of the Information and Communication Technology (ICT) revolution in the 80's and 90's radically challenged the national-territorial bias in social sciences research and policy making¹⁰. As argued elsewhere, the cluster of ICT represents a historically unique process of technological, organisational and above all social transformation at the global level, both in terms of speed and in terms of world-wide impact.

The two clusters of technology Information Technology (IT) and Communication Technology (CT) have each played a crucial role here. At the IT level, there has been the continuous technological improvement (Moore's Law) in semiconductors. This 30 year long continuous technological improvement, combined with the tendency to miniaturise IT, has enabled the physical integration of electronic functions in existing (and new) equipment and led to an ever-increasing diffusion of IT applications throughout practically all sectors of the economy. In short what has been called a 'general purpose' technology (Bresnahan and Trajtenberg, 1995), the diffusion of which has been accompanied by a great many organisational mismatches and tensions (Freeman and Perez, 1988; David, 1991). Ultimately, the possibilities for such ever-increasing miniaturisation (“More than Moore”) opened the avenue to nanotechnology, i.e., the production of electronic material at sub-micron level that can interact with tiny matter and cells, including live cells. These mainly technologically driven developments towards miniaturisation illustrate that the technological trajectory within the IT sector is far from completed with application areas, described today as nano-electronics continuing to expand further to other, new areas.

The technological improvements in the CT cluster have been, if anything, as impressive. Both the continuous developments in the field of optical fibres allowing for the transmission of digital signals without noticeable loss of energy and mobile communication have radically altered the notions of distance. The concept of 'death of distance' (Cairncross, 1997) describes well the radical changes those technologies have brought about at the world level. Mobile communication, with its unique features both in terms of diffusion speed and geographical coverage of number of users (currently half the world population) represents in many ways an ultimate form of global reachability. It implies also along the end of the physical distance factor, the end of segmented information and the end of geographical boundaries in world citizens and/or world consumer's aspirations to find a good job and to enjoy material welfare.

As with other radical social transformations there is no way to reverse those changes: the spirit of global aspirations is, as it were, out of the box. National boundaries in opportunities for jobs, for studying, for communication, for travelling, for social exchanges are increasingly rejected by employees, students, internet users, tourists alike. In terms of life long aspirations, the world has truly become global.

Coming back to our previous discussion on population dynamics, this means effectively that size of population is likely to become a more directly relevant indicator of future potential growth

¹⁰ See among others; Clark, Freeman and Soete, 1981, Freeman, Clark, and Soete, 1982, Freeman and Soete, 1987

and future market opportunities, than GDP which appears more a reflection of the industrial wealth of the past¹¹.

For countries like the EU ones, it means that their future global economic role will decline substantially in the years to come: first, because of the decline in Europe's own share in world population given the current demographic structure of EU population; second, because Europe's is likely to witness over the years to come a substantially lower GDP growth compared to that of most of the large emerging economies. To put it bluntly: in 2025, of the 15 most populated countries in the world: all countries with more than 100 million inhabitants, not a single one will be a European country. ***In 2025, the EU will be primarily composed of relatively small countries.*** Only in areas where the EU-27 acts as a singly country, such as in the case of the WTO, will the EU play an important international role.

There is little doubt, as argued in the previous section that most of the Malthusian doubts arising today are first and foremost related to the combination of increasingly global consumption aspirations confronted with a global and local mismanagement of food supply and growing ecological pressures on “*the power of the earth*” to expand at low costs its supply of food. The “*power of the earth*” to produce food has been estimated by agronomers to be capable of providing sufficient food to no less than 20, even 40 billion people. However, such global food production would require an optimal, ideal earth “gardening” strategy optimizing available land across countries and regions, and harvesting the ideal soil combinations of food, while at the same time eliminating some of the most energy-intensive food production activities, such as meat. The current fragmented global agricultural system is far removed from this ideal optimized world (Svedin, 2008). As a matter of fact, it is clear that once all emissions and other environmental costs of the Western world's energy-intensive food consumption pattern are accounted for, the present world agricultural system would be unable to provide for such a food consumption pattern for the global world population of 6.6 billion, let alone a future world population of 9 to 10 billion. At the same time, the demand pressure, given the global convergence in “consumption aspiration” patterns towards such energy-intensive food consumption patterns is rising rapidly with growing income in the emerging countries. Furthermore, the pressures on available arable land will increase following the emerging profitable opportunities for farming biofuels.

In short, in pure Malthusian tradition the current rise in prices of agricultural commodities, and more broadly natural resources, is likely to have a strong structural component, raising not just major global, macro-economic issues about rising inflationary pressures in both developed and developing countries, but also increasing distributional issues with significant shifts in the terms of trade in favour of countries well endowed with natural resources and, within countries with an increasing number of low income groups in society becoming confronted with difficulties in getting access to basic subsistence commodities.

¹¹ Like numbers of tractors in agriculture or steel were with respect to the measure of industrial wealth in former centrally planned economies.

4. The new “glocal” research and innovation Malthusian policy challenges

As highlighted in section 2, it were first and foremost improvements in technology that enabled the supply of food to keep up with population growth in the 50’s and 60’s of last Century and counter most of our Malthusian fears.

Within the present global context the challenge is, as argued above, much more complex. There is not just a “global” need for the development of major, sometimes radical improvements in energy-saving technologies, sustainable food and energy production, carbon-neutral transport systems, sustainable water management, to name but a few, there is also a need for the quick implementation of such new technological improvements within the fast growing environments of many emerging countries, as illustrated in Figure 2.

This combined, new Malthusian “*glocal challenge*” of ensuring that “*the power of the earth*” remains in line with global consumption aspirations fundamentally questions the organisation of research and innovation activities in the rich, developed countries, and in particular the European ones after the period of decolonization, within the contours of their own national boundaries, or as in the case of the EU, within the contours of the EU.

a) *Recherche sans frontières*¹²

There is little doubt that the process of economic integration in Europe has also had a major effect on intra-European research cooperation and networking. As is well-known the gradual enlargement of the EU in the late 1970s led to a broader set of policies aimed at strengthening intra-European cooperation in areas such as pre-competitive research. In a similar way to trade theories about economic integration, it could be argued that this European research integration process had both positive and negative effects. Positive effects included the ‘creation’ of new research through the additional joint EU research projects initiated, and the new insights into specifically European problems such research provided. Among the negative effects is what could be called research ‘diversion’, i.e. the redirection of research activities, nationally funded but with an international focus, towards European research issues. Elsewhere, I have suggested (Soete, 1997) that these diversion effects of knowledge – with researchers preferring to network with European colleagues primarily for the sake of European financial support – have led to the European *cocooning* of knowledge inside the region’s physical borders, as typified in the notion of a ‘European research *area*’.

At the same time, and of direct relevance to most research communities in the world, the international accessibility of ‘codified knowledge’ increased dramatically through the use of ICT along the lines of our discussion in section 2.

While support for intra-European research collaboration – certainly with respect to the joint use of large research facilities in areas such as ‘big science’ – was very welcome, much of the most interesting collaboration extended well beyond European borders, and became truly global in

¹² This section is partly based on Soete, 2007.

scale. In applied research such as engineering, including energy-saving technologies and medical sciences and technologies, as well as the social sciences and humanities, however, knowledge diversion might well have been a major factor in the growth of intra-European exchange having taken place at the expense of extra-European exchange. In the more basic research areas where open international access had always existed, such 'diversion' had ultimately little impact.

It is what could be called yet another 'European paradox'. As Europe invested in intra-European research, in collaboration and the exchange of scientific knowledge among European scientists, or even in the technological strengthening of the competitive potential of European firms, the advantages of such geographically 'bounded' collaboration became marginal, given the dramatically increased opportunities for exchanging information and cooperation. It could be argued that the Lisbon 2000 summit represented the last major EU attempt to formulate a set of combined European and national policy priorities with respect to domestic knowledge creation and its diffusion, and social and macro-economic policies aimed at fostering European growth dynamics: the peak, but implicitly also the coming to an end, of 50 years of policy priority given to European internal integration.

Our Malthusian discussion in the previous sections, suggests that most of those national (and European) research and technology support programmes were designed at a time when strengthening the international competitiveness of particular high-tech sectors and firms located in Europe was considered essential for Europe's long term welfare. Today though it might be argued that in many areas crucial to Europe's future welfare, such as energy saving technologies, research on sustainable development and climate change, health and the spreading of diseases, food safety, security, social sciences and humanities, etc. it is less the development within Europe's national borders of technological expertise than the global access to such knowledge, the development of joint global standards and the rapid world-wide diffusion of such new technologies to other, non-EU countries which is at stake. In all these areas, the territorial limitation of the funding of research and innovation to domestically located public and private research agents appears contrary to the need for global solutions to safeguard in the long term European welfare.

In short, the Malthusian challenges discussed above call for a much more radical and at the same time more straightforward level playing field approach in developing international research partnerships. Apart from the systematic opening up of European research programmes to partners outside of the EU and in particular from the South, as has now become gradually part of the European framework programmes, there is a need for a more active approach to international North-South research partnerships in those Malthusian areas of global concern described above. As an example of what I mean by such a more active approach, let me list some concrete proposals¹³:

First, there is a growing need to explore systematically the opportunities for a full integration of what could be called Southern "research for development" aspects in the curricula and the research activities of university departments and research institutes in the North. In many medical faculties, food and nutrition departments, geological departments the need for such a

¹³ For more detail see Soete, L. "International Research Partnerships on the move", Paper presented at the Dutch Conference Knowledge on the Move, ISS, The Hague, January 2008.

more systematic integration has already become recognized sometimes under pressure of international, private firms' interests, as well as more globally oriented, private philanthropic organisations. Much more will be needed to be done here. Higher education training and research is continually in search of challenging application environments. Bringing in systematically the Southern development environment as one of the most challenging areas for applied research offers new opportunities for international North-South research partnerships. Furthermore, in many development environments standardized data are now becoming available, opening up new opportunities for micro-based evidence and case study research. In short, there is a natural expansion of the geographical coverage of applied research beyond the Northern developed world.

Second, one should systematically consider the possibilities for the formal twinning between higher education establishments and/or research institutes in the North and the South. Such a twinning process could offer opportunities for re-invigorating North-South research partnerships. Applied to the whole of Europe with its 4000 or so universities and higher education establishments, a coordinated twinning initiative could provide a major impetus for fast research capacity building in the South. The global dominance of "Northern" international research collaboration has been based on the concentration of private and public research funds in the developed countries. The remaining North-South publicly funded research partnerships became generally shaped within the framework of national developed countries' so-called "development cooperation" activities. Often ambitious standards, reflecting specific national development cooperation concerns, were being set for such North-South research partnerships. As a result, those criteria often eliminated large parts of the developed country's research community. North-South research collaboration became as a result a separate, often marginalized research field that focused on areas at the centre of Northern donor agencies' concerns often dominated by short-term, immediate concerns.

In short, a new, more radical vision of "*recherche sans frontiers*" should lead to a renewal of international North-South research partnerships in areas that are key to some of the global Malthusian challenges. In this research is following the process of globalization and the international spread of private research activities with the emergence of new research hotspots – no longer solely in the Northern world but increasingly also in emerging and developing countries.

b) Innovation for local development

The mirror picture of the global Malthusian challenge of international research collaboration consists of the local challenge of the rapid take-up and integration of new technologies within emerging development environments. What we will call here "innovation for local development". Underlying this notion is a vision of development that acknowledges much more the 'endogenous' nature of innovation rather than the external nature of technological change. In the old industrial S&T model, the focus within a context of local development was quite naturally on technology transfer and *imitation*: imitation to some extent as the opposite of innovation. In the new model, innovation is anything but imitation. Every innovation appears now unique with respect to its application. Re-use and re-combinations of sometimes routine, sometimes novel pieces of knowledge are likely to be of particular importance, but their

successful application might ultimately well involve more engineering expertise and design capabilities than research.

The need for a shift in research on innovation in private businesses has been popularized by Prahalad in his book “The Fortune at the Bottom of the Pyramid” (2004). One of the best-known examples of a Bottom of the Pyramid (BoP) innovation is the multiple-fuel stove innovation developed for the rural poor, in which cow dung and biomass (sticks and grass) can be used as cooking fuels. Traditionally these fuels are used in an extremely inefficient way and are dangerous to use due to the smoke inhaled from indoor fires. With the so-called “combination stove” that costs less than \$20, the user can now switch relatively easily from biomass to natural gas, according to his/her needs. There has been a flood of similar examples of BoP innovations being introduced in developing countries by multinational corporations from developed countries, sometimes in poor rural villages, sometimes in urban slums¹⁴.

A number of conclusions can be drawn from such examples: first of all, the likely and most successful location of such innovative process activities, will have to be close to *BoP users* contexts. Given the crucial role of users in the innovation process, this will imply that BoP laboratories will have to be embedded in users’ environments and not be part of traditional high-tech R&D centres and enclaves whether in the developed or developing country. In this sense the notion of “**grassroots innovation**” developed by Anil Gupta (1997) can be considered as the endogenous, intrinsic version of Prahalad’s external, top down version of BoP innovation. This brings to the forefront that for successful BoP innovation, there will be a need for a local business model that fully embodies local behavioural responses to innovation. Hence, the increasingly recognized need in BoP innovation for strategic alliances between large MNCs and local NGOs.

Second, the innovation process itself is likely to be reversed, starting with the design phase which will be confronted most directly with any attempt at finding functional solutions to some of the particular BoP users’ framework conditions. This will involve not just the need to bring the product on the market at a substantially lower price than existing goods, as Prahalad emphasized, but also a clear adaptation to the sometimes poor local infrastructure facilities with respect to energy delivery systems, water access, transport infrastructure, digital access, etc. **Autonomy** is the key word here. It is no surprise that the most rapidly spreading technology in developing countries has been mobile communication with currently more than 3 billion users worldwide. Autonomy from high quality energy, water, broadband network availability is undoubtedly one of the most pervasive drivers for BoP innovation. Another one might well be “cradle to cradle” sustainable innovation. The lack of high quality logistic infrastructure facilities in rural development settings might well imply that once goods are sold, the repair and/or central recollection of obsolete goods or their parts will be expensive. By contrast local re-use along the principles of cradle-to-cradle might well be a new form of sustainable grassroots innovation. It is

¹⁴ For some of those examples in the sanitation area, see Ramani (2008). For an overview of the BoP literature see Weehuizen (2008).

in this sense that one might talk about “*appropriate innovation*” and that there seems to be some analytical similarity with the old notion of “appropriate technology”¹⁵.

Third, the feedback from BoP users and from design developers upstream towards more applied research assistance, even fundamental research in some of the core research labs of European firms might become one of the most interesting examples of reverse South-North transfer of technology, re-invigorating and motivating the research community in the developed world increasingly “in search of relevance.”¹⁶ Not surprisingly, the main focus at the moment within the developed world is on BoP innovations in the health area, a sector where applied medical research is increasingly dominated by access to new technologically sophisticated equipment and much less by some of the more down to earth research questions about, and the list is non-exhaustive: anti-biotic resistance, infectious diseases or resistant tuberculosis. Not surprisingly, health is the sector most in need for what could be called a bottom of the pyramid research re-prioritization.

¹⁵ The notion of appropriate technology was of course much more formalized in terms of a rational set of economically determined “choices of technique” (Sen, 1968), depending very much on capital-labour substitution possibilities. The term “appropriate innovation” by contrast is much more open.

¹⁶ See Soete (2008) “International Research Partnerships on the Move”.

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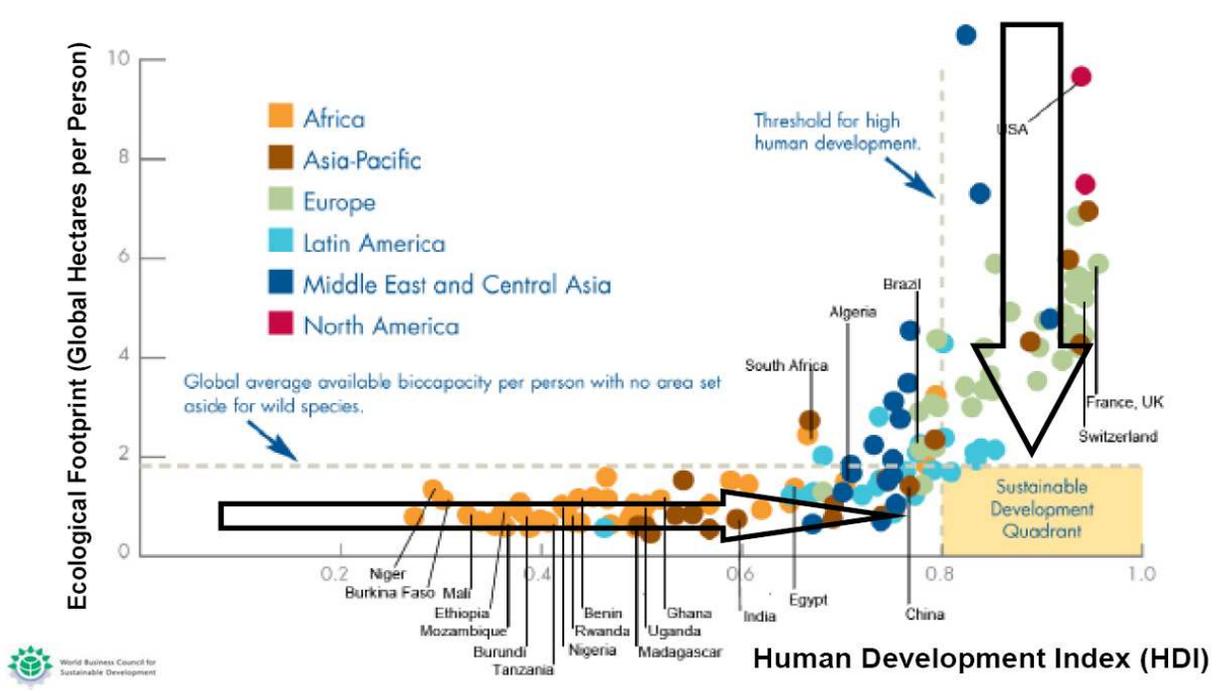
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Figure 2: How will future national societies look like with human development within planet's ecological limits?



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