Financial Liberalization, Exchange Rates, and Economic Development

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ISBN 978-90-5278-879-1
Published by Universitaire Pers Maastricht
Cover design: Christian van Kesteren

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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 vrijdag 20 november 2009 om 14.00 uur

door

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Preface

You hold in your hands the product of my doctoral research: *Financial Liberalization, Exchange Rates, and Economic Development*. The sea portrayed on the cover can be seen as a metaphor for international capital movements: both play an important role in human development but can get tumultuous at times. In my doctoral research I have studied the effects of financial liberalization. My main results indicate that capital controls have mainly negative effects on exchange rates, but that controls on inflows might have positive effects on a domestic level. I also put forward project finance as a form of capital that functions well even in markets with low levels of financial development.

Looking back over the past four years, I realize that I have learnt a lot, both on a professional level, and on a personal level. I also realize that I would not have been able to finish this undertaking without the help of many people. Although it is impossible to name them all, I would like to thank some of the most important ones.

My first words of gratitude go to my supervisor Christian Wolff. Without him I could not even have started on my dissertation. Throughout my project, he allowed my much independence in how I conducted my research and gave me much freedom to develop my own ideas and arguments. I had the opportunity to make my own mistakes and to learn from them, yet he was always available whenever I needed advice.

A special word of thanks also goes to my second supervisor, Stefan Straetmans. His patience and continued confidence in me helped me greatly in completing my dissertation. His love for science and good Belgian beer is contagious and I fondly look back on our late night conversations featuring both.

My other co-authors, Stefanie Kleimeier and Ron Jongen, should not be forgotten. It was a great pleasure to write a paper together with Stefanie and I have learnt a lot from doing research with her. I have enjoyed the time that I have spent with Ron as office mates and am very happy that we ended up working together on a project. I sincerely hope that we can all continue to cooperate in the future. I also thank Bertrand Candelon for his useful advice on my research.

I also would like to thank all other people who shared my experiences and supported me throughout my thesis: Weihua and Natascha, for giving me a second home in Maastricht after I moved to Florence; Amaresh, for his efforts to make me a more cultured —and Indian— person; And of course Rik, Mathijs, and all the

other Ph.D. students at the finance department who greatly improved my working environment.

My last words of thanks go to my my parents Co and Lia, and my brother Roy, for the unconditional support that they have given me over all these years. Words are not enough to describe how valuable they are to me. I can only say: I am proud of you too!

Roald Versteeg
September, 2009

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Chapter 1

Introduction

One of the central tenets of economics is that free markets are superior. In theory, free goods-markets allow customers to buy goods that they like to consume best and forces producers to be competitive. Likewise, free capital markets allow for the most efficient allocation of capital. Rich countries which have too much capital can lend it to poor countries that have too little. Lenders receive higher returns than they could have made at home and borrowing countries can lower their cost of capital and stimulate investments. Furthermore, capital mobility increases the diversification of assets and thereby reduces the riskiness of investments.

A broad consensus emerged among academics and policymakers in the 1990's that capital controls should no longer be a part of the international financial architecture. As a result of this, many countries liberalized their capital accounts and international capital flows increased dramatically in the period between 1970 and 1990. Financial markets flourished and financial innovation made them increasingly sophisticated. Bretton Woods, the period of strong monetary controls and fixed exchange rates that characterized the period between the Second World War and the 1970's, seemed far away.

Yet, although the picture is clear in theory, it is far more complex in practice. There are many imperfections in the market: markets are not complete, information is asymmetric, and credit markets are imperfect. In the presence of these market distortions, the rationale for financial liberalization is less compelling. Furthermore, the recent literature on financial crises has emphasized the possibility of multiple equilibria and self-fulfilling speculative attacks. In a perfect world the 'first-best' solution is to liberalize; in an imperfect world, however, capital controls may be 'second-best': if other market distortions are present, capital controls may still be welfare-enhancing. The recent string of financial crises have painfully demonstrated this point. In 1997, the Asian crisis laid bare the vulnerability of the financial system, created by large capital inflows. The effect the crisis had (not only on the directly affected countries but also the global financial structure as a whole) forcefully thrust capital controls back on the agenda; the countries that had liberalized, such as Thailand and Indonesia were the hardest hit by the crisis, while China and Malaysia,

which relied on capital controls, seemed largely unscathed by it.

The recent events of 2007-2008 have shown that even the economies of the industrialized countries are vulnerable to crashes in the financial system. What started as a string of defaults on sub-prime mortgages in the United States has rapidly evolved into a global financial crisis, the likes of which have not been witnessed since the great depression of the 1930's. Few countries have been spared the pain of this recession and central banks around the world have been forced to resort to extraordinary measures. Iceland lost 90% of the value of its stock market in a day after its complete banking sector collapsed and many other countries have been forced to partially nationalize their banking sectors. These events have led many to doubt the virtues of free markets; calls are being made for 'Bretton Woods II', a return to stricter regulation of financial markets and of international capital flows.

As the clamoring for more international regulation increases, research into capital controls has regained prominence. Industrialized countries will most likely not resort to such drastic measures as closing their capital accounts again, but the current wave of regulation will undoubtedly have an impact upon the decision of developing countries whether to open up their capital accounts. A balanced view on both the costs and benefits of capital controls is important in order to offer guidance for this decision. The aim of this thesis is therefore to obtain new insights into the role of international capital movements, in particular the effects of financial liberalization on exchange rate dynamics and economic development, through an empirical approach.

This thesis consists of a collection of studies; the chapters are self-contained and can be read in any order. As such, some overlap between the different chapters is inevitable, especially in the literature and methodology sections. Rather than forming a tight cluster of chapters focussing on a single topic, the chapters are loosely connected around the central theme outlined above. The thesis has been divided into three parts, each of which focuses on one of the following research questions:

1. What are the characteristics of exchange rate expectations?
2. How does financial liberalization affect parity conditions and exchange rate risk?
3. How is economic growth affected by the use of capital controls and what types of capital are effective when financial markets are underdeveloped?

The first part of this thesis considers survey data on exchange rate expectations. The observable nature of survey expectations offers a direct approach to test the rationality of expectations independently from the issues of model validity. Although much research has been undertaken in this field, none of the previous research has systematically documented the properties of the data itself. Chapter 2 fills this gap by providing a list of empirical stylized facts which characterize the time-series properties of survey foreign exchange rate expectations. Relevant statistical properties are described which are common to a wide variety of currencies and forecast horizons. Although not at the heart of the matter of financial liberalization, the use of survey exchange rate expectations opens up several lines of investigation related to financial liberalization, some of which are mentioned in the conclusion.

The second part of this thesis investigates the links between capital controls and exchange rate dynamics. Chapter 3 investigates whether capital controls are effective in providing countries with additional monetary freedom. More specifically, the interaction between exchange rates, interest differentials and capital controls are considered. Insulating the local economy from financial markets is one of the motivations of governments for maintaining capital controls. A fixed exchange rate and monetary freedom, for instance, can only coexist if there is no capital mobility. This chapter tests the effects of capital account liberalization on deviations from uncovered interest rate parity; both in Western European and emerging countries and proxied by several measures of financial liberalization.

Chapter 4 considers the effect of capital controls on exchange rate volatility. One motivation given for maintaining capital controls is to reduce exchange rate volatility. Large depreciations of the domestic currency seem to be a particular source of concern for domestic policy makers. Currency crises can be very costly to an economy and recent history has seen a large number of them occur in emerging economies. This chapter investigates to what extent capital controls succeed in curbing extreme currency fluctuations. Statistical extreme value analysis is employed to investigate if capital controls succeed in lowering exchange rate volatility. First, the fatness of the tails of the spot exchange rate returns is considered. The fatter the tails, the more likely it is that extreme events will occur. Second, the analysis is extended to quantiles (looking at the largest depreciation that countries can expect to experience over, say, 10 years). The chapter tests whether extreme quantiles are lower in the controlled or liberalized periods.

The third and final part of this thesis considers the broader question of economic development. Many studies have attempted to offer guidelines as to how emerging economies can transform their closed, underdeveloped, markets into open, developed, ones. The last two chapters contained in this part add to this literature by investigating how financial liberalization affects these countries and which type of capital is suitable for instances in which financial markets are not yet well developed.

Chapter 5 studies the link between financial liberalization and economic growth. In this chapter, a new measure of capital controls is constructed. The measure distinguishes (a) between controls on capital inflows and controls on capital outflows, and (b) between controls on various types of capital. Previous studies have postulated that not all types of controls are equally beneficial (or harmful) to developing economies. By studying a broad cross-section of countries, this study separates the effects of each type of control in order to shed light on the question of which types of controls are beneficial and which are not.

Chapter 6 shows that a specific type of capital—project finance— is effective in the least developed markets, where most types of international capital have previously been shown to be less effective. Project finance is characterized by the creation of a legally independent project company, funded primarily with (syndicated) non-recourse finance. It is generally used for complex high-risk projects with large information asymmetries between the principal and the agent. In this study, it is hypothesized that project finance is beneficial to the least developed economies as it is able to compensate for a lack of domestic financial development. It is argued

that the contractual structure unique to project finance leads to better investment management and governance. In the empirical analysis the effects of project finance on growth are measured in a wide cross section of countries. The analysis pays specific attention to the effects on low-income countries, where financial development and governance is weakest.

Finally, chapter 7 brings together the contents of the different chapters, provides prospects for future research, and provides the conclusions.

Part I

Exchange Rate Expectations

Chapter 2

Time-Series Properties of Survey Exchange Rate Expectations*

2.1 Introduction

In the last couple of decades the use of survey exchange rate expectations have gained a lot of popularity. The observable nature of survey expectations offers a direct approach to test the rationality of expectations separate from the validity of exchange rate models. The previous inability to measure expectations forced the simultaneous testing of these joint hypotheses. Indeed, the use of survey expectations has enabled the end of some disputes in the international finance literature, for instance on the relative importance of risk premia versus irrational expectations. MacDonald (2000), Maddala (1991), Takagi (1991), and Jongen, Verschoor, and Wolff (2008) all give comprehensive overviews of the literature on exchange rate expectations; the models of expectations formations and the explanations they have provided for exchange rate behavior. Yet, although a lot of research has been undertaken in this field, none of the previous research has systematically documented the properties of the data itself. Stylized facts have been reported for nominal exchange rates (De Vries, 1994; Mussa, 1979), forward rates (Baillie and Bollerslev, 1994), and asset returns (Cont, 2001), but not yet for survey exchange rate expectations. This chapter fills the gap by summarizing the time series properties that can be empirically observed in the survey expectations data and providing a number of known and less well-known stylized facts about the empirical behavior of exchange rates expectations. In addition this chapter offers a reference point for these stylized facts, by showing how they relate to the stylized facts that characterize spot and forward exchange rates. The stylized facts that are discussed in this chapter are the following:

*Part of this chapter is based on Jongen, Straetmans, and Versteeg (2009)

1. **Unit Root:** The level of the expected exchange rate contains a unit root. The first difference is stationary.
2. **Cointegration:** The expected exchange rate is cointegrated with the spot rate with as cointegrating relation $s^e_{t,t+1} - s_t$, the expected spot return.
3. **News Dominance:** The variation in the expected spot return is lower than the variation in realized spot returns and the variation in the forecast error.
4. **Excess volatility:** The variation in the expected spot return is higher than the variation in the underlying fundamentals.
5. **Serial correlation:** Expected spot returns show positive serial correlation; they exhibit more serial correlation than realized spot returns, but are less persistent than forward premia.
6. **Fat tails:** Expected spot returns, like realized spot returns and forward premia, exhibit fat tails. They contain more outliers than would be expected under, for example, a normal distribution.
7. **Volatility clusters:** The volatility of expected spot returns is not constant over time; instead they are characterized by clusters of high volatility and clusters of low volatility.
8. **Conditional heavy tails:** Expected spot returns are conditionally fat-tailed; even after taking into account volatility clusters, the innovations have a fat-tailed distribution. The conditional fatness of expected spot returns is lower than in forward premia but higher than in realized spot returns.
9. **Mixed expectations formations:** Forecasters can be broadly split into two groups: fundamentalists and chartists; moreover, most forecasters put some weight on both fundamental and chartist techniques.
10. **No predictability:** Survey expectations are not able to outperform either the random walk or the forward premium as a forecast for future spot rates.

The rest of the chapter is structured as follows. In section 2.2 the data is outlined and the survey exchange rate expectations that are used in this study are described. Section 2.3 explains one by one the stylized facts that are outlined above. Section 2.4 concludes this chapter.

2.2 Data

Before the stylized empirical facts of survey exchange rate expectations can be discussed, the variable of interest has to be defined. At first sight it seems obvious that the level of the survey exchange rate expectation, henceforth referred to as the expected spot rate, itself should form the center of the analysis. This variable is of central interest to importers and exporters, who need to make an estimate of the price they will get for their goods in the future. However, there exists a consensus that international capital movements are the dominant factor in exchange rate markets, rather than trade related transactions. And in (international) finance, it is not the (expected) exchange rate which is of central interest, but the expected depreciation or appreciation of the exchange rate. These exchange rate returns will

determine the performance of the invested portfolios. Thus most of the focus will lie on the expected spot return.

This study also introduces benchmarks against which to compare the stylized facts of expected spot rates. The spot foreign exchange rate constitutes the first benchmark. The spot rate forms the natural benchmark against which to compare the expected spot rate. The expected spot rate is a 'derivative' of the spot rate itself; it tries to forecast the future spot rate. If the forecast is perfect, then the time series of the expected spot will be equal to the time series of the spot rate and their stylized facts. If expectations are not perfect but at least rational, they are a composite of the realized spot rate, combined with a white noise forecast error. The forward rate constitutes a second benchmark. Forward markets provide contracts to trade the currency at an agreed price. The forward rate should thus be related to the underlying future spot rate. Moreover, according to the unbiasedness hypothesis of the forward market for foreign exchange, the forward rate should equal the future expected spot rate (apart form a risk premium). Thus, according to the unbiasedness hypothesis, forward rates reflect spot rate expectations of the market participants. As benchmarks for the expected spot return the spot return and the forward premium will be taken.

With regard to mathematical notations, the spot rate at time t is defined as s_t. the survey expectation, formed at time t, of the future spot rate s_{t+1} is denoted as $s^e_{t,1}$; in the rest of the article this is referred to as the expected spot rate. The forward rate, established at time t, for currency delivered at time $t+1$ is defined as $f_{t,t+1}$. All variables have been transformed into natural logarithms to circumvent Siegel's paradox arising from Jensen's inequality[1], and to circumvent numerary conventions. By analogue, the expected spot return is then defined as $s^e_{t,t+1} - s_t$, while the forward premium is defined as $f_{t,t+1} - s_t$. The difference operator and the expectations operator are represented by Δ and E respectively.

The focus will be kept narrow in order to retain as much in-depth treatment of the stylized facts as possible: This chapter will focus only on the one month ahead forecasts of the three major currencies (euro, yen, and pound) and their associated spot and forward rates. Related variables, such as interest rates, will only be covered as the occasion arises. However, the stylized facts mentioned in this article extend to a wide range of currencies and forecast horizons.

The survey expectations have been retrieved from Consensus Economics. Every second Monday of each calendar month Consensus Economics of London publishes 1-, 3-, and 12-month-ahead expectations for a large number of exchange rates. The Consensus Economics forecasts database constitute one fo the most comprehensive sets of foreign exchange rate expectations currently available. Arround 150 expectations of individual market participants are gathered per currency. Next, the aggregate (average) 1 month ahead expectations of the euro/US dollar (euro), Japanese yen/US dollar (yen), and the British pound/US dollar (pound) are obtained.[2]

[1] i.e. $\frac{1}{E(x)} \neq E\frac{1}{x}$

[2] Prior to the introduction of the euro, expectations for the deutschemark/US dollar exchange rate are used, from which the expectations are calibrated against the euro, using the official rate of 1.95583 DEM/euro.

Spot rates, forward rates, and other data used in this chapter are obtained through DataStream. Although survey participants have a few days time to return their expectations, we learned that the vast majority send their responses by e-mail one working day before the publication day (second Monday of the month). This working day is considered as the day on which the expectations are formed. On this day spot exchange rate series are obtained to match with the survey expectations. To verify that the information sets of market participants are not too diverse, all of the analysis throughout this study were re-estimated by using spot data from two or more working days prior to the publication day, yet the overall results remained unchanged.

Figures 2.1 to 2.3 gives a graphical representation of the data used in this chapter. When looking at the level series it can be seen that the expected spot rate $s^e_{t,t+1}$ closely follows the realized spot rate s_{t+1} and the forward rate $f_{t,t+1}$. The difference in smoothness of the innovations becomes apparent when looking at the lower panels of the figures, which depict the return series. The realized spot return Δs_{t+1} is moving up and down most strongly, while the forward premium $f_{t,t+1} - s_t$ moves only very gently over time. The expected spot return $s^e_{t,t+1} - s_t$ fits somewhere in between.

2.3 Stylized Facts

2.3.1 Unit Root Tests

By now, it is well known that many macro-economic time-series are non-stationary, or exhibit a unit root. For example, Meese and Singleton (1982) already point out that spot exchange rates and forward rates exhibit a unit root. This brings us to the first stylized fact:

Fact 1 (Unit Root Property) *The natural logarithm of the expected nominal bilateral exchange rate is non-stationary, while its first difference will be stationary. Expected spot returns and forward premia are also stationary.*

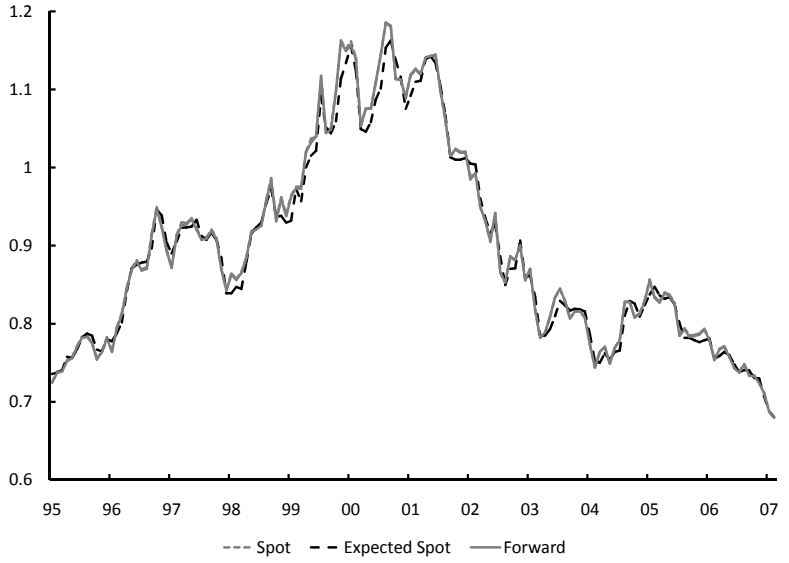
Ignoring higher order dynamics for the moment, these properties are reflected by the stochastic processes for $\{s^e_{t,t+1}\}$, its first difference $\{\Delta s^e_{t,t+1}\}$, the expected spot return and the forward premium:

$$\begin{array}{ll} s^e_{t,t+1} = \phi_1 s^e_{t-1,t} + \epsilon_{1t} & ,\phi_1 = 1, \\ \Delta s^e_{t,t+1} = \phi_2 \Delta s^e_{t-1,t} + \epsilon_{2t} & ,|\phi_2| < 1, \\ \left(s^e_{t,t+1} - s_t\right) = \phi_3 \left(s^e_{t-1,t} - s_{t-1}\right) + \epsilon_{3t} & ,|\phi_3| < 1, \\ \left(f_{t,t+1} - s_t\right) = \phi_4 \left(f_{t-1,t} - s_{t-1}\right) + \epsilon_{4t} & ,|\phi_4| < 1, \end{array} \tag{2.1}$$

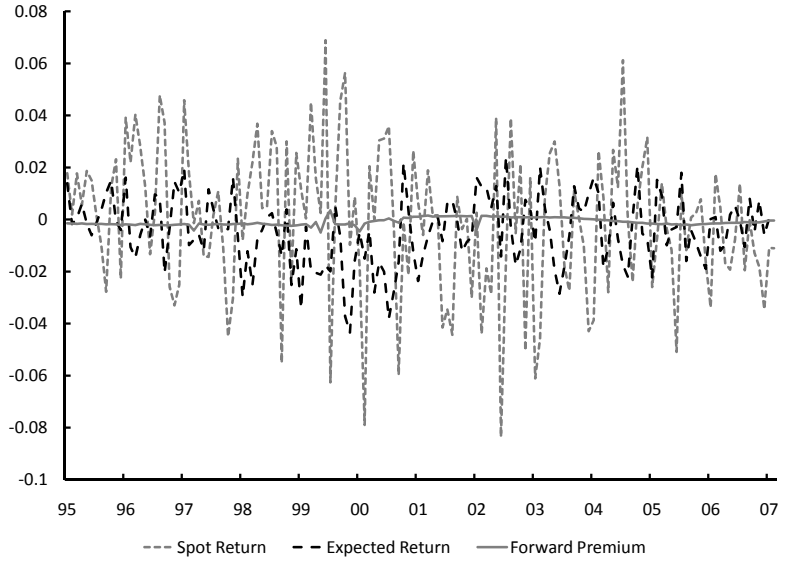
and where the disturbance terms are stationary[3]. As the differences of $s^e_{t,t+1}$ are stationary, $s^e_{t,t+1}$ is said to be integrated of order 1, in short I(1).

[3]Time trends or structural breaks are not detectable in the survey expectational data which implies that stationary series are interpretable as consisting of a covariance stationary part (i.e. with constant and finite unconditional first and second moments) and a deterministic part.

Figure 2.1: Exchange rate data, Euro.
Panel A plots the level data: the spot rate,s_t, the expected spot rate, $s^e_{t,t+1}$, and the forward rate $f_{t,t+1}$. Panel B plots the return data: the realized spot return,Δs_{t+1}, the expected return, $s^e_{t,t+1} - s_t$, and the forward premium, $f_{t,t+1} - s_t$. The sample period runs from November 1995 to December 2007.

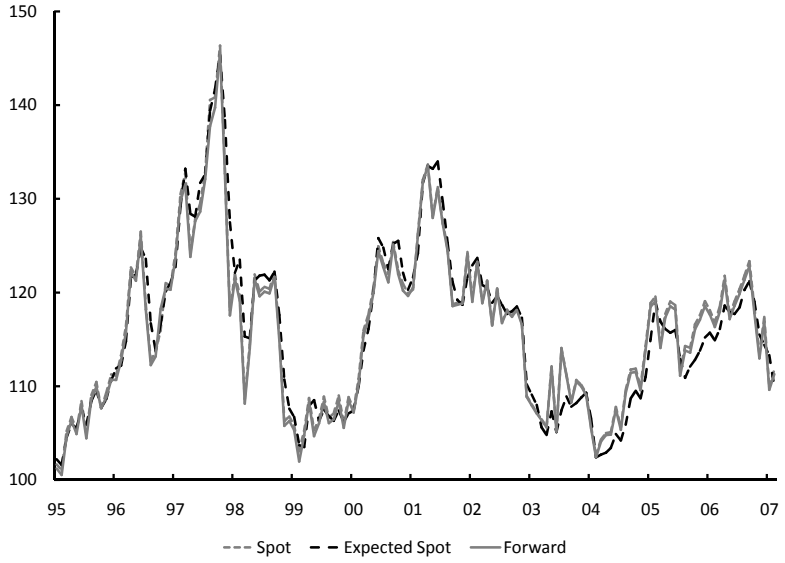


(a) Exchange Rates

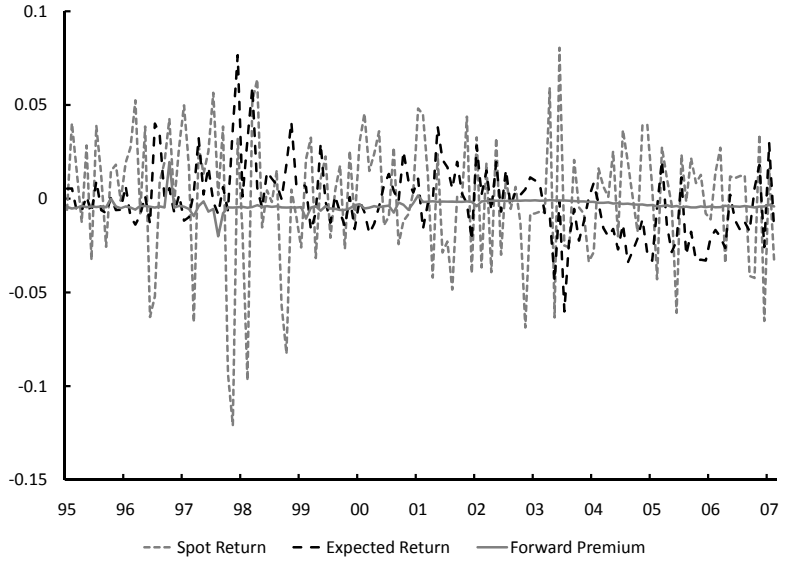


(b) Returns

Figure 2.2: Exchange rate data, Yen.
Panel A plots the level data: the spot rate,s_t, the expected spot rate, $s^e_{t,t+1}$, and the forward rate $f_{t,t+1}$. Panel B plots the return data: the realized spot return,Δs_{t+1}, the expected return, $s^e_{t,t+1} - s_t$, and the forward premium, $f_{t,t+1} - s_t$. The sample period runs from November 1995 to December 2007.

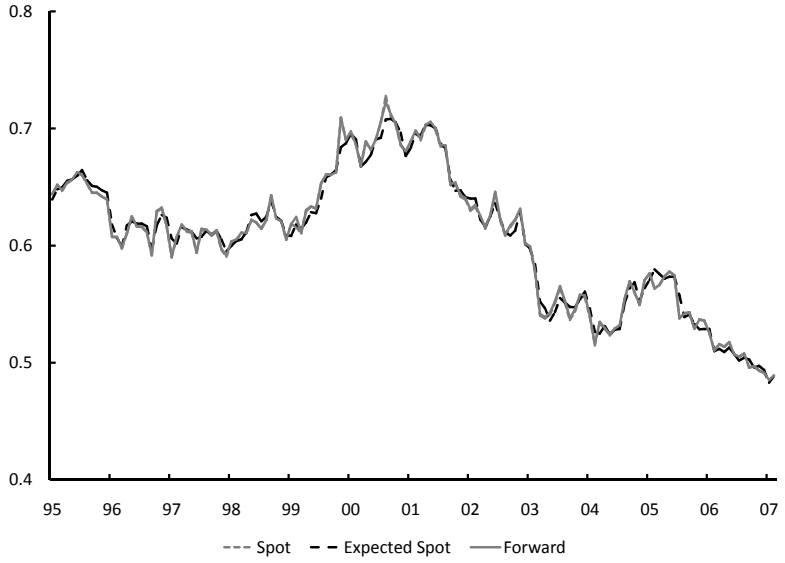


(a) Exchange Rates

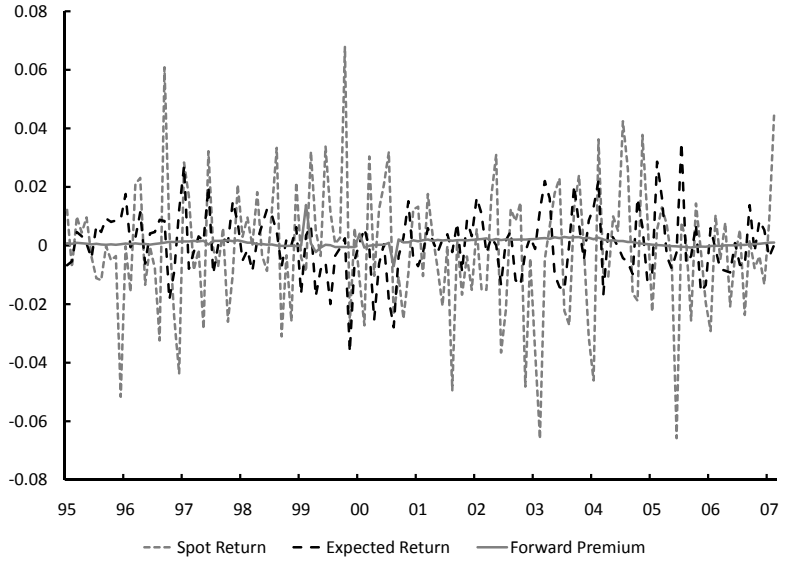


(b) Returns

Figure 2.3: Exchange rate data, Pound.
Panel A plots the level data: the spot rate,s_t, the expected spot rate, $s^e_{t,t+1}$, and the forward rate $f_{t,t+1}$. Panel B plots the return data: the realized spot return,Δs_{t+1}, the expected return, $s^e_{t,t+1} - s_t$, and the forward premium, $f_{t,t+1} - s_t$. The sample period runs from November 1995 to December 2007.



(a) Exchange Rates



(b) Returns

Table 2.1: Unit root tests on exchange rate expectations.
This table reports the results of the unit root tests. The columns marked 'ADF' contain the results of the augmented Said-Dickey-Fuller test and 'PP' contain the results of the modified Phillips-Perron (NG and Perron, 2001). The columns marked 'level' tests for a unit root in the level (e.g. $s^e_{t,t+1}$) and the column 'diff.' tests for a unit root in the first difference (e.g. $\Delta s^e_{t,t+1}$). Lag lengths of the tests have been selected with the use of the Schwarz selection criterium. A *, **, *** denotes rejection of the null of unit root at the 10, 5, and 1 percent significance, respectively.

		Level		Difference	
Currency	Variable	ADF	PP	ADF	PP
Euro	s_t	-0.88	-0.72	-11.27^{***}	-5.46^{***}
	$s^e_{t,t+1}$	-1.03	-0.88	-9.15^{***}	-5.83^{***}
	$f_{t,t+1}$	-0.89	-0.72	-11.38^{***}	-5.48^{***}
	$s^e_{t,t+1} - s_t$	-5.27^{***}	-4.43^{***}		
	$f_{t,t+1} - s_t$	-4.99^{***}	-4.27^{***}		
Yen	s_t	-3.21^{**}	-1.35	-12.93^{***}	-2.83^{***}
	$s^e_{t,t+1}$	-2.25	-1.12	-19.54^{***}	-6.44^{***}
	$f_{t,t+1}$	-2.17	-1.32	-5.71^{***}	-2.70^{***}
	$s^e_{t,t+1} - s_t$	-8.09^{***}	-5.49^{***}		
	$f_{t,t+1} - s_t$	-9.18^{***}	-5.75^{***}		
Pound	s_t	-0.58	-0.14	-12.53^{***}	-5.50^{***}
	$s^e_{t,t+1}$	-0.42	0.03	-10.09^{***}	-5.27^{***}
	$f_{t,t+1}$	-0.17	-0.14	-12.59^{***}	-5.50^{***}
	$s^e_{t,t+1} - s_t$	-10.20^{***}	-5.70^{***}		
	$f_{t,t+1} - s_t$	-9.38^{***}	-5.83^{***}		

Table 2.1 reports test results for the null hypothesis that $\phi = 1$ and for the four time series considered in fact 1. With an eye towards some sensivity analysis, The series are tested for the presence of a unit root using both the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979; Said and Dickey, 1984) as well as the modified Phillips-Perron (PP) test (Ng and Perron, 2001).[4] The tests are also performed for the differenced series up to the point the series are found to be stationary. The testing outcomes reveal that series are either stationary or integrated of order 1: in contrast to the first differenced series (rejection of a unit root at the 1% significance level), the unit root hypothesis cannot be rejected for the level series of the expected exchange rate. The results for the spot and forward rates are very similar and indicate that these variables are also I(1). Finally, both the expected spot return, $s^e_{t,t+1} - s_t$, and the forward premium, $f_{t,t+1} - s_t$ are found to be stationary.

[4]By now there is a whole armada of unit root tests available which all slightly differ in terms of small sample behavior (size, power and bias properties). For sake of simplicity we limit ourselves to two of the most representative and prominent tests in the empirical unit root literature.

2.3.2 Cointegration

The stationarity of the expected spot return and the forward premium found in previous section's table 2.1 relates to the next empirical stylized fact. The observed nonstationarity of spot exchange rates and expected exchange rates and the intuitive observation that the two series are linked to each other, makes for a natural progression to cointegration between the two series.

Recall the definition of stationarity from the previous section and the finding that the level series $s^e_{t,t+1}$ are non-stationary in contrast to the first differenced series $(s^e_{t,t+1} - s^e_{t-1,t})$. A linear combination of two (or more) non-stationary variables can also be stationary. If this happens, the variables are said to be cointegrated.

The stationarity of the expected spot return indicate that such a stationary linear combination indeed exists between the spot exchange rate and the expected spot exchange rate. This constitutes the second fact.

Fact 2 (Cointegration) *The expected exchange rate is cointegrated with the spot rate with as cointegrating relation $s^e_{t,t+1} - s_t$, the expected spot return.*

The existence of the cointegration relation $s^e_{t,t+1} - s_t$ leads to a number of additional inferences. First, consider cointegration between $s^e_{t,t+1}$ and $f_{t,t+1}$. Slightly rewriting the relation gives:

$$f_{t,t+1} - s^e_{t,t+1} = (f_{t,t+1} - s_t) - (s^e_{t,t+1} - s_t), \tag{2.2}$$

Where $(s^e_{t,t+1} - s_t)$ is the original cointegration relation as stated in fact 2. Additionally it is well known in the literature that $f_{t,t+1}$ and s_t also cointegrate with vector $[1, -1]$ De Vries (e.g. 1994). Thus, $f_{t,t+1} - s^e_{t,t+1}$ can be decomposed into two stationary parts and the difference of two stationary variables is also stationary. Therefore, $s^e_{t,t+1}$ and $f_{t,t+1}$ are shown to cointegrate, with $(f_{t,t+1} - s^e_{t,t+1})$ as error correction term.

Furthermore, the above fact also implies that $s^e_{t,t+1}$ is cointegrated with the future spot rates, s_{t+1}. The proof is similar to the previous one; rewrite the relation to obtain:

$$s_{t+1} - s^e_{t,t+1} = (s_{t+1} - s_t) - (s^e_{t,t+1} - s_t), \tag{2.3}$$

Where $(s^e_{t,t+1} - s_t)$ is once again the original cointegration relation and Δs_{t+1} is the realized spot return, which has been shown to be stationary in the previous section[5].

Both variables $(f_{t,t+1} - s^e_{t,t+1})$ and $(s_{t+1} - s^e_{t,t+1})$ are regularly used in the literature. The first variable, $(f_{t,t+1} - s^e_{t,t+1})$, is often used to proxy for the (unobserved) risk premium. Alternatively, it has also been identified as the expected abnormal return on forward rate speculation, by those who discard the existence of a risk premium. The second construct,$(s_{t+1} - s^e_{t,t+1})$, is commonly known as the forecast error. It is used in tests for forecasting ability. Additionally, researchers have used the forecast error to make statements about the rationality of expectations.

[5]Although the above shows that $(s_{t+1} - s^e_{t,t+1})$ are cointegrated, it is not necessarily the case that these relations can be well estimated, see for example Zivot (2000).

The long run relations in themselves are not the only interesting facts that can be deduced from the cointegration between $s^e_{t,t+1}$ and s_{t+1}. As the two variables trend together in the long-run, that also means that at least one of the two has to react to the other, to prevent them from moving away from each other too far, so called error correction. If s_{t+1} does not react to the error correction term, it is said to be exogenous with respect to the (parameters of) the cointegrating relation.

The exogeneity of the spot rate has some interesting implications. First of all it is clear evidence that in the short run, the expected spot rate is not an unbiased predictor of the spot rate; this requires the adjustment speed to be equal to one (and not zero). In addition it means that all the adjustment occurs through $s^e_{t,t+1}$: this makes it reactive to s_t rather than predictive. That is, $s^e_{t,t+1}$ will probably not only be biased, but in general be a bad predictor of s_{t+1}. A proposition which is more formally tested in section 2.3.8.

We will test for cointegration by using both the bivariate Engle-Granger approach ((1987)) as well as the multivariate Johansen procedure ((1991; 1995)). The Engle-Granger procedure starts by running the regression

$$s^e_{t-1,t} = \beta s_{t-1} + \epsilon_t. \tag{2.4}$$

and to test for cointegration. This is done by a performing an ADF test on the residuals $\{\epsilon_t\}$. This test is similar to a normal ADF (albeit with different critical values as given in MacKinnon (1991)). Conditional upon finding cointegration in the first step, the short run error-correction dynamics are identified by means of the regression:

$$\Delta s^e_{t,t+1} = \alpha(s^e_{t-1,t} - \hat{\beta} s_{t-1}) + \phi_1 \Delta s^e_{t-1,t} + \phi_2 \Delta s_{t-1} + \nu_t, \tag{2.5}$$

and where $s^e_{t-1,t} - \hat{\beta} s_{t-1}$ correspond with the stationary residuals from the cointegration regression.

The Johansen procedure is based on estimating a first order vector auto regression (VAR)

$$\Delta y_t = \Pi y_{t-1} + \Phi \Delta y_{t-1} + \epsilon_t, \tag{2.6}$$

and where $y_t = \begin{pmatrix} s^e_{t,t+1} & f_{t,t+1} & s_t \end{pmatrix}'$. Furthermore, Π is decomposed into $\alpha\beta'$, where α and β represent three by two matrices. In order to identify the parameters α and β, the restrictions

$$\alpha\beta' = \begin{pmatrix} \alpha_{1,1} & \alpha_{1,2} \\ \alpha_{2,1} & \alpha_{2,2} \\ \alpha_{3,1} & \alpha_{3,2} \end{pmatrix} \begin{pmatrix} 1 & 0 & \beta_1 \\ 0 & 1 & \beta_2 \end{pmatrix},$$

are imposed. This structure corresponds with the cointegrating relations $(s^e_{t,t+1} - \beta_1 s_t)$ and $(f_{t,t+1} - \beta_2 s_t)$. The VAR's lag order has been chosen on the basis of a likelihood-ratio (LR) test. This test can also not reject the hypothesis that the (restricted) intercept equals zero. In addition, both the trace test and the Eigenvalue statistic confirm the null that two cointegration relations are present. Tables

Table 2.2: Engle-Granger cointegration of exchange rate expectations.
This table reports the Engle-Granger cointegration results of the system $\Delta s^e_{t,t+1} = \alpha_{s^e}(s^e_{t-1,t} - \hat{\beta}_{s^e} s_{t-1}) + \phi_1 \Delta s^e_{t-1,t} + \phi_2 \Delta s_{t-1} + \nu_t$. The long run parameter $\hat{\beta}_{s^e}$ is estimated first with $s^e_{t-1,t} = \beta s_{t-1} + \epsilon_t$. The residuals are substituted in the above equation, which estimates the short run dynamics α. Panel A reports the coefficients of the cointegration relation β and the short run adjustment α; ϕ has been omitted for brevity. Panel B reports the results of several restrictions. The left column reports the ADF unit root test for the residuals $\{\epsilon_t\}$, with the null of no-cointegration. The right column reports the t-test on the restriction that the cointegrating vector $\beta = 1$. Critical Values for the CADF are based on MacKinnon (1991). For other notes on the ADF test, see the notes in table 2.1. A *,**,*** denotes rejection of the null at the 10, 5, and 1 percent significance respectively.

Panel A: Cointegration

			α		
Currency	Relation	β	$\Delta s^e_{t,t+1}$	$\Delta f1_{t,t+1}$	Δs_t
Euro	$(s^e_{t-1,t} - \beta_1 s_{t-1})$	0.998	−0.56		−0.19
		(0.006)	(0.18)		(0.23)
	$(f_{t-1,t} - \beta_2 s_{t-1})$	1.004		−2.83	−2.59
		(0.001)		(1.72)	(1.71)
	$(s^e_{t-1,t} - \beta_3 f_{t-1,t})$	0.993	−0.56	−0.15	
		(0.006)	(0.18)	(0.24)	
Yen	$(s^e_{t-1,t} - \beta_1 s_{t-1})$	1.000	−0.25		−0.01
		(0.000)	(0.14)		(0.22)
	$(f_{t-1,t} - \beta_2 s_{t-1})$	0.999		−0.72	−0.11
		(0.000)		(1.22)	(1.22)
	$(s^e_{t-1,t} - \beta_3 f_{t-1,t})$	1.000	−0.23	−0.23	
		(0.000)	(0.14)	(0.14)	
Pound	$(s^e_{t-1,t} - \beta_1 s_{t-1})$	0.998	−0.39		0.52
		(0.002)	(0.19)		(0.26)
	$(f_{t-1,t} - \beta_2 s_{t-1})$	0.998		−0.87	−0.20
		(0.000)		(1.44)	(1.45)
	$(s^e_{t-1,t} - \beta_3 f_{t-1,t})$	1.000	−0.38	−2.59	
		(0.002)	(0.19)	(1.71)	

Panel B: Restrictions

Currency	Relation	CADF	$\beta = 1$
Euro	$(s^e_{t-1,t} - \beta_1 s_{t-1})$	−2.55**	−0.39
	$(f_{t-1,t} - \beta_2 s_{t-1})$	−1.69*	6.46***
	$(s^e_{t-1,t} - \beta_3 f_{t-1,t})$	−2.76***	−1.09
Yen	$(s^e_{t-1,t} - \beta_1 s_{t-1})$	−3.38***	−1.00
	$(f_{t-1,t} - \beta_2 s_{t-1})$	−2.52**	−14.21***
	$(s^e_{t-1,t} - \beta_3 f_{t-1,t})$	−3.17***	1.17
Pound	$(s^e_{t-1,t} - \beta_1 s_{t-1})$	−4.00***	−0.96
	$(f_{t-1,t} - \beta_2 s_{t-1})$	−2.69***	−7.53***
	$(s^e_{t-1,t} - \beta_3 f_{t-1,t})$	−3.99***	0.17

Table 2.3: Johansen cointegration of exchange rate expectations.
This table report the VECM results of the system $\Delta y_t = \alpha\beta' y_{t-1} + \Phi\Delta y_{t-1} + \epsilon_t$, with $y_t = \begin{pmatrix} s^e_{t,t+1} & f_{t,t+1} & s_t \end{pmatrix}'$. Panel A reports the coefficients of the long run parameters β and the short run adjustment coefficients α(standard errors in brackets); Φ has been omitted for brevity. Panel B reports several LR tests on overidentifying restrictions. The first column reports the test statistic for the restrictions placed on α, as described below. The second and third column report the test results on the restriction that β_{s^e} and β_f are equal to 1. The lower half shows the trace test with respect to the number of cointegration equations (CE). A *,**,*** denotes rejection of the null at the 10, 5, and 1 percent significance respectively. The identifying structure of β' and the restrictions α_r imposed on α look as follows:
$\beta' = \begin{pmatrix} 1 & 0 & \beta_1 \\ 0 & 1 & \beta_2 \end{pmatrix}$, and $\alpha_r' = \begin{pmatrix} \alpha_1 & 0 & 0 \\ 0 & \alpha_2 & 0 \end{pmatrix}$

Panel A: Cointegration

			α		
Currency	Relation	β	$\Delta s^e_{t,t+1}$	$\Delta f1_{t,t+1}$	Δs_t
Euro	$(s^e_{t-1,t} - \beta_{s^e} s_{t-1})$	1.008	−0.48		−0.00
		(0.010)	(0.07)		(0.01)
	$(f_{t-1,t} - \beta_f s_{t-1})$	1.005		−2.06	−1.79
		(0.002)		(0.72)	(0.72)
Yen	$(s^e_{t-1,t} - \beta^e_s s_{t-1})$	1.000	−0.24		−0.01
		(0.000)	(0.06)		(0.02)
	$(f_{t-1,t} - \beta_f s_{t-1})$	0.999		−0.22	−0.41
		(0.000)		(0.48)	(0.47)
Pound	$(s^e_{t-1,t} - \beta^e_s s_{t-1})$	1.000	−0.72		0.02
		(0.002)	(0.08)		(0.02)
	$(f_{t-1,t} - \beta_f s_{t-1})$	0.998		−1.23	−0.59
		(0.000)		(0.63)	(0.64)

Panel B: Restrictions

	Overidentifying restrictions		
Currency	$\alpha = \alpha_r$ $\chi^2(4)$	$\beta_{s^e} = -1$ $\chi^2(1)$	$\beta_f = -1$ $\chi^2(1)$
Euro	7.04	0.41	7.03***
Yen	1.54	0.25	24.25***
Pound	4.80	0.05	14.90***

	Number of coint. equations		
Currency	$CE = 0$	$CE \leq 1$	$CE \leq 2$
Euro	55.93***	19.27***	0.37
Yen	55.93***	19.27***	0.36
Pound	55.44***	17.82***	0.04

2.2 and 2.3 report the cointegration results of the Engle-Granger and Joh ansen methodologies, respectively.

For both tables, the upper part reports the coefficients, while the lower panel contains the results for the cointegration test and the parameter restrictions. The CADF test in table 2.2 and the Eigenvalues and trace test in table 2.3 all indicate that cointegration is present between all variables. Furthermore, the long run relations are very close to the hypothesized values. The relations between $s^e_{t,t+1}$ and s_t and between $f_{t,t+1}$ and s_t are all very close to $[1, -1]$. For the relation $s^e_{t,t+1}$ and s_t this difference is also statistically insignificantly different from $[1, -1]$ in all cases. The tests do indicate, however, a significant difference from the relation $[1, -1]$ for $f_{t,t+1}$ and s_t. However, as this difference is minute in absolute terms, it is almost impossible to attribute economic significance to this difference.

The VECM results of table 2.3 also indicate that several restrictions can be placed on the short run adjustments of the series. Perhaps unsurprisingly, $\alpha_{1,2}$ and $\alpha_{2,1}$ are not significantly differently from zero indicating that there are no feedback effects from $(s^e_{t,t+1} - s_t)$ to $f_{t,t+1}$ and from $(f_{t,t+1} - s_t)$ to $s^e_{t,t+1}$. Also the restriction that $\alpha_{3,1} = \alpha_{3,2} = 0$ can neither be rejected. This indicates that the spot rate s_t is weakly exogenous with respect to the parameters α and β[6].

Moreover, the exogeneity of s_t and the fact that the adjustment speed of s_t is less than one also implies that the error correction term $(s^e_{t,t+1} - s_t)$ will be serially correlated — see also section 2.3.4. To see this point, consider the following system describing $s^e_{t,t+1}$ and s_t:

$$\begin{pmatrix} \Delta s^e_{t,t+1} \\ \Delta s_t \end{pmatrix} = \begin{pmatrix} \alpha_{s^e} \\ \alpha_s \end{pmatrix} \left(s^e_{t,t+1} - s_t\right) + \begin{pmatrix} \epsilon_{s^e,t} \\ \epsilon_{s,t} \end{pmatrix}. \tag{2.7}$$

Where the $\alpha' s$ are the short run adjustment factors to the cointegration relations. If this is premultiplied by [1,-1], the cointegrating vector, then

$$(s^e_{t,t+1} - s_t) = \phi(s^e_{t-1,t} - s_{t-1}) + \nu_t, \tag{2.8}$$

with $\phi = 1 + (\alpha_{s^e} - \alpha_s)$ and $\nu_t = \epsilon_{s^e,t} - \epsilon_{s,t}$. That is, the expected spot return $(s^e_{t,t+1} - s_t)$ follows an AR(1) process, with parameter ϕ. As $\alpha_s = 0$ and $\alpha_{s^e} > -1$, this implies positive serial correlation.

2.3.3 News Dominance and Excess Volatility

Now that the nonstationarity of the expected spot rate has been outlined, focus will shift towards the (stationary) expected spot return. Recall figures 2.1 through 2.3; they depict the historical data of the expected spot return,the realized spot return, and the forward premium. Remember that the graph revealed that the expected spot returns are less volatile than the realized spot returns, but not nearly as smooth as the forward premium. Two stylized facts can be deduced from this graph: (1) the

[6] for a more detailed discussion of exogeneity in error correction models see Johansen (1995) or Urbain (1993). Norrbin and Reffett (1996) explicitly investigate the exogeneity of s_t and $f_{t,t+1}$ and find, like in this chapter, that s_t is exogenous with respect to the cointegration parameters

Table 2.4: News dominance of exchange rate expectations.
This table shows the standard deviations of the exchange rate series (in Panel A). The lower half (Panel B) contains the variance ratio tests comparing $\sigma(\Delta s_t)$ to $\sigma(s^e_{t,t+1}-s_t)$ and $\sigma(s^e_{t,t+1}-s_t)$ to $\sigma(f_{t,t+1}-s_t)$. A *,**,*** denotes rejection of the null of equal variances at the 10, 5, and 1 percent significance respectively.

Panel A: Standard Deviations

Currency	$\sigma_{(\Delta s_t)}$	$\sigma_{(s_{t+1}-s^e_{t,t+1})}$	$\sigma_{(s^e_{t,t+1}-s_t)}$	$\sigma_{(f_{t,t+1}-s_t)}$
Euro	2.80%	3.25%	1.32%	0.14%
Yen	3.43%	3.84%	1.92%	0.30%
Pound	2.23%	2.38%	1.08%	0.16%

Panel B: Variance ratio test

Currency	$\sigma_{(\Delta s_t)} > \sigma_{(s^e_{t,t+1}-s_t)}$	$\sigma_{(s^e_{t,t+1}-s_t)} > \sigma_{(f_{t,t+1}-s_t)}$
Euro	4.47 ***	86.71 ***
Yen	3.19 ***	41.96 ***
Pound	4.24 ***	44.70 ***

feature of news dominance and (2) the excess volatility of expectations. Let us start with the feature of news dominance.

Fact 3 (News Dominance) *The variation in the expected spot return is lower than both the variation in the realized spot return and the exchange rate's forecast error.*

To see the relevance of this observation that expected spot returns have much smaller variances, it is insightful to decompose the realized spot returns into an anticipated part and an unanticipated (or news) part:

$$\Delta s_{t+1} = (s^e_{t,t+1} - s_t) + (s_{t+1} - s^e_{t,t+1}).$$

It follows that the variance of the realized spot return can be decomposed into

$$\sigma^2\left(s_{t+1} - s_t\right) = \sigma^2(s^e_{t,t+1} - s_t) + \sigma^2\left(s_{t+1} - s^e_{t,t+1}\right) + 2cov\left(s^e_{t,t+1} - s_t, s_{t+1} - s^e_{t,t+1}\right), \tag{2.9}$$

It turns out that the variance of the expected spot returns is much smaller than the variance of the realized spot returns. Thus, only a small part of the change in the exchange rate is anticipated and it is the news part that dominates the variance of the realized spot returns.

In table 2.4 it is shown that the variance of the realized spot returns is approximately 4 times as large as the variance of the expected spot returns. The variance of the forecast errors is approximately equal to the realized spot return variance. Stated otherwise, only 25% of the change in the exchange rate is discounted in the survey data.

Table 2.5: Excess volatility of exchange rate expectations.
This table shows the standard deviations of several exchange rate fundamentals. m is the natural logarithm of M1, y is the natural logarithm of real industrial output, i is the money market interest rate, and π measures CPI inflation. The superscript 'US' indicates US data, the rest is local data. Panel A reports the monthly standard deviations of the series. Panel B reports the variance ratio test comparing the variances of the fundamentals to the expected spot returns. A *,**,*** (†, ††, † † †) denotes significantly smaller (larger) variance at the 10, 5, and 1 percent significance respectively.

Panel A: Standard Deviations

Currency	$\sigma_{(s^e_{t,t+1}-s_t)}$	$\sigma_{(\Delta(m-m^{us}))}$	$\sigma_{(\Delta(y-y^{us}))}$	$\sigma_{((i-i^{us}))}$	$\sigma_{(\pi-\pi^{us})}$
Euro	1.32%	1.02%	0.98%	0.11%	0.05%
Yen	1.92%	1.18%	1.23%	0.14%	0.10%
Pound	1.08%	1.21%	1.01%	0.10%	0.09%

Panel B: Variance ratio test

Currency	$\sigma_{(\Delta(m-m^{us}))}$	$\sigma_{(\Delta(y-y^{us}))}$	$\sigma_{((i-i^{us}))}$	$\sigma_{(\pi-\pi^{us})}$
Euro	1.67^{***}	1.81^{***}	155.53^{***}	604.90^{***}
Yen	2.64^{***}	2.44^{***}	194.15^{***}	374.10^{***}
Pound	$0.80^{\dagger}$	1.14	128.32^{***}	148.08^{***}

The table also shows that the variance of the expected exchange rate movements dominates the variance of the forward premium. Notice that the forward premium can be seen as the expected change in the relative fundamentals of the two countries. For example, the Covered Interest Parity (CIP) condition equates the forward premium to the interest differential. This brings us to the next stylized fact:

Fact 4 (Excess Volatility) *The variation in the expected spot returns is higher than the variation in the underlying fundamentals.*

Even when it is assumed that the survey participants can fully predict the changes in the fundamentals excess volatility is still present. Table 2.5 reports the variances of relative (cross country) output growth, relative money growth (M1), relative inflation, and relative short term interest rates. These fundamentals are the most commonly used in exchange rate models. From the table it becomes clear that the variance of the most volatile fundamentals (the change in relative money supplies and the change in relative output) is still way below the variance of the expected spot returns. For the pound the relative money supplies are actually slightly more volatile than the expected spot return. The variances of the interest differentials and the inflation differentials, on the other hand, are very small as compared to the expected spot return variance.

The excess volatility feature of realized exchange rate returns is a long standing puzzle in international finance(see for instance Frankel and Rose, 1995). It is interesting to see that expected spot returns also exhibit excess volatility. Many models of expectations formation assume that forecasts are based on the underlying fundamentals. Under rational expectations the part that is predictable should be linked to the expected change in the fundamentals. However, the excess volatility

feature implies that fundamentals only play a minor role in expectations formations, and are dominated by other forecasting methods. This finding that expectations are build on a composite of different models will be addressed more explicitly in section 2.3.7.

2.3.4 Serial Correlation

The previous section shows that the expected spot returns are in between realized spot returns and forward premia. This section also reports a stylized fact in which expected spot returns form an intermediate case between realized spot returns and forward premia. In the literature it has been widely recognized that realized spot returns exhibit none to very little serial correlation, (e.g. Yang, Su, and Kolari, 2008) while forward premia are known to be very persistent over time (Baillie and Bollerslev, 1994). It turns out that expected spot returns have some serial correlation, but not as much as forward premia.

Fact 5 (Serial Correlation) *Expected spot returns are positively serially correlated; they exhibit more serial correlation than realized spot returns, but are less persistent than forward premia.*

Part of the exchange rate literature assumes that exchange rates behave like martingale processes.[7]. That is, the conditional expectation of the future spot rate equals the current spot rate. If spot rates follow a martingale, spot returns are said to follow a martingale difference sequence and the conditional expectation of the realized spot return equals zero[8]. Formally this boils down to:

$$E[s_{t+1}|\Omega_t] = s_t \tag{2.10}$$

$$E[\Delta s_{t+1}|\Omega_t] = 0. \tag{2.11}$$

Where Ω_t is some information set. The series are said to be a Martingale with respect to the information set Ω_t.The martingale property is the cornerstone of the Efficient Markets Hypothesis, with the form of efficiency depending on the information that is contained in Ω_t.[9]

The martingale hypothesis has often been tested by calculating and testing for the presence of significant serial correlation in historical return series. The absence of serial correlation is a necessary requirement for expected and realized spot returns to be a Martingale with respect to their historical values. The first order serial correlation of the expected spot returns, realized spot returns, and forward premia are reported in table 2.6. The results show that there is no evidence that realized

[7]Some of the literature, instead, focuses on the 'random walk' hypothesis, which stipulates that the realized spot returns are independently and identically distributed (i.i.d.). Although related, this concept is much more restrictive than the martingale hypothesis. The high persistence in exchange rate volatility (see section 2.3.6) provides evidence against the random walk. We therefore focus on the martingale hypothesis rather than the random walk hypothesis.

[8]The second requirement for a martingale is a bounded first moment.

[9]Weak form efficiency, for example, imply that exchange rates are a martingale with respect to historical returns: it excludes the profitability of technical analysis and trading rules.

spot returns have serial correlation. This confirms the consensus in the literature that realized spot returns are well described by the martingale model. Expected spot returns, on the other hand, are found to exhibit positive and significant serial correlation. Otherwise stated, expected spot returns are not a martingale difference sequence with respect to historical expected spot returns.

Table 2.6: Serial correlation of exchange rate expectations.
This table reports on the serial correlation in the exchange rate series. Panel A reports the first order autocorrelation of the realized returns, the expected returns, and the forward premia. A *,**,*** denotes rejection of the null of no serial correlation at the 10, 5, and 1 percent significance respectively, using the Ljung-Box Q-stat. Panel B reports the ARMA(1,1) estimations for the expected returns and the forward premia.

Panel A: Autocorrelation

Currency	Δs_t	$s^e_{t,t+1} - s_t$	$f_{t,t+1} - s_t$
Euro	0.06	0.34^{***}	0.68^{***}
Yen	-0.09	0.37^{***}	0.26^{***}
Pound	0.04	0.16^{*}	0.24^{***}

Panel B: ARMA

	$s^e_{t,t+1} - s_t$		$f_{t,t+1} - s_t$	
Currency	AR	MA	AR	MA
Euro	0.27	0.09	0.97^{***}	-0.69^{***}
	(0.22)	(0.23)	(0.02)	(0.07)
Yen	0.93^{***}	-0.74^{***}	0.93^{***}	-0.78^{***}
	(0.05)	(0.09)	(0.06)	(0.10)
Pound	-0.37	0.58^{**}	0.93^{***}	-0.79^{***}
	(0.29)	(0.25)	(0.06)	(0.10)

The presence of serial correlation in expectational data is consistent with existing theories on adaptive expectations formation, i.e., it seems that market participants partly base next period's spot return expectation on last period's expectation, see also Frankel and Froot (1987). The adaptive nature of the exchange rate expectations is also evidence against the assumption of rational expectations. Modeling the expected spot returns as an ARMA(1,1) is found to be an effective and parsimonious way to model the serial correlation that is present in the data, the results of which are shown in the lower half of table 2.6. Ljung-Box tests do not find any evidence that there serial correlation left in the residual series, indication that almost all of the serial correlation is captured by the ARMA(1,1) specification

The table also reveals that forward premium autocorrelations largely dominate expected and realized spot return autocorrelations. Moreover, upon comparing higher order correlations of expected spot returns and forward premiums, one observes a much slower correlation decay for the forward premium, a phenomenon often

dubbed "long memory" or "fractional integration" in the literature[10]. As the serial correlation of the expected spot returns drops much quicker to zero for increasing lags, one may safely conclude that the latter series are not fractionally integrated.

In conclusion, the expected spot returns behave significantly different with respect to serial correlation than both benchmarks. On the one hand, expected spot returns have significant serial correlations and are clearly not a martingale difference sequence like realized spot returns. At the same time, they do not have the long-memory feature that seems common to forward premia.

2.3.5 Fat Tails

Fact 6 (Fat Tails) *Expected spot returns, like realized spot returns and forward premia, exhibit fat tails. They contain more outliers than would be expected under, for example, a normal distribution.*

Like other financial returns, exchange rate returns are fat tailed and extreme returns can be best described by a Pareto law instead of an exponential tail decline like the normal distribution. Loosely speaking, a hevay tail this implies that periods of excessively positive or negative low returns occur much more often than what the normal distribution predicts. The large number of currency crises observed in the last decades - both over time and across countries - provides some casual evidence. Expected spot returns are not different in this respect. Market participants much more often foresee a large currency depreciation or appreciation than they would if they had based their expectations formation on the assumption of normality. The heavy tail feature feature both characterizes the unconditional and the conditional distribution of the expected spot returns. This section will start with evidence on the former.

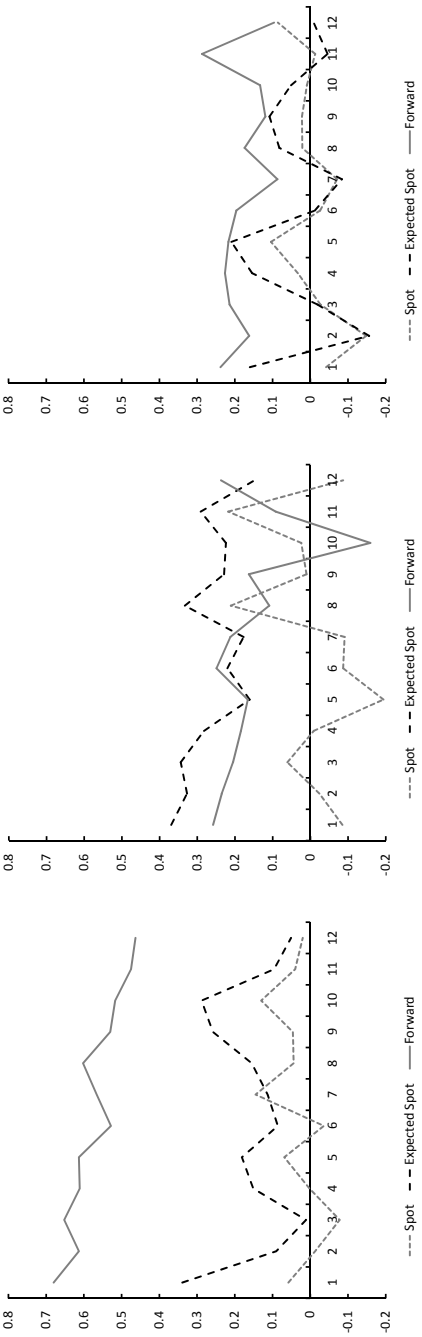
Extreme value theory provides a natural statistical framework to formalize the concept of heavy tails. More specifically - and in analogy with the Central Limit Theorem for averages - it enables one to come up with the limit distributions of extreme returns. Under fairly general conditions there exists a limiting asymptotic d.f. $G(x)$ that characterizes extreme values. More specifically, random variables that exhibit fat tails, like expected spot returns, are characterized, in the limit, by a Fréchet distribution:

$$G(x) = \begin{cases} 0 & , \quad x \leq 0 \\ e^{-x^{-\alpha}} & , \quad x > 0. \end{cases}$$

where α represents the tail index. The lower the value of this tail index α, the slower the probability density's decay as one moves further in the tail. This indicates a higher probability mass concentrated in the tails, i.e., fatter tails. Additionally, the tail index α can be interpreted as the maximum amount of bounded moments[11].

[10] Unfortunately, the graphs of the yen and the pound are atypical as compared to most other currencies.

[11] Consequently, a tail index lower than 2 implies that the 2^{nd} moment (variance) of the unconditional distribution function does not exist.



(a) Euro (b) Yen (c) Pound

Figure 2.4: Serial Correlation of Exchange Rate Data.
This figure plots the autocorrelation of the realized spot return,Δs_{t+1}(dotted), the expected return, $s^e_{t,t+1} - s_t$(dashed), and the forward premium, $f_{t,t+1} - s_t$(solid). The horizontal axis contains the n^{th} order autocorrelation.

Note that different heavy tailed distributions all exhibit this common limiting behavior, e.g. the class of symmetric stable distributions ($\alpha < 2$), the student-t distribution or the GARCH process. However, when studying the tail behavior, it is not necessary to know which parametric heavy tailed model is effectively valid over the full distributional support.

Let $X_{(1)} < ... < X_{(n-m)} < ... < X_{(n)}$ represent the ascending order statistics of a return series X. To estimate the tail index α, the popular Hill (1975) estimator will be used, which is defined as

$$\hat{\alpha_n} = \left[\frac{1}{m} \sum_{j=0}^{m-1} \left(\ln X_{(n-j)} - \ln X_{(n-m)} \right) \right]^{-1}, \tag{2.12}$$

with m the number of highest order statistics used in the estimation and $X_{(n-m)}$ the tail cut off point. The serial correlation present in the data has been removed by means of an ARMA(1,1) process, and the number of order statistics m are chosen on the basis of the algorithm provided by Beirlant, Dierckx, Goegebeur, and Matthys (1999). Further details on the Hill estimator are provided in Embrechts, Klüppelberg, and Mikosch (1997).

Table 2.7: Tail exponents of exchange rate expectations.
This table reports the tail exponents of the unconditional distribution. Panel A contains the coefficients of α, estimated with the Hill estimator. The Beirlant(1997) algorithm has been used to obtain the optimal number of tail observations m to estimate α, which are reported in Panel B. Serial correlation has been removed prior to estimating the tail exponents.

Panel A: Tail estimates			
Currency	Δs_t	$s^e_{t,t+1} - s_t$	$f_{t,t+1} - s_t$
Euro	4.22	4.10	1.70
Yen	2.90	2.17	1.33
Pound	3.63	4.00	2.02
Panel B: Number of tails observations			
Currency	Δs_t	$s^e_{t,t+1} - s_t$	$f_{t,t+1} - s_t$
Euro	18	23	23
Yen	36	37	37
Pound	19	15	50

The results, given in table 2.7, show that the tail exponent of the expected spot returns lies approximately between 2 and 4 which is very similar to the degree of tail fatness of the realized exchange rate. Moreover, this is also in line with most previous studies, see (e.g. De Vries, 1994). From the point estimates for α it also follows that the variance of these series is finite, but their kurtosis might not be well defined . In contrast, the forward premium exhibit tail indexes mostly below 2, which suggests that a finite variance does not exist.

2.3.6 Volatility Clusters

Fact 7 (Volatility Clusters) *The volatility of expected spot returns is not constant over time; instead they are characterized by clusters of high volatility and clusters of low volatility.*

Like fat-tailedness, volatility clusters are common to financial times series, including realized spot returns and forward premia. These clusters have already been recognized by Mandelbrot (1963). However, it was the introduction of generalized autoregressive conditional heteroskedasticity (GARCH), in the middle of the eighties, which has revived interest in this feature of the data. In a GARCH model, the variance of a random variable is conditional on its own past. This way of modeling directly captures the stylized fact that future volatility is dependent on the currently observed volatility[12]. Formally the GARCH(1, 1) model can be written as follows:

$$\epsilon_t|\Omega_{t-1} \sim D(0, h_t) \tag{2.13}$$

$$h_t = \omega_0 + \omega_1\epsilon_{t-1}^2 + \omega_2 h_{t-1}. \tag{2.14}$$

Where ϵ_t are the innovations conditional on some information set Ω_{t-1}, and $D(0, h_t)$ is some distribution function with mean 0 and conditional variance h_t.

In this case, both a normal and a student-t distribution have been used to approximate the distribution function D.[13] The residuals have been conditioned on the past of the series, by means of an ARMA(1,1)[14]. Table 2.8 shows that the GARCH parameters are significantly different from 0. They also sum up to numbers very close to 1. These results show that volatility clustering is clearly present in the data and that those clusters are very persistent over time.

Conditional heteroskedasticity is an important explanation for the fat-tailedness in the unconditional distribution described in the previous fact. For instance, even if the conditional innovation is normally distributed, the mixture of normal distributions with different variances will create a fat-tailed distribution. However, volatility clusters can still not adequately account for the degree of fat-tailedness in the unconditional distribution of the expected spot returns. To fully account for the fat-tailedness, it is still necessary to impose a fat-tailed distribution on the conditional innovations.

Fact 8 (Conditional Fat Tails) *Expected spot returns are conditionally fat-tailed; even after taking into account volatility clusters, the innovations have a fat-tailed distribution. The conditional fatness of expected spot returns is lower than in forward premia but higher than in realized spot returns.*

[12] There exist other ways to model (conditional) heteroskedasticity. However, as GARCH is currently the most popular, attention will be focused on this method.

[13] Both the conditional and the unconditional return distributions exhibit heavy tails. Thus, the popular assumption of conditional normality in GARCH modelling is overly simplistic. We therefore also consider GARCH models with conditional heavy tails (student-t distribution).

[14] Only a constant has been included for the realized spot returns, as they have no signs of serial correlation

Table 2.8: Volatility Clusters.
This table shows the generalized autoregressive conditional heteroskedasticity (GARCH) results. $\alpha(L)x_t = \beta(L)\epsilon_t$, with $\epsilon_t \sim D(0, h_t)$ and $h_t = \omega_0 + \omega_1\epsilon_{t-1}^2 + \omega_2 h_{t-1}$. The parameters of the mean equation and ω_0 are suppressed for brevity. The left half of the table reports the results where the variances are assumed to be conditionally normal, while the right half reports the results under the assumption that the errors are conditionally studentized, with ν degrees of freedom.

		Normal errors			Studentized errors			
Currency	Series	ω_1	ω_2	$\omega_1 + \omega_2$	ω_1	ω_2	$\omega_1 + \omega_2$	ν
Euro	Δs_t	0.05	0.89	0.94	0.05	0.89	0.94	> 100
		(0.061)	(0.112)		(0.061)	(0.115)		
	$s^e_{t,t+1} - s_t$	−0.09	1.03	0.94	−0.11	1.04	0.93	20
		(0.004)	(0.007)		(0.039)	(0.013)		
	$f_{t,t+1} - s_t$	1.06	−0.03	1.04	1.53	0.17	1.70	3.23
		(0.316)	(0.100)		(0.611)	(0.129)		
Yen	Δs_t	0.23	0.40	0.62	0.23	0.40	0.62	> 100
		(0.110)	(0.196)		(0.110)	(0.198)		
	$s^e_{t,t+1} - s_t$	0.24	0.35	0.59	0.14	0.54	0.69	4.65
		(0.090)	(0.204)		(0.125)	(0.410)		
	$f_{t,t+1} - s_t$	0.04	0.84	0.87	0.03	0.94	0.97	2.71
		(0.038)	(0.111)		(0.020)	(0.024)		
Pound	Δs_t	−0.10	1.02	0.92	−0.10	1.03	0.92	20
		(0.021)	(0.001)		(0.025)	(0.016)		
	$s^e_{t,t+1} - s_t$	−0.07	1.03	0.96	−0.07	1.02	0.95	20
		(0.003)	(0.000)		(0.016)	(0.001)		
	$f_{t,t+1} - s_t$	0.00	0.95	0.95	1.28	0.28	1.56	3.43
		(0.004)	(0.032)		(0.721)	(0.212)		

Baillie and Bollerslev (1989) propose modeling the conditional innovation of the GARCH with a t-distribution to account for the remaining fat-tailedness. The right part of table 2.8 reports the GARCH(1,1) results when a conditional studentized distribution is used, instead of the assumption of conditional normality. The estimated degrees of freedom ν are reported in the last column. First, note that the GARCH parameters themselves stay relatively unchanged between the two estimations. Second, the expected spot returns still have some conditional fat-tailedness remaining: the degrees of freedom ν lie around 20 for the euro and the pound and around 4 for the yen. The parameter ν can be interpreted as a parametric estimate of the (conditional) tail index α, discussed in the previous section. Compared to the values of α between 2 and 4, that where found for the unconditional distribution, these numbers are already substantially higher, showing the effect of the volatility clusters themselves on the unconditional fatness.

Now look at the results for the realized spot rates and the forward premium. The conditional fatness for the expected spot returns is considerably higher than for the realized spot returns, but not nearly as fat as for the forward premia. The realized spot returns actually show little sign of conditional fatness: the estimates for ν are larger than 100 in two out of three cases, making it next to indistinguishable from a normal distribution. The forward premia on the other hand still have very fat tails for the conditional distribution. The estimates of ν come very close to 2 in some instances.

Baillie and Bollerslev (1989) observed that GARCH effects and conditional fat tailedness are much more pronounced for data measured on a daily or weekly level, rather than on the monthly level. Therefore, it can be expected that the results reported here are a conservative estimate of the volatility clusters and conditional fat-tailedness of expectations that are formed at a higher frequency.

2.3.7 Expectations Formation

Most of the facts reported so far indicate that the time series properties of expected spot returns are a mixture between realized spot returns and forward rates. An explanation to this general finding can be sought in how market participants form their expectations. As it turns out, forecasters are heterogeneous; there are large differences between the models used by different market participants. Moreover, each market participant herself tends to use more than one model to form her expectations.

Fact 9 (Mixed Expectation Formation) *Forecasters can be broadly split into Fundamentalists and Chartists. Moreover, most forecasters use both fundamental models and chartist techniques in forming their expectations.*

The possibility that market participants hold fundamentally different opinions on market movements has received considerable attention in the literature. Modeling heterogeneous agents offers an interesting avenue to provide new insights into some of the anomalies that are identified in the financial economics literature; see

Hommes (2006) for an overview. The view that the foreign exchange market is dominated by two different types of participants — fundamentalists and chartists — has been popularized by Frankel and Froot (1986, 1990). Fundamentalists make use of structural economic models to calculate the fundamental value of the exchange rate, upon which they base their expectations. Chartists use technical analysis and base their expectations predominantly on past movements of the exchange rate itself. Forecasts based on fundamental models are likely to behave similar to forward rates, which themselves are closely linked to interest rate differentials by Covered Interest Parity. Forecasts based on technical analysis are likely to behave similar to the realized exchange rate returns from which they draw their information. Thus the combination of these two forecasting techniques will lead to a 'composite' time series with properties that partially match those of realized spot returns and partially those of forward premia. Exactly what has been found throughout this chapter.

Two further important remarks can be made about the heterogeneity of forecasters. First, in general a single agent cannot be described as either purely fundamentalist nor as purely chartist. In several surveys that have been taken amongst foreign exchange forecasters it has been found that most agents use a combination of both fundamentalist and chartist techniques to form their expectations about future exchange rates (Liu and Mole, 1998; Cheung and Chinn, 2001; Menkhoff and Taylor, 2007; Allen and Taylor, 1990; Taylor and Allen, 1992). Allen and Taylor (1990) and Taylor and Allen (1992) show that for short forecast horizons typically 90 percent of market participants place some weight on technical analysis. Second, the weight that forecasters attach to a particular technique is not constant over time. Agents update their beliefs about chartist and fundamentalist techniques and tend to switch to the techniques that have performed relative well in the past (De Grauwe and Grimaldi, 2005, 2006). Furthermore, they tend to put more weight on fundamentalist techniques when they perceive that exchange rates have drifted further away from their 'fundamental' values (Reitz and Westerhoff, 2003). Liu (1996) provides evidence, however, that the weight on fundamentalist techniques has never surpassed 40 percent in the recent history. Frankel and Froot (1986, 1990) furthermore provide evidence that the share of market participants that can be identified as fundamentalists has decreased over time in the favor of chartists. They propose that this can explain the bubble behavior of the dollar in the 80's as well as the large increase in the volume of foreign exchange trading that took place in the same period. On longer forecast horizons fundamentalist techniques regain some of their importance, however, in forecasting (Jongen, Verschoor, Wolff, and Zwinkels, 2009).

2.3.8 Forecasting

Fact 10 (No predictability) *Survey expectations are not able to outperform either the random walk or the forward premium as a forecast for future spot rates.*

Survey expectations are based on a mixture of fundamental and technical forecast models, as shown in the previous section. Both these techniques independently have been shown to not work very well as forecasts. Therefore the bad performance of

the surveyed forecasters is neither an exception, nor very surprising. The failure of structural exchange rate models to explain currency movements has since long been widely acknowledged. (Meese and Rogoff, 1983a,b) and (Meese, 1990) exhaustively tested different theoretical models and concluded that all of them performed worse than a naive random walk assumption, the one month forecasts performing the worst of all horizons. Moreover, it has been shown previously that exchange rates are a Martingale with respect to their own past. Chartist models based on past exchange rate movements therefore also perform badly as forecasts for future exchange rate movements. Therefore, it is natural to extrapolate this bad forecast performance to the individual survey forecasters themselves.

Table 2.9: Forecasts based on exchange rate expectations.
This table reports on the forecast performance of the expected spot exchange rate versus the current spot rate and the forward rate. Panel A contains the Root Mean Squared Error (RMSE) of s_t, s^e_{t-1}, and f_t as forecasts of s_{t+1}. Panel B contains the modified Diebold-Mariano(1997) that compares the forecast performance of s^e_{t-1} against s_t(left) and f_t(right). A *,**,*** denotes rejection of the null that s^e_{t-1} is at least equally good at forecasting as the respective benchmark, at the 10, 5, and 1 percent significance respectively.

Panel A: RMSE			
Currency	s_t	$s^e_{t,t+1}$	$f_{t,t+1}$
Euro	0.028	0.033	0.028
Yen	0.034	0.038	0.034
Pound	0.022	0.024	0.022
Panel B: Diebold-Mariano test			
Currency	s_t		$f_{t,t+1}$
Euro	3.53^{***}		3.36^{***}
Yen	2.47^{**}		2.18^{**}
Pound	2.12^{**}		1.89^{*}

Table 2.9 shows the performance of aggregate survey expectations as forecasts for future exchange rates. This performance is compared with the forecasts given by the random walk hypothesis (naïve expectation) and the forward rate (which can be seen as the markets expectation of the future exchange rate). The survey expectation is significantly the worst predictor of the three forecasts and the random walk comes out as the best forecast. This result is typical and corroborates with previous results about forecaster performance. MacDonald and Marsh (1994); Macdonald and Marsh (1996) look at a set of individual forecasters that forecasts 3-month-ahead movements in the D-mark, pound, and yen exchange rate versus the dollar and find that almost none of them is able to beat either the random walk or the forward rate. Elliott and Ito (1999) look at 1-, 3-, and 6-month ahead forecasts of yen/dollar movements by Japanese exporters and also report that almost none of the forecasters can beat a naive random walk. The evidence is a bit more mixed if looked at a trading rule. Elliott and Ito (1999) define a trading rule in which the forecaster takes a fixed long (short) forward position in the foreign currency if she believes the forward rate

undervalues (overvalues) the value of the foreign currency. They show that in this setup a majority of the forecasters outperform the random walk in terms of profits. This finding, however, is tempered by Marsh and Power (1996). By taking also risk into account, in addition to only returns, they return to the sober conclusion that almost none of the forecasters could beat the random walk.

2.4 Conclusion

This chapter describes a set of stylized facts and time series properties that characterize the empirically observed nature of survey exchange rate expectations. These stylized facts largely overlap with the stylized facts that are known about realized spot returns and forward premia, such as the presence of unit roots, volatility clusters and fat tails. Moreover, when the characteristics of realized spot returns and forward premia diverge from each other, for example in the case of excess volatility, serial correlation, or conditional fat-tails the expected spot returns are found to take an intermediate position. Expected spot returns are less volatile than realized spot returns, but more so than forward premia. Unlike realized spot returns expected spot returns exhibit serial correlation, yet they are less persistent than forward premia. The conditional fat-tailedness is less than forward premia but more than realized spot rates. A possible explanation for this phenomenon lies in the way that market participants form their expectations. They base their expectation on a mixture of chartist techniques, which are based on realized spot returns, and fundamental models, which we argue share many characteristics with the forward premia.

The stylized facts mentioned above should be seen as general statements, mostly of a qualitative nature. They do not impose specific models or specific parametric specifications on the data. Rather, the stylized facts can be seen as a set of constraints; a good theoretical or empirical model on exchange rate expectations should be able to account for these facts. They also serve to create awareness about the limitations of most estimation techniques used. Most models succeed in incorporating several of the facts outlined above, but rarely are they able to account for all them simultaneously.

Although this chapter has linked the observed stylized facts to some of the existing economic interpretations and the relevance to practitioners, this coverage is far from complete. For example, the question whether the fat tails in exchange rate expectations are only caused by the nature of the underlying series, the realized spot returns, or are also partly due to (irrational) forecasting behavior of the market participants is not answered in this paper. Questions like these are relevant and deserve the attention of researchers, but fall outside the scope of this study. It is left to future research to provide answers to these questions and to develop models that can fully account for the observed nature of survey exchange rate expectations as outlined above.

Part II

Financial Liberalization and Exchange Rates

Chapter 3

Are Capital Controls in the Foreign Exchange Market Effective?*

3.1 Introduction

One of the largest puzzles in international finance is the apparent failure of both forward premia and interest differentials to predict future spot exchange rates over the post-Bretton Woods period, i.e., the so-called forward discount bias puzzle or rejection of Uncovered Interest Parity (UIP)[1].

Another topic that received recent interest from both the academic community and policy makers is the issue of capital controls and financial liberalization. The shockwave that was sent through the international financial system when the Asian tigers - most of them recently liberalized - crashed, led to a change in the debate on capital controls. Nowadays, a significant fraction of the academic community supports controls on specific situations, see e.g. Krugman (1999b) or Rodrik (1998). As for the IMF, it stresses the importance of a good phasing out of controls to limit the stress liberalization puts on a financial system (Fischer, 1998).

The two topics are intertwined in the sense that one of the main reasons to impose controls is to insulate an economy from international forces (Ariyoshi, Habermeier, Laurens, Otker-Robe, Canales-Kriljenko, and Kriljenko, 2000). Governments may choose for the freedom to pursue a fixed exchange rate together with (limited) monetary freedom, at the cost of imperfect capital mobility. If monetary freedom is indeed achieved together with a stable fixed exchange rate, this implies that international parity conditions have to be violated.

*Part of this chapter is based on Straetmans, Versteeg, and Wolff (2008)

[1]Some of the most influential early work in this field are Frankel (1976), Fama (1984), Frankel and Froot (1987), and McCallum (1994) amongst others. Recent surveys include Chinn (2006), Engel (1996), and Taylor (1995).

In order to evaluate the impact of capital controls on monetary freedom, we investigate whether capital control proxies can explain (part of) the forward discount bias. The suggestion that there might be a connection between capital controls and the rejection of Uncovered interest Parity is not new, see e.g. Chinn and Meredith (2005); Dahlquist and Gray (2000); Frankel and Poonawala (2006); Gros (1992); however, the former papers do not contain explicit tests for the presence of a 'capital control effect'. The few studies look at controls specifically have mixed results. Controls were found to be partially effective in Germany (Dooley and Isard, 1980) and Argentina (Phylaktis, 1988) but at best marginally in Chile (De Gregorio, Edwards, and Valdes, 2000; Valdes-Prieto and Soto, 1998).

Whether capital controls enable policymakers to reduce the link between exchange rates and interest rates (monetary freedom) is not the only motivation for this research. Capital controls are costly and should be abolished if they do not achieve the desired goal. Finally, insofar as parity conditions such as UIP reflect the benchmark of financial integration, deviations from these parity conditions due to capital controls imply imperfect integration and reduced risk sharing opportunities.

Anticipating on the results, we find very little evidence for a capital control effect on the observed forward discount bias and this irrespective of whether one considers developed currencies or emerging currencies. The remainder of this chapter is structured as follows. Section 3.2 contains a literature review and discusses some previous evidence on the effect of capital controls. Section 3.3 describes the choice and construction of two capital control variables. In section 3.4 we report forward premium regressions augmented with the capital control proxies to measure the potential effect on the forward premium slope. The chapter ends with some concluding remarks (section 3.5).

3.2 Overview

If foreign exchange markets are processing information efficiently, investors should not be able to realize systematically abnormal returns. Conditional upon the existence of a forward market for foreign exchange (a condition not always fulfilled in emerging countries), the efficient market hypothesis for foreign exchange can be expressed in two alternative ways:

$$E_t s_{t+1} - s_t = (f_{t,1} - s_t), \tag{3.1}$$

$$E_t s_{t+1} - s_t = (r_{t,1} - r^*_{t,1}), \tag{3.2}$$

With E the expectations operator, s_t and $f_{t,1}$ the natural logarithm of the spot and 1-month forward rate, and r, r^* the 1-month nominal interest rates on similar domestic and foreign securities, respectively.

Equation 3.2 holds when speculators drive the (market) expected spot rate to the forward rate. Otherwise stated, the forward rate (or alternatively the forward premium) is an unbiased predictor of the future exchange rate (or alternatively the change in the future exchange rate). Similarly, Uncovered Interest Parity (equation

3.2) holds when investors require identical returns on similar investment at home and abroad.

Many papers impose the Covered Interest Parity (CIP) relation which results in the equivalence of equation 3.2 and equation 3.2. Although there is strong empirical support for CIP, it may break down when there are limits to arbitrage[2].

As the empirical evidence is not very supportive for the twin hypotheses of forward unbiasedness and UIP, a large number of extensions has emerged to explain their apparent failure. One way is to augment equations (1-2) with time varying risk premia (see e.g. Fama, 1984; Cavaglia, Verschoor, and Wolff, 1994; Wolff, 1987). Learning (Lewis, 1989), Deviations from rationality (Frankel and Froot, 1987) or peso problems (Kaminsky, 1993; Flood and Rose, 1996) constitute a second class of literature. More recently, evidence has been presented that the severity of the bias is decreasing with the maturity of the forward contract (Lothian and Wu, 2003; Chinn and Meredith, 2005).

Insofar as they potentially limit arbitrage and speculation, capital controls may also partly cause distortions in the parity relations (1-2). Capital controls and their effects - if any - remain a controversial topic. Opinions on the usefulness of controls seem to swing like a pendulum. The argument dates back as far as the mercantilists who sought to control flows of bullion. This ideological school was subsequently denounced by Adam Smith in favor of free markets. The 20th century saw a large revival of capital controls, driven by the war effort of both world wars. Afterwards the Bretton Woods system combined capital controls with fixing exchange rates. Keynes - revived by Tobin (1978) - considered capital controls as an important cornerstone of Bretton Woods, i.e., guaranteeing its stability. The meltdown of the Gold Exchange Standard induced a liberalization wave that lasted through the nineteen-nineties.

Recently the pendulum seems to be at a turning point. The widespread financial consequences of the 1997 Asian crisis reoriented the debate on the virtues and vices of capital controls. The countries that applied capital account liberalization recipes were hit hardest, while Malaysia, China, and India - all three relying on capital controls to weather the storm - seemed to suffer less from the 1997 fallout. Some prominent authors publicly supported Malaysia in its imposition of capital controls (Stiglitz, 2002; Krugman, 1999b; Eichengreen, 2004; Kaplan and Rodrik, 2002).

The argument for capital controls focuses on the theory of the second best. We live in an imperfect world, and examples of market failures are plenty. In such a world, introducing an additional distortion such as a capital control might work welfare enhancing by offsetting some of the other distortions. This is especially true if markets are incomplete and exhibit asymmetric information, as is often the case in emerging markets (see e.g. Stiglitz, 2002). In the absence of a solid institutional framework, controls on inflows can ration capital to limit the negative effects of capital controls.

Capital controls are often used as a tool to influence exchange rate movements, more specifically to dampen their volatility. Eichengreen, Rose, and Wyplosz (1994)

[2]As this study is specifically looking at the possible effects of capital controls, care is taken to test separately for both conditions, without relying on the CIP condition to hold.

point out that capital controls can play a role in sustaining fixed exchange rate regimes. The same authors also argue that the potential gain in monetary freedom due to capital controls can be valuable to national governments as it allows them to use both the monetary and fiscal instruments to guide the economy.

However, capital controls remain a distortion and as such should only be maintained if the benefits outweigh the costs. The latter can be sizeable. The direct administrative costs alone are not negligible: for a control to remain effective, it has to be revised often to close the loopholes exploited by investors; time and resources have to be expended to execute the controls; authorizations have to be given and taxes collected etc.

The economic effects can also be large although a clear link with economic growth has not been established (Rodrik, 1998). Controls also limit the potential for portfolio diversification and decrease the amount of risk that can be shared and diversified (Voth, 2003). Thus the cost of capital increases for local firms (Bekaert and Harvey, 2000a)[3]. There is even some evidence that capital controls might actually worsen the problems they try to solve. The volatility of exchange rates might be exacerbated by capital controls (Glick and Hutchison, 2005) and they can increase the probability of a currency crisis (Bordo, Eichengreen, Klingebiel, and Martinez-Peria, 2001). Dornbusch (1998) even warns against the possibility of capital control induced contagion. Thus an accurate cost-benefit analysis of capital controls provides important input to policymakers who have to decide whether they want to keep controls or liberalize them.

Yet it is difficult to pin down precisely the theoretical and empirical effects of capital controls for several reasons. First of all, their variety is close to innumerable. Loosely speaking, capital controls can be divided into administrative controls such as outright bans, and market-based controls such as taxes; controls that aim to curb short-term capital flows versus long-term capital flows; or controls on inflows versus controls on outflows.

A second problem with the measurement of the effects of capital controls is its inherent "fungibility", see e.g. Valdes-Prieto and Soto (1998) and De Gregorio, Edwards, and Valdes (2000). Loosely speaking, the fungibility property of capital controls means that clever and imaginative speculators always find ways to (legally) circumvent capital controls. For example, investors can shift capital into sectors or financial products that are not taxed, such as derivatives. The use of transfer pricing is another example. By artificially changing the prices charged to subsidiaries, capital flows can be disguised as trade flows and thus shifted from the (controlled) capital account to the liberalized current account. Moreover, it can be expected that investors become more adept at circumventing the controls over time, which decreases capital control effectiveness even further, unless the government continually keeps closing loopholes.

Although the above suggests that it is difficult to determine how large the effect of capital controls are, it is clear in which direction the effect should go. As the controls are directed at distorting UIP and forward unbiasedness, we hypothesize

[3]Forbes (2005) summarizes a number of other costs that capital controls impose on a microeconomic level.

that effective controls should drive the coefficients in equations 1 and 2 away from unity. Moreover, the effect is expected to be negative in sign, as most countries want to dampen the movement of the exchange rate to create some exchange rate stability. This corresponds with the stylized fact that slope estimates of regressing spot returns on lagged forward premiums (or alternatively lagged interest differentials) are typically found to fall below 1.5. Even when capital controls are unable to explain part of the bias phenomenon, controls may still increase monetary freedom provided the absolute value of the forward premium slope comes closer to zero when capital controls are in place. The forward premium regression testing framework will be further discussed in the methodology section 3.3.

3.3 Data and Methodology

3.3.1 Data

Traditionally information on capital controls has been limited to annual data on the capital account provided by the IMF. More specifically, the IMF publishes an annual dummy variable in the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Previous attempts to measure the effect of capital controls have typically used this IMF dummy[4].Although the dummy is available for a large number of countries, the binary character implies that is a rather crude measure (are there capital controls in place: yes or no?).

Several attempts have been made to improve on the measurement and dating of capital account liberalizations. Edison and Warnock (2003) and Bekaert, Harvey, and Lundblad (2005) developed indices that date the liberalization of equity market liberalization. However, indices that reflect the liberalization of the capital account as a whole (i.e., including controls on forward exchange markets, fixed income securities and bank deposits) are more interesting for the current study that focuses on the foreign exchange market. Good examples of these measures are the indices of Kaminsky and Schmukler (2003) and Miniane (2004).

This study uses both the IMF dummy as well as the more refined Kaminsky and Schmukler (2003) and Miniane (2004) measures. Notice that the latter indices are not available for emerging economies. The liberalization dates have been summarized in table 3.1.

Kaminsky and Schmukler (2003) (denoted by K & S in the rest of the chapter) have extracted information from a variety of sources (including the IMF) to date the liberalization of capital markets. For each year they indicate whether a market is either 'repressed', 'partially liberalized', 'or fully liberalized'. The extent of control on the capital account is measured by looking at regulations on offshore borrowing, multiple exchange rate regimes, and controls specific to capital outflows. A market is deemed 'fully liberalized' if there are no multiple exchange rates or restrictions on outflows, and only minor impediments to offshore borrowing.

[4]for example Alesina, Grilli, and Milesi-Ferretti (1994), Chanda (2001), Epstein and Schor (1992), Garret (1995), Grilli and Milesi-Ferretti (1995), Leblang (1995), Milner (1996), Razin and Rose (1994), and Rodrik (1998) all use the IMF dummy in their studies.

Table 3.1: Liberalization dates of capital controls.
Panel A: *K & S* and *Miniane* refer to liberalization measured according to (Kaminsky and Schmukler, 2003) and (Miniane, 2004), respectively. *IMF Dummy* refers to the position as reported in the IMF Annual Report on Exchange Arrangements and Exchange Restrictions. As Miniane and the IMF only report on capital controls annually, all liberalizations are set at the beginning of the year of the liberalization. Panel B: The left column indicates the state of the capital account at the beginning of the sample, which runs from March 1984 to November 2006. liberalizations and closings refer to the position as reported in the IMF Annual Report on Exchange Arrangements and Exchange Restrictions. As the IMF only report on capital controls annually, all liberalizations and closings are set at the beginning of the year of the liberalization.

Panel A: Developed countries				
Country	K & S		Miniane	IMF Dummy
Denmark	September	1988	1988	1988
France	December	1989	1989	1993
Italy	December	1991	1988	1993
Norway	December	1987	1989	1995
Austria	n/a[a]		1991	1991
Portugal	July	1992	1991	1993
Spain	December	1992	1992	1994
Sweden	December	1988	1989	1993
Panel B: Emerging countries				
Country	Begin Sample		Closings	Liberalizations
Indonesia	Liberalized		1997	
Jamaica	Closed			1997
Kuwait	Liberalized		1997	
Lebanon	Liberalized		1998	
Venezuela	Liberalized		1985	1997
			2003	

[a] Kaminsky and Schmukler do not have Austria in their sample.

This capital control proxy measures *de facto* capital controls, as opposed to the *de jure* nature of e.g. the IMF proxy. In contrast to *de jure* measures which only capture the official information of the government, *de facto* measures attempt to capture the extent to which capital controls are actually enforced. As governments do not necessarily enforce the restrictions they put in place, large discrepancies between *de facto* and *de jure* proxies for capital controls may exist[5].

In this study, the date of liberalization for the K & S proxy is taken to be the first month that the capital account is classified as 'fully liberalized'. Formally the variable $CAP_{i,t}^{K\&S}$ is defined as follows:

$$CAP_{i,t}^{K\&S} = \begin{cases} 0, & \text{if KS = 'fully liberalized';} \\ 1, & \text{else.} \end{cases} \tag{3.3}$$

[5]Levy-Yeyati and Sturzenegger (2005) have shown that the difference between *de jure* and *de facto* measures can make a big difference by comparing their *de facto* exchange rate regimes, with the IMF's *de jure* exchange rate regimes.

In the sample under investigation there have been no temporary controls; all countries started with a (partially) closed market and have then moved to a liberalized market, without reimposing controls on the capital account later on.

Another capital control proxy has been derived by Miniane (2004) who developed an index based on the new post-96 capital control classification of the IMF[6]. The latter classification reports the existence of capital controls for 13 financial market segments including capital markets, direct investment, financial institutions, and multiple exchange rate systems. The Miniane index equals the proportion of segments that have capital controls. This proxy has a *de jure* character and does not measure the severity of the capital controls. However, it contains a lot more information than the IMF variable because is based on 13 different financial market segments.

A score of 0 indicates a fully liberalized market, and a score of 1 a fully closed market. As none of the countries achieves a score of 0 (the US for instance has a score of 0.29) and there seem to be two modes around 0.2 (open) and 0.8 (closed), the cutoff point should lie between those two modes. Therefore we have classified all economies with a score of less than 0.5 as open, and economies with scores equal to or above 0.5 as closed[7]. Mathematically, the variable $CAP_{i,t}^{Miniane}$ is defined as follows:

$$CAP_{i,t}^{Miniane} = \begin{cases} 0, & \text{if Miniane} < 0.5 \\ 1, & \text{if Miniane} \geq 0.5 \end{cases} \tag{3.4}$$

Exchange rate data on both spot and 1-month forward rates are obtained from Thomson DataStream. All exchange rates are expressed in local currency units per US Dollar. Forward rates are sampled on the last trading day of the month. As for 1-month money market and deposit rates, they are taken from the International Financial Statistics database in the middle of each month; consequently spot rates also have to be sampled in the middle of the month if one wants to test parity condition (2). We let the sample start in 1983 because the Miniane capital control proxy only runs from that date onwards. The year 1983 also hallmarks the end of domestic interest controls in the United States, the so-called regulation Q. Thus the starting date ensures that the numéraire currency is free of both domestic and international controls on capital, isolating the effect of the controls to those employed by the domestic countries.

We measure the capital control effects for a developed (European) and an emerging currency panel. The first currency panel focuses on the capital market liberalizations that took place in Western Europe. The selection of countries is based on two simple criteria. A country is included if it has data available on the liberalization date for at least two out of three capital control proxies considered, and the liberalization took place within the sample period. We let the European sample end with

[6]Before 1996, the IMF only reported the aforementioned binary variable indicating the existence of capital controls. The new AREAER has expanded the coverage on capital controls. In a tabulated format they report on controls in 13 main segments; most are even further disaggregated.

[7]The results are not very sensitive if the cut-off point is varied between 0.45 – 0.55.

the introduction of the Euro in December 1998, also for those European currencies that are not part of the eurozone.

As for the emerging currency panel, the countries are selected so as to reflect sufficient heterogeneity in geographic location and economic development. Emerging country data run from March 1984 until November 2006. Data for 1983 have been omitted due to limited interest rate availability in that year.

Descriptive statistics (table 3.2) already reveal some of the stylized facts known in the literature. First of all it can be noted that the emerging economies have much larger interest rate spreads than the European countries, and consequently also have on average sizeable depreciations versus the dollar. Furthermore the sign of the average exchange rate movement is not in all cases equal to the sign of the corresponding forward premium and interest differential, indicating that for some countries the UIP coefficient will be negative rather than equal to 1.

Table 3.2: Descriptive statistics.
All exchange rates are expressed in local currency units per U.S. Dollar. $s_{t+1} - s_t$ is the monthly change in the spot exchange rate expressed in local currency units per Dollar; $i_t - i_t^*$ is the money market rate differential vis-a-vis America; $f_t - s_t$ is the 1 month forward premium; . All variables are expressed as monthly percentages and s_t is defined at the end of the month. Panel A contains the European sample, and Panel B the emerging economies. The emerging sample does not have forward rates available.

Panel A: Developed countries

	$s_{t+1} - s_t$		$i_t - i_t^*$		$f_t - s_t$	
Country	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev
Austria	-0.19	3.28	0.19	0.26	-0.06	0.24
Denmark	-0.14	3.25	0.12	0.22	0.15	0.29
France	-0.10	3.22	0.44	0.23	0.14	0.25
Italy	0.10	3.20	0.29	0.30	0.39	0.25
Norway	0.04	3.02	-0.06	0.24	0.26	0.30
Portugal	0.33	3.25	0.55	0.38	0.83	1.07
Spain	0.06	3.24	0.42	0.29	0.45	0.36
Sweden	0.05	3.06	0.30	0.50	0.26	0.34

Panel B: Emerging countries

	$s_{t+1} - s_t$		$i_t - i_t^*$	
Country	Mean	Std. Dev.	Mean	Std. Dev.
Indonesia	0.83	6.98	0.95	0.58
Jamaica	1.09	4.65	0.98	0.69
Kuwait	0.00	1.38	0.03	0.14
Lebanon	1.97	8.56	0.70	0.29
Venezuela	1.94	7.55	1.36	1.10

3.3.2 Methodology

To test the effect of capital controls on the parity conditions in equations 3.2-3.2 we make use of the standard specification used in the forward discount bias literature:

$$\Delta s_{i,t+1}^{l/\$} = \alpha_i + \beta_i(i_{i,t} - i_{i,t}^{\$}) + \epsilon_{t+1}, \tag{3.5}$$

where $\Delta s_{i,t+1}^{l/\$}$ is the change in the spot exchange rate, $(i_{i,t} - i_{i,t}^{\$})$ the interest differential between the local currency and Dollar 1-month money market rate, and $\epsilon_{i,t+1}$ the error term. For the speculative efficiency hypothesis, the interest differentials are replaced by the forward premium $(f_{i,t,1}^{l/\$} - s_{i,t}^{l/\$})$. To test for the effects of capital controls on these equations, a cross-term with a dummy indicating the presence of capital controls is added.

$$\Delta s_{i,t+1}^{l/\$} = \alpha_i + \beta_i(i_{i,t} - i_{i,t}^{\$}) + \gamma_i I_{i,t}^{cap}(i_{i,t} - i_t^{\$}) + \epsilon_{t+1}, \tag{3.6}$$

where $I_{i,t}^{cap}$ is the dummy indicating the existence of capital controls, and $\epsilon_{i,t+1}$ the error term. $I_{i,t}^{cap}$ represents either the dummy based on Kaminsky and Schmukler (2003)(K & S), Miniane (2004), or the IMF.

The whole system is estimated using Seemingly Unrelated Regression (SUR) estimation, allowing for correlation between the cross-sectional error terms. Correlation between the different exchange rates can be expected, especially in the European sample as most of these countries took part in the European Monetary System (EMS). These correlations make SUR preferable over OLS. More specifically the system is estimated using feasible GLS, with panel corrected standard errors for the covariance structure. Fixed effects have been included in the estimation; F-tests cannot, in the majority of cases, reject the null that all the $\alpha's$ are equal to zero, so these results have been suppressed for brevity.

Next to the unrestricted results, we also report the results when β_i is restricted to be equal across the cross-sections.

In the results section we test against the alternative hypothesis that capital controls increase monetary freedom. Monetary freedom is increased by capital controls if they drive the forward premium slope estimate to zero. This boils down to the alternative hypothesis $|\beta| > |\beta+\gamma| > 0$. Under the null hypothesis of a zero capital control effect, the absolute levels of the slope estimates should be equal with and without capital controls, i.e., $|\beta| = |\beta+\gamma|$. This joint null hypothesis can be split in two parts: either the signs of β and $\beta+\gamma$ are equal. If however the signs of the coefficient alters after liberalization, the testable hypothesis changes to: $\beta = -(\beta+\gamma)$ or $2\beta+\gamma = 0$.

$$\begin{cases} \gamma = 0, & \text{if the signs of } \beta \text{ and } \beta+\gamma \text{ equal} \\ 2\beta+\gamma = 0, & \text{if the signs of } \beta \text{ and } \beta+\gamma \text{ different} \end{cases} \tag{3.7}$$

In the first case, regimes with capital controls have lower absolute levels of the coefficients, implying lower sensitivity to interest rates (designated H_{a+}). In the second case controls actually increase the sensitivity to interest rates (designated

H_{a-}).

$$\begin{aligned} H_0 &: |\beta| = |\beta + \gamma| \\ H_{a+} &: |\beta| > |\beta + \gamma| \\ H_{a-} &: |\beta| < |\beta + \gamma| \end{aligned} \tag{3.8}$$

3.4 Results

3.4.1 European Liberalizations

Tables 3.3 and 3.4 report the regression results for the UIP and forward premium regressions, respectively. Regression results for the three capital control proxies are reported separately in three vertical panels. The first column in each panel shows the results for the standard regression specifications without dummy. As expected, we replicate the stylized fact of the downward slope bias in $\hat{\beta}$. Notice that the goodness-of-fit (R^2) is generally found to be higher for the forward premium regressions. Moreover, interest differentials have much less to say about future spot changes than forward premiums: the restricted SUR coefficient for UIP almost equals 0 whereas the restricted forward premium slope is 0.36 and significantly different from zero. The remaining columns in each vertical panel report estimates of the direct capital control effect γ as well as the slope value under the presence of capital controls $(\beta + \gamma)$. For capital controls to have the effect of giving some monetary freedom, $(\beta + \gamma)$ should be smaller than β. If capital controls have no effect, then the two should be equal, implying that γ is equal to zero.

The inclusion of the capital control dummy hardly leads to any significant results. In the sample based on Kaminsky and Schmukler (2003)(K & S), only Sweden seems to be able to drive the UIP away from 1 (albeit insignificantly). Italy and Spain also have a negative γ, which is much smaller in size than the 0.77 of Sweden. The other countries exhibit positive coefficients. France forms the outlier on the other side with a coefficient of 1.07, the other countries again have coefficients close to zero. Jointly, the capital control variable turns out to be insignificant. Looking at β, also nothing surprising happens. One additional country (Portugal) shows a negative coefficient, the others are slightly lower than their initial values; UIP can be rejected for 6 out of 7 countries. These results correspond (by construction) to the small positive loadings on the capital controls. The opposite is the case for $((\beta+\gamma)$; values are on average slightly closer to one, and for France the UIP hypothesis can no longer be rejected. Overall, this set of results supports the view that capital controls are not effective. Perhaps a rather bleak - but to many not unexpected - message for governments considering the imposition of controls in the hope it will give some autonomy. However, the following results, that *do* show some effects of capital controls, are even less positive for those governments.

The second set of results using the Miniane (2004) index rejects the null of no effects of capital controls. The aggregate coefficient of γ stays rather constant at an insignificant 0.22 (versus 0.20). This would indicate that the capital controls have different effects on different countries.

Table 3.3: The impact of capital controls on uncovered interest parity.
$\Delta s^{l/\$}_{i,t+1} = \alpha_i + \beta_i * (i_{i,t} - i^{\$}_{i,t}) + \gamma_i * I^{cap}_{i,t} * (i_{i,t} - i^{\$}_{t}) + \epsilon_{t+1}$, $\Delta s^{l/\$}_{i,t+1}$ is the change in the spot exchange rate, $(i_{i,t} - i^{\$}_{i,t})$ the interest differential between the local and Dollar 1 month money market rate, $I^{cap}_{i,t}$ the dummy indicating the existence of capital controls, and $\epsilon_{i,t+1}$ the error term. (standard errors in brackets). Data is middle of the month. $I^{cap}_{i,t}$ represents either the dummy based on Kaminsky and Schmukler (2003)(K & S), Miniane (2004), or the IMF dummy. The leftmost column 'plain' is the baseline specification without the inclusion of a capital control proxy. $*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates a significant difference from 0(1) at the 10%, 5%, and 1% respectively. Sample period: January 1983 to September 1998.

	Plain	K & S			MINIANE			IMF DUMMY		
Country	β	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$
Denmark	$-0.17^{\dagger\dagger\dagger}$	$-0.78^{\dagger\dagger\dagger}_{**}$	0.14	$-0.64^{\dagger\dagger\dagger}$	$-0.62^{\dagger\dagger\dagger}_{**}$	0.43	$-0.19^{\dagger\dagger\dagger}$	$-0.50^{\dagger\dagger\dagger}_{*}$	0.02	$-0.47^{\dagger\dagger\dagger}$
	(0.21)	(0.32)	(0.52)	(0.51)	(0.30)	(0.45)	(0.39)	(0.26)	(0.37)	(0.37)
France	$-0.19^{\dagger\dagger\dagger}$	$-0.97^{\dagger\dagger\dagger}_{**}$	1.03	0.06	$-0.79^{\dagger\dagger\dagger}_{**}$	1.45^{**}	0.67	$-0.71^{\dagger\dagger\dagger}$	0.24	$-0.47^{\dagger\dagger\dagger}$
	(0.29)	(0.41)	(0.80)	(0.77)	(0.39)	(0.72)	(0.65)	(0.43)	(0.45)	(0.38)
Italy	0.79^{*}	0.59	-0.18	0.41	0.92^{*}	-0.43	0.49	-0.05	0.65	0.60
	(0.44)	(0.51)	(0.41)	(0.49)	(0.55)	(0.44)	(0.47)	(0.75)	(0.58)	(0.45)
Norway	$-0.05^{\dagger\dagger\dagger}$	$-0.38^{\dagger\dagger\dagger}$	0.16	$-0.22^{\dagger\dagger\dagger}$	$-0.26^{\dagger\dagger\dagger}$	0.10	$-0.16^{\dagger\dagger\dagger}$	1.35	-1.66	$-0.31^{\dagger\dagger\dagger}$
	(0.27)	(0.33)	(0.43)	(0.40)	(0.35)	(0.43)	(0.36)	(1.81)	(1.92)	(0.31)
Austria	$-0.06^{\dagger\dagger\dagger}$				$-0.87^{\dagger\dagger\dagger}_{*}$	1.13^{*}	$0.26^{\dagger}$	$-0.77^{\dagger\dagger\dagger}_{*}$	1.17^{**}	0.40
	(0.25)				(0.45)	(0.59)	(0.43)	(0.40)	(0.59)	(0.40)
Portugal	$0.36^{\dagger\dagger}$	$-0.09^{\dagger\dagger\dagger}$	0.42	$0.33^{\dagger\dagger}$	$-0.20^{\dagger\dagger\dagger}$	0.97^{***}	0.77^{**}	$0.05^{\dagger\dagger}$	0.24	$0.29^{\dagger\dagger}$
	(0.27)	(0.39)	(0.35)	(0.29)	(0.32)	(0.32)	(0.30)	(0.47)	(0.41)	(0.28)
Spain	$0.33^{\dagger\dagger}$	$0.07^{\dagger\dagger\dagger}$	-0.04	$0.03^{\dagger\dagger}$	0.62	-0.78^{**}	$-0.17^{\dagger\dagger\dagger}$	-0.13	0.28	$0.15^{\dagger\dagger\dagger}$
	(0.31)	(0.34)	(0.35)	(0.41)	(0.43)	(0.38)	(0.33)	(0.91)	(0.81)	(0.32)
Sweden	$-0.03^{\dagger\dagger\dagger}$	$-0.12^{\dagger\dagger\dagger}$	-0.77	$-0.89^{\dagger\dagger}$	$-0.03^{\dagger\dagger\dagger}$	-0.73	$-0.76^{\dagger\dagger}$	$-0.38^{\dagger}$	0.29	$-0.09^{\dagger\dagger\dagger}$
	(0.21)	(0.21)	(0.71)	(0.73)	(0.22)	(0.73)	(0.74)	(0.73)	(0.73)	(0.21)
R^2	0.0189	0.0283			0.0378			0.0237		
Restricted	$0.08^{\dagger\dagger\dagger}$	$-0.10^{\dagger\dagger\dagger}$	0.20	$0.11^{\dagger\dagger\dagger}$	$-0.07^{\dagger\dagger\dagger}$	0.22	$0.15^{\dagger\dagger\dagger}$	$-0.25^{\dagger\dagger\dagger}$	0.36^{*}	$0.11^{\dagger\dagger\dagger}$
	(0.13)	(0.17)	(0.17)	(0.19)	(0.18)	(0.19)	(0.15)	(0.21)	(0.18)	(0.13)
R^2	0.0138	0.0151			0.0139			0.0164		
$\forall\alpha_i$ equal	1.03	0.54			0.79			0.73		
$\forall\beta_i$ equal	1.28	1.75			2.17^{**}			0.55		
$\forall\gamma_i$ equal			0.82			4.07^{***}			0.64	
$\forall\gamma_i = 0$			0.73			3.77^{***}			0.82	

Spain is able to (significantly) dampen the effect of interest differentials on exchange rates. Italy and Sweden have insignificant negative values for γ. All other countries show a UIP coefficient that is rather higher when capital controls are in place, than in a liberalized market. For example, Portugal scores a β of -0.20 when liberalized, but comes as high as 0.77 when controls are still in place, a difference of 0.97. France also shows a big difference from -0.79 in liberalized markets to 0.67 when capital controls were still in place. Both are significant changes at the 5% level and are now insignificantly different from 1. Norway again switches sign of β. Spain and Italy, which have negative γ's ,however, show very high coefficients for β, even up to 0.92 for Italy.

The set of results with the IMF dummy gives the strongest evidence against the effectiveness of capital controls. The restricted value for γ is significantly positive, yet the joint test cannot reject that the γ's are equal to zero. Except for Norway, all countries show positive γ's. The fact that the γ of Norway goes from positive to negative, is somewhat surprising and not repeated in the following samples. Also the standard errors of the estimates of Norway are much bigger than those of the other countries. Spain and Sweden also show modestly positive values for gamma.

The results for Forward Unbiasedness (table 3.4) are similar to those of the of the UIP results for the Miniane sample. They are only more pronounced. The results again reject the hypothesis that capital controls have no effect on forward unbiasedness. However, the restricted coefficient shows that γ is positive, rather than negative as was hypothesized. Thus capital controls are driving the results *towards* forward unbiasedness, not away from it. Both K & S and Miniane show a coefficient of around 0 (0.09 and -0.16 respectively) in the absence of capital controls, and 0.44 otherwise. Moreover, the restricted capital control coefficient is now significant in both samples, at 5% and 1%.

The tests also reveal that the effects are not homogeneous across countries. In general it can be noted that the dispersion of the coefficients is larger compared to the UIP regression. The absolute size of the coefficients is bigger than those of the UIP regressions. The standard errors on the other hand stay relatively similar in size, pushing up the significance level. In the case of France, the existence of capital controls even pushes the sum of β and γ above unity.

Looking at the results, the same pattern emerges as for the UIP. On one side, Spain, Sweden, and Italy have negative coefficients in the samples of K & S and Miniane. Of the negative γ's only the one of Spain in the sample based on Miniane is significant. This is also the only instance in the entire sample where the liberalized UIP coefficient scores above 1.

In short, the forward regressions only reinforce earlier results; there is hardly any evidence that countries can use capital controls to drive exchange rates away from parities. Instead the little evidence that is there, points in the opposite direction, showing that exchange rates are actually more sensitive to forward premia when capital controls are in place.

The results of testing for the absolute effects of capital controls(table 3.5) give slightly more support for the effectiveness capital controls than the previous results, but still do not give much hope for countries that plan to use capital controls.

Table 3.4: The impact of capital controls on forward unbiasedness.
$\Delta s^{l/\$}_{i,t+1} = \alpha_i + \beta_i * (f^{l/\$}_{i,t,1} - s^{l/\$}_{i,t}) + \gamma_i * I^{cap}_{i,t} * (f^{l/\$}_{i,t,1} - s^{l/\$}_{i,t}) + \epsilon_{i,t+1}$, $\Delta s^{l/\$}_{i,t+1}$ is the change in the spot exchange rate, $(f^{l/\$}_{t,1} - s^{l/\$}_{t})$ the forward premium, $I^{cap}_{i,t}$ the dummy indicating the existence of capital controls, and $\epsilon_{i,t+1}$ the error term. (standard errors in brackets). $I^{cap}_{i,t}$ represents either the dummy based on Kaminsky and Schmukler (2003)(K & S), Miniane (2004), or the IMF dummy respectively. The leftmost column 'plain' is the baseline specification without the inclusion of a capital control proxy. $*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates a significant difference from 0(1) at the 10%, 5%, and 1% respectively. Sample period: January 1983 to December 1998.

	Plain	K & S			MINIANE			IMF DUMMY		
Country	β	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$
Denmark	$-0.51^{\dagger\dagger\dagger}_{***}$	$-1.02^{\dagger\dagger\dagger}_{***}$	0.88^{*}	$-0.15^{\dagger\dagger\dagger}$	$-1.04^{\dagger\dagger\dagger}_{***}$	0.88^{**}	$-0.16^{\dagger\dagger\dagger}$	$-0.44^{\dagger\dagger\dagger}_{**}$	-0.03	$-0.47^{\dagger\dagger\dagger}$
	(0.16)	(0.25)	(0.49)	(0.44)	(0.22)	(0.40)	(0.35)	(0.20)	(0.38)	(0.36)
France	$0.30^{\dagger\dagger\dagger}$	$-0.78^{\dagger\dagger\dagger}_{**}$	2.29^{***}	1.51^{***}	$-0.75^{\dagger\dagger\dagger}_{***}$	2.36^{***}	$1.61^{\dagger\dagger\dagger}_{***}$	$-0.29^{\dagger\dagger\dagger}$	0.89^{**}	$0.60^{\dagger}_{**}$
	(0.20)	(0.31)	(0.45)	(0.36)	(0.28)	(0.39)	(0.30)	(0.34)	(0.36)	(0.24)
Italy	0.48	0.42	-0.14	0.28	0.69	-0.49	0.20	$-0.40^{\dagger}$	0.97	0.58
	(0.46)	(0.51)	(0.48)	(0.54)	(0.52)	(0.51)	(0.54)	(0.73)	(0.61)	(0.46)
Norway	$-0.26^{\dagger\dagger\dagger}$	$-0.69^{\dagger\dagger\dagger}_{**}$	0.85^{*}	$0.15^{\dagger\dagger}$	$-0.63^{\dagger\dagger\dagger}_{***}$	0.58	$-0.05^{\dagger\dagger\dagger}$	-0.58	0.41	-0.07
	(0.28)	(0.33)	(0.44)	(0.38)	(0.35)	(0.45)	(0.36)	(1.33)	(1.44)	(0.31)
Austria	$-0.12^{\dagger\dagger\dagger}$				$-1.11^{\dagger\dagger\dagger}_{***}$	1.04^{**}	$-0.08^{\dagger\dagger\dagger}$	$-0.20^{\dagger\dagger\dagger}$	0.53	$0.33^{\dagger\dagger}$
	(0.20)				(0.34)	(0.43)	(0.31)	(0.31)	(0.46)	(0.32)
Portugal	$0.50^{\dagger\dagger\dagger}_{***}$	$0.13^{\dagger\dagger\dagger}$	0.41	$0.55^{\dagger\dagger\dagger}_{***}$	0.17	0.34	$0.51^{\dagger\dagger\dagger}_{***}$	$0.22^{\dagger\dagger}$	0.27	$0.49^{\dagger\dagger\dagger}_{***}$
	(0.09)	(0.27)	(0.26)	(0.09)	(0.26)	(0.25)	(0.09)	(0.34)	(0.32)	(0.09)
Spain	0.68^{***}	0.62^{**}	-0.17	0.46	1.21^{***}	-1.00^{***}	$0.21^{\dagger\dagger\dagger}$	0.77	-0.11	0.65^{**}
	(0.26)	(0.27)	(0.35)	(0.38)	(0.36)	(0.36)	(0.28)	(0.86)	(0.80)	(0.26)
Sweden	$0.41^{\dagger}_{***}$	$0.38^{\dagger}$	-0.78	$-0.41^{\dagger\dagger}$	0.47	-1.07	$-0.60^{\dagger\dagger}$	$-0.47^{\dagger}$	1.01	0.54
	(0.32)	(0.33)	(0.68)	(0.70)	(0.34)	(0.70)	(0.71)	(0.81)	(0.81)	(0.33)
R^2	0.0497	0.0683			0.0851			0.0532		
Restricted	$0.36^{\dagger\dagger\dagger}_{***}$	$0.09^{\dagger\dagger\dagger}$	0.35^{**}	$0.44^{\dagger\dagger\dagger}_{***}$	-0.16	0.60^{***}	$0.44^{\dagger\dagger\dagger}_{***}$	$-0.45^{\dagger\dagger\dagger}_{***}$	0.87^{***}	$0.42^{\dagger\dagger\dagger}_{***}$
	(0.07)	(0.15)	(0.14)	(0.08)	(0.16)	(0.16)	(0.08)	(0.15)	(0.15)	(0.08)
R^2	0.0298	0.0349			0.0382			0.0494		
$\forall\alpha_i$ equal	1.48	1.24			1.24			1.00		
$\forall\beta_i$ equal	5.71^{***}	4.94^{***}			6.23^{***}			0.71		
$\forall\gamma_i$ equal			4.50^{***}			7.47^{***}			0.80	
$\forall\gamma_i = 0$			4.44^{***}			7.14^{***}			1.36	

Table 3.5: The impact of capital controls on parity conditions in absolute values.
This table reports the f-tests associated with the Wald test of the hypothesis that capital controls drive coefficients to zero, indicating monetary independence. Under the null $|\beta| = |\beta+\gamma|$, under the alternative capital controls drive coefficients either to zero (+), or away from zero (-). *Uncovered Interest Parity* refers to the coefficients from table 3.3 and *Forward Premia* refers to the coefficients from table 3.4. The columns represent the capital control dummy based on respectively Kaminsky and Schmukler (2003)(K & S), Miniane (2004), and the IMF dummy. $*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates that $|\beta|$ is significantly larger(smaller) than $|\beta+\gamma|$ at the 10%, 5%, and 1% respectively.

Panel A: Uncovered Interest Parity

	K & S		MINIANE		IMF DUMMY	
Country	F-test	+/−	F-test	+/−	F-test	+/−
Denmark	0.07	+	0.93	+	0.00	+
France	0.92	+	0.02	+	0.28	+
Italy	0.20	+	0.96	+	0.24	-
Norway	0.14	+	0.05	+	0.35	+
Austria			0.82	+	0.48	+
Portugal	0.17	-	1.11	-	0.34	-
Spain	0.02	+	0.45	+	0.00	-
Sweden	1.17	-	1.01	-	0.16	+

Sign test: 69.6% *of the cases has $|\beta| > |\beta+\gamma|$

Panel B: Forward Premia

	K & S		MINIANE		IMF DUMMY	
Country	F-test	+/−	F-test	+/−	F-test	+/−
Denmark	3.23^*	+	4.89^{**}	+	0.01	-
France	2.12	-	$4.03^{\dagger\dagger}$	-	0.45	-
Italy	0.08	+	0.92	+	0.03	-
Norway	0.91	+	1.70	+	0.08	+
Austria			5.71^{**}	+	0.09	-
Portugal	2.46	-	1.81	-	0.70	-
Spain	0.23	+	7.75^{***}	+	0.02	+
Sweden	0.00	-	0.02	-	0.01	-

Sign test: 47.8% of the cases has $|\beta| > |\beta+\gamma|$

No single country is able to significantly change the absolute sensitivity to interest rates. The only consolation to be found is the fact that, at least for a majority of the countries, the effect goes in the correct direction, as shown by the sign test. Of specific interest are the results of Sweden. While these results for Sweden were most supportive of capital controls in the previous test, they now show that in an absolute sense capital controls have been ineffective.

The results for the forward rates yield more significant results, mainly resulting from lower standard errors, rather than the size of the coefficients. The countries that have significant shifts in their absolute responsiveness are slightly skewed in favor of capital controls. Denmark, Austria and Spain had effective controls. The controls of France have been counter-productive in creating exchange rate stability. The overall count, however, is slightly less than 50% in favor of capital controls, mainly caused by the results for the AREAER dummy, which are much more negative than the other results.

3.4.2 Emerging Countries

Frankel and Poonawala (2006) find that on average, UIP holds better in emerging countries than in developed countries. Combined with the stylized fact that emerging countries are more prone to the use capital controls, this tentatively leads to the conclusion that capital controls might not be one of the prime driving factors behind the observed deviations in UIP. Intuitively, if capital controls are one of the explanations of the deviation from UIP, then those countries that primarily employ them should have larger deviations, not smaller ones. However, the data set allows for formal testing of the implications that flow from their results.

Table 3.6 reports the results for the emerging countries. The standard Fama specification reveals few surprises. Again the coefficients are far below 1 and some are negative. The results do not replicate the finding of Frankel and Poonawala (2006) that UIP holds better in emerging countries than in developed economies. The restricted β for the emerging economies (0.30) is not much different from the restricted coefficients for the UIP and FP results of the European countries (0.08 and 0.36 respectively). Surprising is the large and positive coefficient of 2.22 for Lebanon. Still, this coefficient is neither significantly different from 1 nor from 0, implying that the deviant result probably has little economic interpretation.

Adding the IMF capital control dummy to the specification shows that, also here, results are not much different from the European sample, although only one capital controls proxy can be used rather than three. For Indonesia and Jamaica, the imposition of capital controls drives the β up towards zero, pushing it slightly above zero in the case of Jamaica. Lebanon and Venezuela experience the opposite effect; imposing capital controls again drives β towards zero, but given the positive coefficient in liberalized markets, this means that it is driven down. Lebanon also shows the most extreme change between regimes, with the coefficient changing by more than 5 in absolute value; the only coefficient that is significantly different from zero.

Changing the focus from the deviations from parity towards the sensitivity of

the exchange rate to interest differentials does not change the picture. In this respect there is very little reason to believe that emerging countries behave differently than developed countries. Although, yes, they are more active in establishing and abolishing capital controls and tinker more with the regulations in place, the effect of those controls are not more effective than the ones in the European countries.

Table 3.6: The impact of capital controls on uncovered interest parity in emerging countries. $\Delta s^{l/\$}_{i,t+1} = \alpha_i + \beta_i * (i_{i,t} - i^{\$}_{i,t}) + \gamma_i * I^{cap}_{i,t} * (i_{i,t} - i^{\$}_{t}) + \epsilon_{t+1}$, $\Delta s^{l/\$}_{i,t+1}$ is the change in the spot exchange rate, $(i_{i,t} - i^{\$}_{i,t})$ the interest differential between the local and Dollar 1 month deposit rate, $I^{cap}_{i,t}$ the dummy indicating the existence of capital controls measured by the IMF dummy, and $\epsilon_{i,t+1}$ the error term. (standard errors in brackets). Data is middle of the month. The column 'plain' is the baseline specification without the inclusion of a capital control proxy.
The rightmost columns reports the f-tests associated with the hypothesis that capital controls drive coefficients to zero, indicating monetary independence. Under the null $|\beta| = |\beta+\gamma|$, under the alternative capital controls drive coefficients either to zero (+), or away from zero (-).
$*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates a significant difference from 0(1) at the 10%, 5%, and 1% respectively. Sample period: March 1984 to November 2006.

	Plain	IMF DUMMY			Absolute	
Country	β	β	γ	$\beta+\gamma$	$+/-$	F-test
Indonesia	−0.57	−1.22	0.64	−0.58	+	0.53
	(0.74)	(1.14)	(0.88)	(0.74)		
Jamaica	0.37	−1.16	1.29	0.13	+	1.52
	(0.41)	(1.30)	(1.04)	(0.45)		
Kuwait	−0.11	−0.09	−0.39	−0.48	-	0.04
	(0.60)	(0.63)	(2.03)	(1.94)		
Lebanon	2.22	0.60	−5.17***	−4.56	-	0.71
	(1.77)	(1.85)	(1.94)	(3.08)		
Venezuela	0.57	0.62	−0.04	0.58	+	0.00
	(0.42)	(0.68)	(0.63)	(0.43)		
R^2	0.041	0.043				
Restricted	0.30	0.23	0.08	0.31	-	0.05
	(0.25)	(0.39)	(0.36)	(0.25)		
R^2	0.038	0.034				
$\forall\alpha_i$ equal	1.81	2.94**				
$\forall\beta_i$ equal	0.88	0.72				
$\forall\gamma_i$ equal			2.29*			
$\forall\gamma_i = 0$			1.84			

3.4.3 Cross-Rates

Normally, the two specifications tested above should be numéraire-invariant (Schotman, Straetmans, and De Vries, 2005). However, it cannot be excluded that the effects of capital controls differ across countries. In the sample at hand, most countries were part of the EMS. Thus it might be interesting to look at the interaction

Table 3.7: The impact of capital controls on uncovered interest parity, Pound.
$\Delta s^{l/\pounds}_{i,t+1} = \alpha_i + \beta_i * (i_{i,t} - i^{\pounds}_{i,t}) + \gamma_i * I^{cap}_{i,t} * (i_{i,t} - i^{\pounds}_{t}) + \epsilon_{t+1}$, $\Delta sl/\pounds_{i,t+1}$ is the change in the spot exchange rate, $(i_{i,t} - i^{\pounds}_{i,t})$ the interest differential between the local and foreign 1 month money market rate, $I^{cap}_{i,t}$ the dummy indicating the existence of capital controls, and $\epsilon_{i,t+1}$ the error term. (standard errors in brackets). Data is middle of the month. $I^{cap}_{i,t}$ represents either the dummy based on Kaminsky and Schmukler (2003)(K & S), Miniane (2004), or the IMF dummy respectively. The leftmost column 'plain' is the baseline specification without the inclusion of a capital control proxy. $*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates a significant difference from 0(1) at the 10%, 5%, and 1% respectively. Sample period: January 1983 to September 1998.

	Plain	K & S			MINIANE			IMF DUMMY		
Country	β	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$
Denmark	$-0.06^{\dagger\dagger\dagger}$	$-0.39^{\dagger\dagger\dagger}_{***}$	0.35	$-0.05^{\dagger\dagger\dagger}$	$-0.18^{\dagger\dagger\dagger}$	0.18	$0.00^{\dagger\dagger\dagger}$	$-0.22^{\dagger\dagger\dagger}_{*}$	0.22	$0.00^{\dagger\dagger\dagger}$
	(0.09)	(0.24)	(0.24)	(0.22)	(0.12)	(0.20)	(0.18)	(0.12)	(0.20)	(0.18)
France	$-0.05^{\dagger\dagger\dagger}$	$-0.48^{\dagger\dagger\dagger}_{**}$	0.35	$-0.13^{\dagger\dagger\dagger}$	$-0.18^{\dagger\dagger\dagger}$	0.13	$-0.05^{\dagger\dagger\dagger}$	$-0.31^{\dagger\dagger\dagger}$	0.20	$-0.11^{\dagger\dagger\dagger}$
	(0.12)	(0.22)	(0.22)	(0.19)	(0.16)	(0.20)	(0.17)	(0.21)	(0.21)	(0.13)
Italy	$0.06^{\dagger\dagger\dagger}$	$-0.09^{\dagger\dagger\dagger}$	0.09	$-0.01^{\dagger\dagger\dagger}$	$0.12^{\dagger\dagger\dagger}$	-0.13	$-0.01^{\dagger\dagger\dagger}$	$-0.37^{\dagger\dagger\dagger}$	0.46	$0.10^{\dagger\dagger\dagger}$
	(0.16)	(0.26)	(0.26)	(0.18)	(0.23)	(0.26)	(0.19)	(0.32)	(0.32)	(0.17)
Norway	$-0.21^{\dagger\dagger\dagger}_{*}$	$-0.46^{\dagger\dagger\dagger}_{***}$	0.41	$-0.05^{\dagger\dagger\dagger}$	$-0.37^{\dagger\dagger\dagger}_{**}$	0.31	$-0.06^{\dagger\dagger\dagger}$	$-0.51^{\dagger\dagger\dagger}$	0.29	$-0.22^{\dagger\dagger\dagger}$
	(0.12)	(0.28)	(0.28)	(0.22)	(0.17)	(0.28)	(0.20)	(0.47)	(0.50)	(0.14)
Austria	$0.03^{\dagger\dagger\dagger}$				$-0.42^{\dagger\dagger\dagger}_{*}$	0.42^{**}	$0.00^{\dagger\dagger\dagger}$	$-0.48^{\dagger\dagger\dagger}_{*}$	0.45^{**}	$-0.03^{\dagger\dagger\dagger}$
	(0.12)				(0.25)	(0.19)	(0.13)	(0.25)	(0.20)	(0.12)
Portugal	$0.18^{\dagger\dagger\dagger}$	$-0.23^{\dagger\dagger\dagger}$	0.46	$0.23^{\dagger\dagger\dagger}_{*}$	$-0.17^{\dagger\dagger\dagger}$	0.49^{***}	$0.32^{\dagger\dagger\dagger}_{**}$	$-0.03^{\dagger\dagger\dagger}$	0.22	$0.19^{\dagger\dagger\dagger}$
	(0.12)	(0.19)	$(0.19)^{**}$	(0.13)	(0.17)	(0.18)	(0.13)	(0.22)	(0.22)	(0.12)
Spain	$0.01^{\dagger\dagger\dagger}$	$-0.11^{\dagger\dagger\dagger}$	0.30	$0.19^{\dagger}$	$0.36^{\dagger\dagger\dagger}_{*}$	-0.58^{**}	$-0.22^{\dagger\dagger\dagger}$	$-0.32^{\dagger\dagger\dagger}$	0.30	$-0.02^{\dagger\dagger\dagger}$
	(0.13)	(0.44)	(0.44)	(0.45)	(0.21)	(0.23)	(0.14)	(0.35)	(0.35)	(0.14)
Sweden	$-0.30^{\dagger\dagger\dagger}_{***}$	$-0.33^{\dagger\dagger\dagger}_{***}$	-0.31	$-0.64^{\dagger\dagger\dagger}$	$-0.26^{\dagger\dagger\dagger}_{**}$	-0.32	$-0.59^{\dagger\dagger\dagger}$	$-0.44^{\dagger\dagger\dagger}$	0.13	$-0.30^{\dagger\dagger\dagger}_{***}$
	(0.10)	(0.45)	(0.45)	(0.45)	(0.10)	(0.45)	(0.44)	(0.39)	(0.40)	(0.10)
R^2	0.0244	0.0369			0.0393			0.0300		
Restricted	$-0.07^{\dagger\dagger\dagger}$	$-0.26^{\dagger\dagger\dagger}_{***}$	0.34^{***}	$0.08^{\dagger\dagger\dagger}$	$-0.21^{\dagger\dagger\dagger}_{***}$	0.24^{***}	$0.03^{\dagger\dagger\dagger}$	$-0.26^{\dagger\dagger\dagger}_{**}$	0.21^{**}	$-0.05^{\dagger\dagger\dagger}$
	(0.06)	(0.07)	(0.09)	(0.09)	(0.07)	(0.08)	(0.07)	(0.10)	(0.09)	(0.06)
R^2	0.0133	0.0276			0.0203			0.0173		
$\forall\alpha_i$ equal	1.23	2.08^{*}			1.51			1.67		
$\forall\beta_i$ equal	2.08^{**}	0.92			1.62			0.46		
$\forall\gamma_i$ equal			0.49			3.14^{***}			0.33	
$\forall\gamma_i = 0$			1.57			3.18^{***}			1.06	

Table 3.8: The impact of capital controls on uncovered interest parity, Deutsche Mark.
$\Delta s^{l/dm}_{i,t+1} = \alpha_i + \beta_i * (i_{i,t} - i^{dm}_{i,t}) + \gamma_i * I^{cap}_{i,t} * (i_{i,t} - i^{dm}_{t}) + \epsilon_{t+1}$, $\Delta s^{l/dm}_{i,t+1}$ is the change in the spot exchange rate, $(i_{i,t} - i^{dm}_{i,t})$ the interest differential between the local and foreign 1 month money market rate, $I^{cap}_{i,t}$ the dummy indicating the existence of capital controls, and $\epsilon_{i,t+1}$ the error term. (standard errors in brackets). Data is middle of the month. $I^{cap}_{i,t}$ represents either the dummy based on Kaminsky and Schmukler (2003)(K & S), Miniane (2004), or the IMF dummy respectively. The leftmost column 'plain' is the baseline specification without the inclusion of a capital control proxy. $*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates a significant difference from 0(1) at the 10%, 5%, and 1% respectively. Sample period: January 1983 to September 1998.

	Plain	K & S			MINIANE			IMF DUMMY		
Country	β	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$
Denmark	$-0.04^{\dagger\dagger\dagger}$	$-0.24^{\dagger\dagger\dagger}$	0.21	$-0.03^{\dagger\dagger\dagger}$	$-0.13^{\dagger\dagger\dagger}$	0.11	$-0.02^{\dagger\dagger\dagger}$	$-0.09^{\dagger\dagger\dagger}$	0.09	$0.00^{\dagger\dagger\dagger}$
	(0.10)	(0.15)	(0.15)	(0.10)	(0.15)	(0.13)	(0.10)	(0.15)	(0.13)	(0.10)
France	$0.12^{\dagger\dagger\dagger}$	$-0.60^{\dagger\dagger\dagger}_{*}$	0.69^{**}	$0.09^{\dagger\dagger\dagger}$	$-0.49^{\dagger\dagger\dagger}$	0.58^{**}	$0.10^{\dagger\dagger\dagger}$	$-0.46^{\dagger\dagger\dagger}$	0.59	$0.14^{\dagger\dagger\dagger}$
	(0.12)	(0.32)	(0.32)	(0.13)	(0.31)	(0.28)	(0.13)	(0.43)	(0.41)	(0.13)
Italy	$0.04^{\dagger\dagger\dagger}$	$0.12^{\dagger\dagger}$	-0.09	$0.03^{\dagger\dagger\dagger}$	$0.15^{\dagger\dagger}$	-0.13	$0.02^{\dagger\dagger\dagger}$	$-0.59^{\dagger\dagger\dagger}$	0.54^{*}	$-0.05^{\dagger\dagger\dagger}$
	(0.16)	(0.25)	(0.25)	(0.18)	(0.33)	(0.22)	(0.19)	(0.40)	(0.31)	(0.17)
Norway	$-0.04^{\dagger\dagger\dagger}$	$-0.21^{\dagger\dagger\dagger}$	0.21	$0.00^{\dagger\dagger\dagger}$	$-0.11^{\dagger\dagger\dagger}$	0.08	$-0.03^{\dagger\dagger\dagger}$	0.16^{***}	-0.14	$0.02^{\dagger\dagger\dagger}$
	(0.11)	(0.16)	(0.16)	(0.13)	(0.23)	(0.21)	(0.12)	(0.83)	(0.79)	(0.12)
Austria	$-0.06^{\dagger\dagger\dagger}$				$-0.62^{\dagger\dagger\dagger}$	0.63	$0.01^{\dagger\dagger\dagger}$	$-0.57^{\dagger\dagger}$	0.61	$0.03^{\dagger\dagger\dagger}$
	(0.17)				(0.51)	(0.57)	(0.19)	(0.51)	(0.57)	(0.19)
Portugal	$0.28^{\dagger\dagger\dagger}_{**}$	$0.02^{\dagger\dagger\dagger}$	0.25	$0.27^{\dagger\dagger\dagger}_{**}$	$-0.19^{\dagger\dagger\dagger}$	0.40^{**}	$0.21^{\dagger\dagger\dagger}_{*}$	$0.20^{\dagger\dagger}$	0.10	$0.30^{\dagger\dagger\dagger}_{**}$
	(0.12)	(0.21)	(0.21)	(0.12)	(0.23)	(0.18)	(0.12)	(0.32)	(0.25)	(0.13)
Spain	$-0.23^{\dagger\dagger\dagger}_{*}$	$-0.20^{\dagger\dagger\dagger}$	-0.16	$-0.36^{\dagger\dagger\dagger}_{*}$	$0.27^{\dagger\dagger}$	-0.37	$-0.11^{\dagger\dagger\dagger}$	$-0.72^{\dagger\dagger\dagger}_{*}$	0.45	$-0.27^{\dagger\dagger\dagger}_{*}$
	(0.13)	(0.16)	(0.16)	(0.21)	(0.33)	(0.25)	(0.14)	(0.40)	(0.33)	(0.14)
Sweden	$-0.13^{\dagger\dagger\dagger}$	$-0.12^{\dagger\dagger\dagger}$	-0.14	$-0.26^{\dagger\dagger\dagger}$	$-0.11^{\dagger\dagger\dagger}$	-0.14	$-0.25^{\dagger\dagger\dagger}$	$-0.88^{\dagger\dagger\dagger}_{*}$	0.74	$-0.14^{\dagger\dagger\dagger}$
	(0.10)	(0.20)	(0.20)	(0.21)	(0.10)	(0.21)	(0.21)	(0.51)	(0.49)	(0.10)
R^2	0.0239	0.0337			0.0348			0.0289		
Restricted	$-0.01^{\dagger\dagger\dagger}$	$-0.12^{\dagger\dagger\dagger}_{*}$	0.18^{***}	$0.06^{\dagger\dagger\dagger}$	$-0.11^{\dagger\dagger\dagger}$	0.15^{**}	$0.04^{\dagger\dagger\dagger}$	$-0.21^{\dagger\dagger\dagger}_{*}$	0.21^{**}	$0.00^{\dagger\dagger\dagger}$
	(0.05)	(0.07)	(0.06)	(0.06)	(0.07)	(0.08)	(0.06)	(0.11)	(0.10)	(0.05)
R^2	0.0134	0.0213			0.0161			0.0161		
$\forall\alpha_i$ equal	1.59	1.18			1.04			1.90^{*}		
$\forall\beta_i$ equal	2.23^{**}	0.52			0.64			1.04		
$\forall\gamma_i$ equal			1.50			2.07^{**}			0.69	
$\forall\gamma_i = 0$			1.51			2.04^{**}			0.94	

Table 3.9: The impact of capital controls on forward unbiasedness, Pound.
$\Delta s^{l/£}_{i,t+1} = \alpha_i + \beta_i * (f^{l/£}_{i,t,1} - s^{l/£}_{i,t}) + \gamma_i * I^{cap}_{i,t} * (f^{l/£}_{i,t,1} - s^{l/£}_{i,t}) + \epsilon_{i,t+1}$, $\Delta s_{i,t+1}$ is the change in the spot exchange rate, $(f^{l/£}_{t,1} - s^{l/£}_{t})$ the forward premium versus the pound, $I^{cap}_{i,t}$ the dummy indicating the existence of capital controls, and $\epsilon_{i,t+1}$ the error term. (standard errors in brackets). $I^{cap}_{i,t}$ represents either the dummy based on Kaminsky and Schmukler (2003)(K & S), Miniane (2004), or the IMF dummy respectively. The leftmost column 'plain' is the baseline specification without the inclusion of a capital control proxy. $*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates a significant difference from 0(1) at the 10%, 5%, and 1% respectively. Sample period: January 1983 to December 1998.

	Plain	K & S			MINIANE			IMF DUMMY		
Country	β	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$
Denmark	-0.56 $^{\dagger\dagger\dagger}_{***}$	-1.19 $^{\dagger\dagger\dagger}_{***}$	1.90 ***	0.70	-1.01 $^{\dagger\dagger\dagger}_{***}$	1.02 ***	0.01 †††	-0.94 $^{\dagger\dagger\dagger}_{***}$	0.85 **	-0.09 †††
	(0.17)	(0.28)	(0.52)	(0.45)	(0.19)	(0.38)	(0.35)	(0.19)	(0.38)	(0.35)
France	0.34 $^{\dagger\dagger\dagger}_{*}$	-0.85 $^{\dagger\dagger\dagger}_{**}$	2.39 ***	1.54 ***	-0.47 $^{\dagger\dagger\dagger}_{**}$	1.46 ***	0.99 ***	-0.66 $^{\dagger\dagger\dagger}_{*}$	1.04 **	0.37 $^{\dagger\dagger\dagger}_{*}$
	(0.20)	(0.34)	(0.50)	(0.36)	(0.26)	(0.38)	(0.29)	(0.39)	(0.41)	(0.22)
Italy	0.04 ††	0.17	-0.33	-0.17 ††	0.34	-0.68	-0.34 ††	-0.72 ††	0.85	0.13 †
	(0.42)	(0.64)	(0.72)	(0.49)	(0.54)	(0.72)	(0.57)	(0.77)	(0.81)	(0.46)
Norway	-0.74 $^{\dagger\dagger\dagger}_{***}$	-1.49 $^{\dagger\dagger\dagger}_{***}$	1.60 **	0.11	-1.53 $^{\dagger\dagger\dagger}_{***}$	1.52 **	-0.01 ††	-1.35 ††	0.63	-0.72 $^{\dagger\dagger\dagger}_{**}$
	(0.30)	(0.38)	(0.69)	(0.54)	(0.42)	(0.72)	(0.51)	(0.94)	(1.03)	(0.33)
Austria	0.00 †††				-1.50 $^{\dagger\dagger\dagger}_{***}$	1.29 ***	-0.21 †††	-1.42 $^{\dagger\dagger\dagger}_{***}$	1.26 ***	-0.17 †††
	(0.22)				(0.46)	(0.35)	(0.23)	(0.46)	(0.36)	(0.22)
Portugal	0.52 †††	0.32 ††	0.16	0.47 $^{\dagger\dagger\dagger}_{***}$	0.44 †	0.05	0.48 $^{\dagger\dagger\dagger}_{***}$	0.18 ††	0.33	0.51 $^{\dagger\dagger\dagger}_{***}$
	(0.08)	(0.33)	(0.33)	(0.09)	(0.32)	(0.31)	(0.08)	(0.37)	(0.37)	(0.08)
Spain	0.49 $^{\dagger\dagger}_{*}$	1.48 ***	-1.60 ***	-0.12 †††	1.65 ***	-1.80 ***	-0.15 †††	0.09	0.33	0.42 ††
	(0.26)	(0.43)	(0.49)	(0.29)	(0.42)	(0.48)	(0.29)	(0.81)	(0.82)	(0.26)
Sweden	-0.25 †††	-1.31 $^{\dagger\dagger\dagger}_{*}$	1.35	0.04 †††	-0.08 ††	-1.97 *	-2.05 $^{\dagger\dagger\dagger}_{**}$	-1.35 ††	1.23	-0.12 †††
	(0.38)	(0.73)	(0.82)	(0.43)	(0.40)	(1.16)	(1.09)	(0.97)	(1.05)	(0.41)
R^2	0.0564	0.0844			0.0871			0.0669		
Restricted	0.33 $^{\dagger\dagger\dagger}_{***}$	-0.47 $^{\dagger\dagger\dagger}_{**}$	0.93 ***	0.47 $^{\dagger\dagger\dagger}_{***}$	-0.33 $^{\dagger\dagger\dagger}_{**}$	0.74 ***	0.41 †††	-0.56 $^{\dagger\dagger\dagger}_{***}$	0.95 ***	0.38 $^{\dagger\dagger\dagger}_{***}$
	(0.07)	(0.20)	(0.20)	(0.08)	(0.14)	(0.14)	(0.08) ***	(0.16)	(0.16)	(0.07)
R^2	0.0272	0.0458		0.0428				0.0484		
$\forall\alpha_i$ equal	1.56	1.45			1.84 *			2.07 **		
$\forall\beta_i$ equal	7.05***	6.75 ***			7.16 ***			1.60		
$\forall\gamma_i$ equal			6.69 ***			5.92 ***			0.57	
$\forall\gamma_i = 0$			6.68 ***			6.25 ***			2.36 **	

Table 3.10: The impact of capital controls on forward unbiasedness, Deutsche Mark.
$\Delta s^{l/dm}_{i,t+1} = \alpha_i + \beta_i * (f^{l/dm}_{i,t,1} - s^{l/dm}_{i,t}) + \gamma_i * I^{cap}_{i,t} * (f^{dm}_{i,t,1} - s^{dm}_{i,t}) + \epsilon_{i,t+1}$, $\Delta s_{i,t+1}$ is the change in the spot exchange rate, $(f^{l/dm}_{t,1} - s^{l/dm}_{t})$ the forward premium versus the Deutsche mark, $I^{cap}_{i,t}$ the dummy indicating the existence of capital controls, and $\epsilon_{i,t+1}$ the error term. (standard errors in brackets). $I^{cap}_{i,t}$ represents either the dummy based on Kaminsky and Schmukler (2003)(K & S), Miniane (2004), or the IMF dummy respectively. The leftmost column 'plain' is the baseline specification without the inclusion of a capital control proxy.
$*(\dagger), **(\dagger\dagger), ***(\dagger\dagger\dagger)$, indicates a significant difference from 0(1) at the 10%, 5%, and 1% respectively. Sample period: January 1983 to December 1998.

	Plain	K & S			MINIANE			IMF DUMMY		
Country	β	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$	β	γ	$\beta+\gamma$
Denmark	-0.61 $^{\dagger\dagger\dagger}_{***}$	-1.67 $^{\dagger\dagger\dagger}_{***}$	1.58 ***	-0.09 †††	-1.48 $^{\dagger\dagger\dagger}_{***}$	1.37 ***	-0.11 †††	-1.42 $^{\dagger\dagger\dagger}_{***}$	1.34 ***	-0.07 †††
	(0.17)	(0.21)	(0.23)	(0.17)	(0.20)	(0.23)	(0.18)	(0.20)	(0.22)	(0.18)
France	0.64 $^{\dagger\dagger}_{***}$	-0.25 ††	1.07 **	0.83 ***	-0.31 †††	1.07 **	0.76 ***	-0.42 ††	1.20 *	0.78 ***
	(0.18)	(0.49)	(0.47)	(0.19)	(0.46)	(0.43)	(0.18)	(0.68)	(0.66)	(0.18)
Italy	-0.07 ††	-0.35 †	0.40	0.05 ††	-0.24	0.11	-0.13 ††	-1.78 $^{\dagger\dagger\dagger}_{**}$	1.64 **	-0.14 †††
	(0.43)	(0.77)	(0.57)	(0.45)	(0.79)	(0.56)	(0.45)	(0.89)	(0.70)	(0.43)
Norway	-0.27 †††	-0.67 $^{\dagger\dagger\dagger}_{*}$	0.83 **	0.16 †††	-0.87 $^{\dagger\dagger\dagger}_{*}$	0.76 *	-0.11 †††	-0.76	0.67	-0.09 †††
	(0.24)	(0.34)	(0.36)	(0.27)	(0.45)	(0.45)	(0.26)	(1.32)	(1.27)	(0.25)
Austria	0.29 †	0.00			1.09	-0.92	0.17 ††	1.13 $^{\dagger\dagger\dagger}_{***}$	-0.95	0.18 †
	(0.38)	(0.00)			(0.82)	(0.96)	(0.45)	(0.82)	(0.97)	(0.45)
Portugal	0.49 $^{\dagger\dagger\dagger}_{***}$	0.07 ††	0.44	0.51 $^{\dagger\dagger\dagger}_{***}$	0.29 †	0.18	0.46 $^{\dagger\dagger\dagger}_{***}$	0.00 ††	0.49	0.49 $^{\dagger\dagger\dagger}_{***}$
	(0.08)	(0.38)	(0.36)	(0.08)	(0.38)	(0.37)	(0.09)	(0.45)	(0.43)	(0.08)
Spain	0.21 †††	0.27 †††	-0.33	-0.07 ††	1.69 ***	-1.43 ***	0.26 †††	-0.36 †	0.60	0.24 †††
	(0.24)	(0.25)	(0.42)	(0.50)	(0.49)	(0.43)	(0.24)	(0.81)	(0.71)	(0.25)
Sweden	-0.31 †††	-0.03 ††	-0.20	-0.22 ††	-0.05 †††	-0.46	-0.51 †††	-3.40 $^{\dagger\dagger}_{***}$	3.02 *	-0.38 †††
	(0.38)	(0.45)	(0.51)	(0.46)	(0.45)	(0.51)	(0.46)	(1.71)	(1.54)	(0.40)
R^2	0.0563	0.1011			0.0913			0.0840		
Restricted	0.31 $^{\dagger\dagger\dagger}_{***}$	-0.30 $^{\dagger\dagger\dagger}_{**}$	0.67 ***	0.37 $^{\dagger\dagger\dagger}_{***}$	-0.46 $^{\dagger\dagger\dagger}_{***}$	0.87 ***	0.41 †††***	-0.95 $^{\dagger\dagger\dagger}_{***}$	1.33 ***	0.37 $^{\dagger\dagger\dagger}_{***}$
	(0.07)	(0.13)	(0.12)	(0.07)	(0.15)	(0.15)	(0.08)	(0.17)	(0.17)	(0.07)
R^2	0.0262	0.0506			0.0449			0.0586		
$\forall\alpha_i$ equal	2.95 ***	2.39 **			3.10 ***			3.30 ***		
$\forall\beta_i$ equal	7.43 ***	7.40 ***			6.99 ***			2.86 ***		
$\forall\gamma_i$ equal			4.62 ***			5.90 ***			1.52	
$\forall\gamma_i = 0$			8.28 ***			7.29 ***			5.70 ***	

Table 3.11: The impact of capital controls on parity conditions in absolute values, Pound. This table reports the f-tests associated with the hypothesis that capital controls drive coefficients to zero, indicating monetary independence. Under the null $|\beta| = |\beta + \gamma|$, under the alternative capital controls drive coefficients either to zero (+), or away from zero (-). *Uncovered Interest Parity* refers to the coefficients from table 3.7 and *Forward Premia* refers to the coefficients from table 3.9. The columns represent the capital control dummy based on respectively Kaminsky and Schmukler (2003)(K & S), Miniane (2004), and the IMF dummy.
$*(\dagger), * *(\dagger\dagger), * * *(\dagger\,\dagger\,\dagger)$, indicates that $|\beta|$ is significantly larger(smaller) than $|\beta + \gamma|$ at the 10%, 5%, and 1% respectively.

Panel A: Uncovered Interest Parity

	K & S		MINIANE		IMF DUMMY	
Country	F-test	+/−	F-test	+/−	F-test	+/−
Denmark	2.16	+	0.62	+	0.95	+
France	2.60	+	0.39	+	0.90	+
Italy	0.11	+	0.10	+	0.45	+
Norway	2.21	+	1.24	+	0.34	+
Austria			1.50	+	5.17**	+
Portugal	0.00	-	0.38	-	0.34	-
Spain	0.02	-	0.25	+	0.75	+
Sweden	0.46	-	0.52	-	0.11	+

Sign test: 73.9% **of the cases has $|\beta| > |\beta + \gamma|$

Panel B: Forward Premia

	K & S		MINIANE		IMF DUMMY	
Country	F-test	+/−	F-test	+/−	F-test	+/−
Denmark	0.86	+	5.73**	+	5.01**	+
France	23.19†††	-	1.57	-	0.37	+
Italy	0.00	-	0.00	-	0.36	+
Norway	4.80**	+	4.42**	+	0.37	+
Austria			13.50***	+	12.21***	+
Portugal	0.24	-	0.02	-	0.80	-
Spain	6.18**	+	7.77***	+	0.16	-
Sweden	2.15	+	2.91†	-	1.94	+

Sign test: 60.9% of the cases has $|\beta| > |\beta + \gamma|$

Table 3.12: The impact of capital controls on parity conditions in absolute values, Deutsche Mark.
This table reports the f-tests associated with the hypothesis that capital controls drive coefficients to zero, indicating monetary independence. Under the null $|\beta| = |\beta + \gamma|$, under the alternative capital controls drive coefficients either to zero (+), or away from zero (-). *Uncovered Interest Parity* refers to the coefficients from table 3.8 and *Forward Premia* refers to the coefficients from table 3.10. The columns represent the capital control dummy based on respectively Kaminsky and Schmukler (2003)(K & S), Miniane (2004), and the IMF dummy. $*(\dagger), **(\dagger\dagger), ***(\dagger\,\dagger\,\dagger)$, indicates that $|\beta|$ is significantly larger(smaller) than $|\beta + \gamma|$ at the 10%, 5%, and 1% respectively.

Panel A: Uncovered Interest Parity

	K & S		MINIANE		IMF DUMMY	
Country	F-test	+/−	F-test	+/−	F-test	+/−
Denmark	2.16	+	0.69	+	0.18	+
France	1.36	+	1.01	+	0.42	+
Italy	0.14	+	0.36	+	3.07*	+
Norway	0.70	+	0.14	+	0.03	+
Austria			1.38	+	1.06	+
Portugal	1.44	-	0.01	-	0.16	-
Spain	1.01	-	0.13	+	1.90	+
Sweden	0.47	-	0.46	-	2.26	+

Sign test: 73.9% **of the cases has $|\beta| > |\beta + \gamma|$

Panel B: Forward Premia

	K & S		MINIANE		IMF DUMMY	
Country	F-test	+/−	F-test	+/−	F-test	+/−
Denmark	46.10***	+	36.77***	+	36.58***	+
France	1.01	-	0.64	-	0.22	-
Italy	0.07	+	0.04	+	5.52**	+
Norway	1.04	+	2.79*	+	0.28	+
Austria			0.92	+	0.97	+
Portugal	1.51	-	0.23	-	1.28	-
Spain	0.09	+	10.94***	+	0.72	+
Sweden	0.16	-	0.81	+	3.85**	+

Sign test: 69.6% *of the cases has $|\beta| > |\beta + \gamma|$

with two most influential currencies within Europe, the Pound Sterling and the Deutsche Mark (DM). The DM was seen by many as the unofficial leading currency within the EMS. Making the German financial markets an important anchor for the local governments. The Pound plays a less central role in the EMS, as England decided to step out of the exchange rate mechanism after the peg was broken in 1992. Still, it represents one of the major currencies in the world and the second largest economy in the EU. On a side note, both currencies were liberalized before 1983, isolating the effect of capital account liberalization in the host countries in the sample.

The results for the Pound and Mark regressions can be seen in tables 5 to 8. The cross rates show no significantly different story compared to the previous two tables. Most coefficients change only moderately. For the plain regressions without capital controls, the restricted coefficients are very much alike. The difference between the lowest and highest estimate is less than 0.15. The differences are somewhat bigger for the regressions that include the capital control variables. For the UIP regressions, the dispersion in the coefficients is smaller for the cross-rates than against the Dollar; most coefficients are closer to zero. For the forward unbiasedness regressions the opposite is the case. The coefficients are further away from zero, compared to the Dollar results. This is the case for both the negative values and positive values.

There are slight variations in the direction in which the capital controls work, but in most cases the direction is the same. Austria has a negative loading in the forward regression against the DM, versus positive coefficients elsewhere, while Italy has positive gamma's against the DM. For the other countries there is little evidence that capital controls have different effects on the exchange rates against different countries. The absolute value tests also yield very similar results to those of the dollar specification (tables 3.11 and 3.12; For the majority of the sample the results point towards slightly productive, but insignificant, capital controls. Even those results that are significant also point towards the (limited) effectiveness of capital controls.

As the three countries investigated represent three of the most important currencies in the sample, there is also little reason to assume that there are other currencies for which the results would differ. Therefore it seems that also under capital controls, the specifications are numraire-invariant. The gist of the results remains the same. There are some countries that may be able to create lower responsiveness of their exchange to interest rate differentials and forward rates with capital controls (Spain, Sweden, and Italy), but more countries actually experience a larger responsiveness. The latter group is also more pronounced in terms of size of the coefficients and significance. For the forward regressions, the average restricted γ is about 0.80.

3.5 Conclusion

In this chapter we investigate the link between capital controls and UIP and forward unbiasedness. One of the important reasons for governments to use capital controls is to maintain a degree of monetary independence. If capital controls indeed allow for

monetary freedom and exchange rate regulation simultaneously, this should result in deviations from parity conditions.

The results show that capital controls are not able to drive interest rates and forward rates (further) away from parity conditions. Instead there is slight evidence that capital controls increase the responsiveness of exchange rates to those variables. Moreover, there is also limited evidence that capital controls have a significant effect on the absolute responsiveness.

This is in contrast to the hypothesized effect of capital controls on exchange rates. Moreover it is in contrast to the objectives of the governments that employ capital controls. The results of this chapter show that governments might even have less room to set monetary policy if capital controls are employed, as shown by the coefficients that lie closer to parity conditions and further away from 0. Moreover, the results show that there is little to no difference between developing countries and developed countries in the effects of the capital controls. This is in line with other papers that find that capital controls might actually reach the opposite effect than what they are implemented for. Glick and Hutchison (2005) find for instance that capital controls increase the likelihood of a speculative attack and a currency crisis; this while many governments employ controls in the hope they insulate their economy from currency crises.

These results once more accentuate that governments should not overestimate the effects of capital controls and even consider that they can backfire. Recent history has provided us with just such an example where capital controls backfired; the capital controls imposed by Thailand in December 2006 come to mind. Thailand was forced to back down on its newly imposed controls within a day, after the Thai stock market crashed. This works as a reminder to those considering capital controls: 'caveat emptor', or let the user of capital controls beware.

Chapter 4

The Effect of Capital Controls on Exchange Rate Risk*

4.1 Introduction

Recent history has shown that large swings in the exchange rate are not uncommon: from the Asian tigers to Russia and Argentina, most emerging markets have experienced a currency crash during the last decade of the 20th century. However, investors and policymakers typically dislike large and abrupt exchange rate fluctuations. Especially large depreciations of the domestic currency are met with concern. Calvo and Reinhart (2002) document an endemic 'fear of floating'. Although many countries officially moved away from a fixed exchange rate to a floating regime, they find that many countries still actively use policy measures to control the exchange rate movements. This 'fear of floating' is rooted in the fact that large exchange rate swings come at a cost. Bordo, Eichengreen, Klingebiel, and Martinez-Peria (2001) have calculated that the average currency crisis entails a cost of around 8 to 9% of GDP for the second half of the twentieth century.

Imposing capital controls constitutes one of the most far reaching policy measures to control exchange rate movements. Capital controls enable governments to directly limit the possibility to speculate on the currency. Although capital controls might seem a tool too heavy to use to smooth exchange rate returns, many countries do seem to use them for — at least partly — this reason. (De Grauwe, 2000; von Hagen and Zhou, 2005)

This chapter investigates to what extent capital controls succeed in curbing extreme currency fluctuations. There is already a body of literature on the effectiveness of capital controls. However, earlier studies mainly focused on Chile (see for instance

*Part of this chapter is based on Versteeg and Straetmans (2008)

De Gregorio, Edwards, and Valdes, 2000; Edwards and Rigobon, 2005; Herrera and Valdes, 1999)[1]. These papers established that the effects of the Chilean capital controls on the exchange rate were limited. Taking a wider cross-section of countries that includes both developed and emerging markets constitutes a first contribution of this study. The second contribution constitutes the application of statistical extreme value analysis (EVT) to measuring the impact of capital controls on the tail behavior of currency returns (extreme events). It is well known that financial returns — forex returns do not constitute an exception — are nonnormally distributed and exhibit "heavy tails", see e.g. Mandelbrot (1963) for an early reference. Loosely speaking, the heavy tail feature implies that the empirical distribution of exchange rate returns contains more probability mass in the tails than under the normal. The tail decay of heavy tailed processs is typically characterized by a Pareto law whereas the tail probabilities of normally distributed processes decline exponentially to zero. The parameter governing the Pareto tail decline is the well known "tail index" and fluctuates between 2 and 4 for most financial returns. For earlier applications of EVT to the tails of exhange rate returns, see e.g. Koedijk, Schafgans, and De Vries (1990); Koedijk, Stork, and De Vries (1992) or Hols and De Vries (1991). More recent applications of EVT in the economic literature include the identification of currency crises (Pozo and Amuedo-Dorantes, 2003; Haile and Pozo, 2006) and the measurement of extreme linkages between markets (Straetmans, Verschoor, and Wolff, 2008; Quintos, Fan, and Phillips, 2001).

Although extreme value analysis has gained ground in the literature, studies that tests for the structural stability of tail risk are relatively rare. Koedijk, Schafgans, and De Vries (1990) tested whether the introduction of the European Monetary System had a dampening effect on forex tail risk. More recently, Candelon and Straetmans (2006) apply an endogenous structural change test to find out whether breaks in the tail index coincide with shifts in foreign exchange rate regimes. Structural breaks in forex tail risk around periods of financial liberalization constitute relevant info for both policymakers and investors. To governments, breaks signal whether their policies were effective and desirable. To investors, breaks in tail risk imply that that they need to update their information on the Value-at-Risk (VaR) of their currency trading portfolio's.

Anticipating on the results, we find that capital controls are not effective in reducing the potential for extreme forex depreciations. Instead, periods of capital controls are associated with larger exchange rate depreciations. The rest of this chapter is structured as follows. In section 4.2 the EVT and the tail and quantile estimators are described. The dataset is explained in section 4.3. All the results are presented in section 4.4 and 4.5 ends with the concluding remarks.

[1]The unremunerated reserve requirement of Chile is, together with the Malaysian controls, the most well-known example of capital controls.

4.2 Theory

Consider a stationary sequence $X_1, X_2, \ldots, X_n$ of independent and identically distributed (i.i.d.) random variables with a cumulative distribution function F (c.d.f. F). Define the maximum of this sequence of random draws by:

$$M_n = max\left(X_1, X_2, \ldots, X_n\right). \tag{4.1}$$

The probability that this maximum is below an arbitrary level x is given by

$$P\left\{M_n \leq x\right\} = F^n(x). \tag{4.2}$$

Extreme value theory studies the limiting distribution of the (appropriately scaled) order statistic M_n. Under fairly general conditions there exists a limiting asymptotic d.f. $G(x)$ that characterize extreme values:

$$P\{a_n(M_n - b_n) \leq x\} \xrightarrow{w} G(x), \tag{4.3}$$

This "extreme value" d.f. $G(x)$ can take three functional forms: one has thin tails (Gumbel), one is bounded from above (Weibull), and one is characterized by fat tails (Fréchet) . Exchange rate returns do exhibit fat tails and are in principle unbounded, which leaves the Fréchet distribution as the only relevant distribution:

$$G(x) = \begin{cases} 0 & , \quad x \leq 0 \\ e^{-x^{-\alpha}} & , \quad x > 0. \end{cases} \tag{4.4}$$

Where α represents the tail index. The lower the value of the tail index α, the slower the probability density's decay as one moves further in the tail. This indicates a higher probability mass concentrated in the tails and hence fatter tails. Additionally, the tail index α can be interpreted as the maximum amount of bounded moments[2]. Different heavy tailed distributions all exhibit this common limiting behavior, e.g. the class of symmetric stable stable distributions ($\alpha < 2$), the student-t distribution or the GARCH process. However, when studying the tail behavior, we do not need to know which parametric heavy tailed model is effectively valid over the full distributional support.

To estimate the tail index α, we will employ the popular Hill (1975) estimator. Let $X_{(1)} \leq X_{(2)} \leq \ldots \leq X_{(n)}$ be the ascending order statistics of the sequence of r.v. $X_1, X_2, \ldots, X_n$. The Hill statistic is then defined as:

$$\hat{\alpha_n} = \left[\frac{1}{m}\sum_{j=0}^{m-1}\left(lnX_{(n-j)} - lnX_{(n-m)}\right)\right]^{-1}, \tag{4.5}$$

where m is the number of highest order statistics. Further details on the Hill estimator and related procedures to estimate the tail index are provided in Jansen and

[2]Consequently, a tail index lower than 2 implies that the 2^{nd} moment (variance) of the unconditional distribution function does not exist.

De Vries (1991) or the monograph by Embrechts, Klüppelberg, and Mikosch (1997). Notice that the estimation approach is semi-parametric in nature in the sense that we only have to know the value of the threshold parameter m and the order statistics in order to calculate the estimator.

The selection of the number of highest order statistics m constitutes an important problem in extreme value analysis. Loretan and Phillips (1994) and Embrechts, Klüppelberg, and Mikosch (1997) suggest to pick m in a region where the estimate of α is more or less stable. One knows that such a region exists because of the well known bias-variance tradeoff for tail estimators like the Hill statistic More formally, one chooses m such that the asymptotic mean-squared error (AMSE) of the estimate is minimized (Goldie and Smith, 1987). This study uses the Beirlant, Dierckx, Goegebeur, and Matthys (1999) algorithm to select m[3].

Upon knowledge of the tail index estimate $\widehat{\alpha}$, we would also like to estimate the accompanying quantiles at the boundary of the historical sample or beyond. Given a very small exceedance probability $p \sim 1/n$, the tail quantile estimator $\widehat{q}\,(p)$ formulated in de De Haan, Jansen, Koedijk, and De Vries (1994) reads

$$\widehat{q} = X_{(n-m)} \left(\frac{m}{pn} \right)^{\frac{1}{\widehat{\alpha}}}, \tag{4.6}$$

and where the "tail cut-off point" $X_{n-m,n}$ is the $(n-m)$-th ascending order statistic (or loosely speaking the m-th smallest return) from a sample of size n such that $q > X_{n-m,n}$. At first sight, the quantile results may seem redundant once the tail index has been reported. However, looking at definition (4.6) it can be seen that q_p is both a function of the tail index α as well as of the scale parameter $X_{(n-m)}$. Estimators of the tail index, such as the Hill estimator used here, are scale invariant, however. Thus it might very well be that there are no significant shifts in α while there are shifts in q_p, or vice versa[4].

We are not only interested in the values of the tail indexes and quantiles themselves, but rather the parameter stability over the two different capital account regimes. Temporal constancy tests for (4.5) and (4.6) are fairly easily established upon knowing he asymptotic behavior of these two estimators. Asymptotic normality has been established for both estimators under fairly general conditions (mainly the requirement that return series are identically and independently (i.i.d.) distributed and thus do not exhibit any nonlinear dependence over time). More specifically, for $m/n \to 0$ as $m, n \to \infty$, it has been shown that the tail index statis-

[3]Loosely speaking, this technique requires running an exponential regression model (ERM) on the basis of the scaled log-spacings between the subsequent extreme order statistics from a Pareto-type distribution. The Ordinary Least Squares (OLS) that can be run on this data returns the empirical AMSE for different values of m. Where m will be chosen at the minimum of the empirical AMSE.

[4]Intuitively this makes sense. Lets consider two sequences of i.i.d. student-t distributions with the same degrees of freedom $\nu_1 = \nu_2 = \nu$, but with $\sigma_1^2 > \sigma_2^2$. Both will be characterized with the same value of the tail index α, which is given by ν. At the same time $X_{(n-m),1}$ will be larger than $X_{(n-m),2}$, given the larger variance of the first s.r.v.; ergo, $q_{p,1} > q_{p,2}$. The converse also holds true. If $\sigma_1^2 = \sigma_2^2$, but $\nu_1 < \nu_2$, $q_{p,1}$ will also be larger than $q_{p,2}$.

tic $\sqrt{m}\,(\widehat{\alpha}-\alpha)$ and tail quantile statistic $\frac{\sqrt{m}}{\ln\left(\frac{m}{pn}\right)}\left[\frac{\widehat{q}(p)}{q(p)}-1\right]$ are both asymptotically normal, see e.g. Hall (1982) or Haeusler and Teugels (1985) for the former result and De Haan, Jansen, Koedijk, and De Vries (1994) for the latter result. Structural change tests for estimates of the tail index α and the tail quantile q can now be based on the following statistics

$$T_\alpha = \frac{\hat{\alpha_1} - \hat{\alpha_2}}{\sqrt{\frac{\hat{\alpha_1^2}}{m_1} + \frac{\hat{\alpha_2^2}}{m_2}}}, \tag{4.7}$$

and

$$T_q = \frac{\hat{q_{p,1}} - \hat{q_{p,2}}}{\sqrt{\left[\frac{1}{\alpha_1\sqrt{m}} q_{p,1} \ln\left(\frac{m_1}{pn_1}\right)\right]^2 + \left[\frac{1}{\alpha_2\sqrt{m}} q_{p,2} \ln\left(\frac{m_2}{pn_2}\right)\right]^2}}. \tag{4.8}$$

One can safely assume that the above test statistics come sufficiently close to normality for the relatively large empirical sample sizes employed in this study, see e.g. Hall (1982), Embrechts, Klüppelberg, and Mikosch (1997) or Hartmann, Straetmans, and De Vries (2004).

4.3 Data

We use nominal bilateral exchange rates for European and emerging currencies against the US $. Data are downloaded from Datastream. The European currency data start on January 1^{st} 1973 and ends at December 31^{st} 1998 (introduction of the euro)[5]. The starting point of the emerging country data differs from currency to currency due to unavailability of data. The data runs until December 31^{st} 2006, the last year for which we have capital control data available. Table 4.2, in the results section, reports the exact number of observations available for the complete sample and both subsamples.

We date financial liberalization using the annual dummy from the IMF Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). It is the most widely used capital control proxy. After 1996, the IMF replaced the dummy variable by a new type of proxy that extends their coverage of capital controls. As an alternative, we therefore follow the procedure of Mody and Murshid (2005) and Chinn and Ito (2006) to complete the dummy series for the post-1996 era.

As for the European countries we employ the more detailed liberalization datings of Kaminsky and Schmukler (2003) and Miniane (2004). Data limitations prevent the use of those two indices for the emerging economies. The liberalization dates are summarized in table 3.1.

Kaminsky and Schmukler (2003)(henceforth K & S) indicate, for each year, whether a market is either 'repressed', 'partially liberalized', or 'fully liberalized'. The degree of control on the capital account is measured by monitoring regulations

[5]Given that most countries in the European sample are part of the Euro, post 1998 data do not exhibit much cross-sectional variation.

on offshore borrowing, multiple exchange rate regimes, and controls specific to capital outflows. A market is deemed 'fully liberalized' if there are no multiple exchange rates or restrictions on outflows, and only minor impediments to offshore borrowing. For this study we date the liberalization as the periods in which the markets are classified 'fully liberalized'.

$$CAP_{i,t}^{K\&S} = \begin{cases} 0, & \text{if KS = 'fully liberalized';} \\ 1, & \text{else.} \end{cases} \tag{4.9}$$

Miniane (2004) has developed an index comprised of 13 segments, which include capital markets, direct investment, financial institutions, and multiple exchange rates. The liberalization score is given by $\frac{n}{13}$, with n the number of controls in place. A score of 0 indicates a fully liberalized market, and a score of 1 a fully closed market. None of the countries achieve a score of 0 (the US for instance has a score of 0.29) and the capital control proxy's histogram exhibits two modes around 0.2 (open) and 0.8 (closed). We therefore classify all economies with a score of less than 0.5 as open, and economies with scores equal to or above 0.5 as closed (equation 4.10)[6]:

$$CAP_{i,t}^{Miniane} = \begin{cases} 0, & \text{if Miniane} < 0.5 \\ 1, & \text{if Miniane} \geq 0.5. \end{cases} \tag{4.10}$$

Like the dummy variable, Miniane (2004) is based on the AREAER and only reports annually. We therefore make the simplifying assumption that all liberalizations reported have taken place at January $1^s t$

4.4 Results

4.4.1 Unconditional Volatilities

As a benchmark for the rest of the analysis we start with reporting unconditional standard deviations for liberalized and controlled periods of the capital account. Table 4.1 reports annualized standard deviations of daily exchange rate returns under both regimes, together with the Goldfeldt-Quandt test for heteroskasticity (the null hypothesis being that the unconditional standard deviation stays constant across subsamples). The emerging countries have on average a higher annualized standard deviation than the European countries, which is not surprising given the fact that emerging countries are more prone to currency crises, and tend to have larger swings in inflation and interest rates.

When looking at the temporal changes in standard deviations, almost all markets show larger movements in returns when markets are controlled. All European currencies experience a drop in volatility after liberalization around 2 percent. As for the emerging market volatilities, only Lebanon, Malaysia, and Mexico experienced lower volatility when capital controls were in place.

[6]The results are not sensitive to varying the cut off point over the interval [0.45; -0.55]

Table 4.1: The impact of capital controls on unconditional variances.
This table reports reports the unconditional standard deviations for the daily exchange rate returns. The two left columns report the annualized standard deviation of the daily exchange rate returns; the left column representing the controlled regime and the right column the liberalized regime. For each country, the regime with the highest standard deviation is marked with a dagger. The two right columns report the variance ratio and the Goldfeld-Quandt test for heteroskedasticity. A *, **, or *** indicates rejection of homoskedasticity at a 10, 5, or 1 percent significance level respectively.

Panel A: Developed Countries						
Country	Std. Con.		Std. Lib.		Variance Ratio	
Austria	12.87%	†	11.70%		1.21	***
Denmark	12.16%	†	11.44%		1.13	***
France	12.58%	†	10.72%		1.38	***
Italy	12.42%	†	10.70%		1.35	***
Norway	11.14%		11.36%	†	1.04	
Portugal	13.99%	†	11.00%		1.62	***
Spain	13.02%	†	10.56%		1.52	***
Sweden	15.82%	†	13.12%		1.45	***
Panel B: Emerging Countries						
Country	Std. Con.		Std. Lib.		Variance Ratio	
Chile	17.72%	†	9.49%		3.48	***
Ecuador	23.45%	†	14.52%		2.60	***
Egypt	12.42%	†	6.95%		3.19	***
El Salvador	18.96%	†	5.26%		12.00	***
Gambia	18.48%	†	13.43%		1.89	***
Guyana	39.57%	†	11.55%		11.74	***
Honduras	25.80%	†	16.15%		2.55	***
Indonesia	31.12%	†	15.54%		4.01	***
Jamaica	28.93%	†	11.64%		6.18	***
Jordan	14.84%	†	1.13%		171.20	***
Lebanon	1.40%		30.41%	†	469.58	***
Malaysia	7.61%		15.77%	†	4.29	***
Mexico	8.57%		32.77%	†	14.62	***
Trin. & Tob.	20.88%	†	10.03%		4.34	***
Uruguay	27.21%	†	19.60%		1.93	***
Venezuela	32.55%	†	29.96%		1.18	***
Zambia	44.85%	†	17.08%		6.89	***

At first sight the finding that exchange rate volatility is higher under regimes of capital account regulation might seem counterintuitive; indeed when a capital tax is included in standard theoretical models of the exchange rate such as the Dornbusch model, capital controls are shown to have a *decreasing* effect on exchange rate volatility (Frankel, 1996; Frenkel, Schmidt, Stadtmann, and Nickel, 2002). However, other empirical studies also find higher exchange rate risk in the presence of capital controls. Capital controls increase the probability of a currency crisis occurring (Glick and Hutchison, 2005). A study on the Chilean Unremunerated Reserve Requirement (URR) also shows that for this control the unconditional exchange rate volatility increases with the size of the control (Edwards and Rigobon, 2005).

The problem with standard deviations as a measure of exhange rate risk is that they assume tail symmetry of the forex return distribution. However, the incidence of extreme appreciations and depreciations is not necessarily the same which might distort measures that equally weight upward and downward movements like the standard deviation. Moreover, we know that exchange rate returns are nonnormally distributed and exhibit more tail probability mass than under the normal. Given the interpretation of the tail index as reflecting the maximal number of distributional moments that is defined and bounded (cf. theory section), it follows that processes with α below 2 do not exhibit finite variance; but tail characteristics like the tail index and resulting extreme quantiles can still be calculated.

4.4.2 Tail Indices

Table 4.2 reports Hill-estimates for the data set of emerging and developed currency returns. The reported $\widehat{\alpha}$ refer to the right tail of the return distribution, i.e., the extreme depreciation tail. We further distinguish between full sample and subsample (controlled and liberalized) results. As concerns the full sample results, the European countries show tail indexes between 3.0 and 4.1, while the emerging countries have estimates ranging between 1.5 and 2.3. These results are in line with previous studies such as Koedijk, Stork, and De Vries (1992). Strikingly, emerging countries exhibit lower tail indices than developed currencies and often even falling below 2 which suggests that the variance for these series may not be defined.

The European currency tail indices significantly increase after liberalization at the 1% level for a majority of cases. The jumps in α also seem economically significant: on average the $\alpha's$ increase with almost 2 units. In the controlled period the developed currency average is 3.3 — almost equal to the lowest observation in the complete period; whereas the average jumps to 5.3 in the liberalized period. Moreover, the result is robust to the choice of the liberalization variable. Using the more advanced measures of Miniane (2004) and Kaminsky and Schmukler (2003), the signs of the differences do not change, and the magnitude and significance levels are also roughly similar, with most countries still showing a significant change at the 1% level (the results are given in table 4.5 in the appendix).

In the emerging sample the evidence is more mixed. Lebanon, Malaysia, and Mexico show higher values of the tail index, i.e. thinner tails, when capital controls

Table 4.2: The impact of capital controls on the tail index.
This table reports the tail index estimates α based on the Hill-estimator. The complete sample is split into the part with capital controls — *con* —, and the liberalized sample — *lib*. Sample sizes n and the number of order statistics m used to calculate the Hill-estimator are reported in the first four columns. m is calculated on the basis of Beirlant et al. (1999). The t-statistic $\tau_{\alpha_{con}=\alpha_{lib}}$ tests for the equality of the tail index in both samples. A *, **, or *** refers to the rejection of the null at a 10, 5, or 1 percent significance level respectively.

Panel A: Developed Countries								
	n_{con}	m_{con}	n_{lib}	m_{lib}	α	α_{con}	α_{lib}	$\tau_{\alpha_{con}=\alpha_{lib}}$
Austria	4695	116	4393	60	3.73	3.61	4.97	-1.88 **
Denmark	3913	63	5175	148	3.86	3.72	4.51	-1.33 *
France	5218	112	3870	70	3.45	3.37	6.39	-3.65 ***
Italy	5218	171	3870	85	3.50	3.01	5.90	-4.24 ***
Norway	5739	113	3349	140	3.09	3.21	4.20	-2.12 ***
Portugal	5218	179	3870	85	3.02	2.53	5.01	-4.31 ***
Spain	5479	160	3609	64	3.19	2.89	6.22	-4.11 ***
Sweden	5218	164	3870	63	3.80	3.73	5.51	-2.36 ***
Panel B: Emerging Countries								
	n_{con}	m_{con}	n_{lib}	m_{lib}	α	α_{con}	α_{lib}	$\tau_{\alpha_{con}=\alpha_{lib}}$
Chile	7306	463	781	20	1.87	1.75	6.15	-3.19 ***
Ecuador	3150	66	1304	58	1.04	1.73	1.73	0.01
Egypt	2107	38	2607	91	2.01	3.25	2.03	2.13 **
El Salvador	1847	110	2607	42	2.12	2.10	1.86	0.69
Gambia	542	47	3912	110	1.84	1.55	1.92	-1.25
Guyana	1847	159	2607	88	1.70	1.75	1.29	2.36 ***
Honduras	3150	153	1304	129	1.43	1.57	1.40	0.93
Indonesia	2607	249	6262	184	1.87	1.38	2.68	-6.04 ***
Jamaica	4692	320	2607	51	1.46	1.39	3.19	-3.96 ***
Jordan	3388	193	2346	151	1.13	2.22	1.78	2.01 **
Lebanon	2346	39	6523	647	1.31	4.13	1.21	4.41 ***
Malaysia	6262	222	2607	49	1.98	3.03	2.09	2.60 ***
Mexico	2868	82	6001	583	1.55	3.08	1.43	4.77 ***
Trin. & Tob.	4170	364	3129	153	1.73	2.01	1.70	1.76 **
Uruguay	2869	216	6000	176	1.61	1.51	2.33	-4.01 ***
Venezuela	4173	127	4696	270	1.99	2.30	1.69	2.69 ***
Zambia	6262	331	2607	118	1.65	1.60	2.33	-3.16 ***

are in place which seems in line with previous results on standard deviations[7].

On the other hand, and similar to the European outcomes, Chile, Indonesia, Jamaica, Uruguay, and Zambia all have thinner tails in the liberalized period (significant at the 1% level). Prior to liberalization all values for these countries were below 2, while after liberalization, they increase to levels above 2. In the case of Chile the tail index even rises above 6, indicating thinner tails than most developed countries. Egypts, Guyana, Jordan, and Venezuela are mixed cases with both significantly fatter tails and lower standard deviations after liberalization.

The results point into the same direction as those of Koedijk, Stork, and De Vries (1992) :they found that exchange rate returns have fatter tails under fixed exchange rate regimes than under floating exchange rate regime, both for a sample of EMS currencies as well as a number of emerging countries.

Although pegging the currency is not identical to imposing capital controls, both policy measures constitute an attempt by the government to exert (direct) control on the currency exchange. Through this control over the exchange market, the government increases the costs of investors to speculate in the exchange rate market and make it unattractive for speculators to arbitrage away small deviations from perceived equilibrium levels. However, once the exchange rate misalignment exceeds a critical level, a sudden large shift can be expected. In other words, exchange rate control may replace frequent small movements by infrequent large movements: tails become fatter.

4.4.3 Quantile Estimates

The unconditional variance and the tail index are useful intermediary concepts to express the risk that is present in the currency returns; but in the end what matters most to investors is how likely an extreme movement in the exchange rate of a given magnitude will be or, conversely, how large a sudden sharp drop in the exchange rate with a given probability of occurrence will be. The latter problem amounts to estimating the quantile of the unconditional distribution of exchange rate returns (One can also think of it as the unconditional Value-at Risk of an open position in forex). As we are interested in extreme movements of the exchange rate, we want to calculate quantiles close to the boundary of the historical sample. The marginal exceedance probabilities (or significance levels) are set equal to $1/0.5n$, $1/n$, and $1/2n$ (i.e., corresponding with extreme quantiles that are in-sample, at the boundary of the sample and out-of-sample, respectively).

For the developed countries, the number of observations per sub sample varies between 3,600 and 5,500. The probability levels are calibrated to approximately $\frac{1}{2{,}500} \approx \frac{1}{0.5n}$, $\frac{1}{5{,}000} \approx \frac{1}{n}$, and $\frac{1}{10{,}000} \approx \frac{1}{2n}$, which corresponds to 0.04%, 0.02%, and 0.01% respectively. The sub samples sizes of the emerging countries are much more

[7]The results for Malaysia, however, might be due to the IMF classification of capital controls. According to the IMF AREAER, Malaysia was liberalized at the time of the Asia crisis, when it experienced most volatility; however, Malaysia did reimpose temporary controls during the crisis; in fact it is one of the most quoted examples of the use of controls on outflows. This makes the interpretation of the results for this country very difficult.

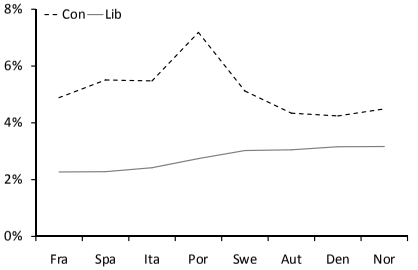
Table 4.3: The impact of capital controls on quantiles, developed countries.
This table reports the quantile estimates q based on different exceedance probabilities p. These exceedance probabilities roughly correspond to $1/0.5n$, $1/n$, and $1/2n$. The complete sample is split into the part with capital controls – *con* –, and the liberalized sample – *lib*. The t-statistic $\tau_{q_{con}=q_{lib}}$ tests for the equality of the quantiles in both samples. A *, **, or *** refers to the rejection of the null at a 10, 5, or 1 percent significance level respectively. Sample sizes and the number of order statistics are equal to those reported in table 4.2.

	p = 0.04%				p = 0.02%				p = 0.01%			
Country	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$
Austria	3.97%	4.34%	3.05%	2.40***	4.78%	5.26%	3.51%	2.32**	5.76%	6.37%	4.03%	2.25**
Denmark	3.78%	4.24%	3.16%	1.85**	4.52%	5.11%	3.68%	1.72**	5.41%	6.16%	4.29%	1.62*
France	4.20%	4.88%	2.27%	4.60***	5.14%	6.00%	2.53%	4.26***	6.28%	7.37%	2.82%	3.98***
Italy	4.20%	5.47%	2.42%	4.80***	5.12%	6.89%	2.72%	4.52***	6.24%	8.67%	3.06%	4.28***
Norway	4.46%	4.49%	3.17%	2.23**	5.58%	5.57%	3.73%	2.16**	6.98%	6.91%	4.41%	2.10**
Portugal	5.12%	7.18%	2.74%	4.57***	6.44%	9.44%	3.15%	4.29***	8.10%	12.41%	3.61%	4.04***
Spain	4.45%	5.51%	2.28%	4.82***	5.53%	7.00%	2.55%	4.53***	6.87%	8.90%	2.85%	4.28***
Sweden	4.60%	5.12%	3.02%	3.94***	5.52%	6.16%	3.43%	3.71***	6.63%	7.42%	3.89%	3.53***

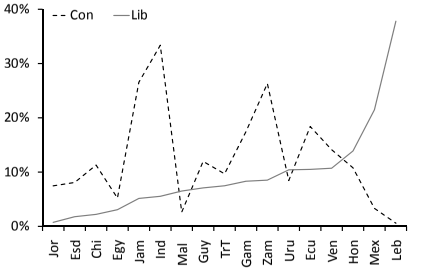
Table 4.4: The impact of capital controls on quantiles, emerging countries.
This table reports the quantile estimates q based on different exceedance probabilities p. These exceedance probabilities are constructed as follows: ,$p = 0.1\%$ corresponds to roughly $1/2n$ for the small samples, $p = 0.01\%$ corresponds to a bit more than $1/2n$ for the large subsamples, while $p = 0.04\%$ is somewhere in between. The complete sample is split into the part with capital controls – *con* –, and the liberalized sample – *lib*. The t-statistic $\tau_{q_{con}=q_{lib}}$ tests for the equality of the quantiles in both samples. A *, **, or *** refers to the rejection of the null at a 10, 5, or 1 percent significance level respectively. Sample sizes and the number of order statistics are equal to those reported in table 4.2.

	p = 0.1%				p = 0.04%				p = 0.01%			
Country	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$
Chile	9.7%	11.3%	2.2%	7.14***	15.9%	19.1%	2.6%	6.36***	33.3%	42.1%	3.2%	5.37***
Ecuador	48.3%	18.4%	10.5%	1.58*	116.3%	31.2%	17.8%	1.23	438.5%	69.6%	39.8%	0.92
Egypt	6.0%	5.2%	3.1%	2.26**	9.4%	6.9%	4.8%	1.20	18.7%	10.6%	9.6%	0.26
El Salvador	5.4%	8.1%	1.8%	4.06***	8.3%	12.5%	2.9%	3.22***	16.0%	24.2%	6.1%	2.41***
Gambia	9.3%	17.4%	8.3%	1.23	15.3%	31.5%	13.4%	1.12	32.6%	76.9%	27.7%	0.99
Guyana	8.9%	12.0%	7.1%	1.53*	15.2%	20.2%	14.4%	0.80	34.2%	44.7%	42.4%	0.09
Honduras	13.2%	10.8%	13.9%	-0.69	25.0%	19.3%	26.7%	-0.71	66.1%	46.7%	71.6%	-0.72
Indonesia	11.7%	33.4%	5.5%	3.96***	19.1%	64.9%	7.8%	3.48***	40.0%	177.7%	13.1%	2.93***
Jamaica	20.0%	26.5%	5.1%	4.70***	37.5%	51.2%	6.9%	4.17***	96.9%	138.7%	10.6%	3.52***
Jordan	25.0%	7.5%	0.7%	6.79***	56.3%	11.3%	1.2%	5.46***	191.9%	21.1%	2.7%	4.17***
Lebanon	25.7%	0.6%	37.8%	-6.59***	51.8%	0.7%	80.6%	-5.53***	149.7%	1.0%	253.4%	-4.44***
Malaysia	4.7%	2.6%	6.5%	-2.94***	7.5%	3.6%	10.1%	-2.44***	15.0%	5.6%	19.6%	-1.98**
Mexico	14.8%	3.3%	21.5%	-6.32***	26.8%	4.5%	40.8%	-5.57***	65.7%	7.0%	107.6%	-4.68***
Trin. & Tob.	11.0%	9.7%	7.5%	1.23	18.7%	15.3%	12.8%	0.68	41.8%	30.4%	28.9%	0.15
Uruguay	15.4%	8.4%	10.4%	-0.99	27.3%	15.4%	15.4%	0.00	64.6%	38.6%	28.0%	0.84
Venezuela	13.4%	14.1%	10.7%	1.40*	21.3%	21.0%	18.4%	0.53	42.8%	38.4%	42.0%	-0.28
Zambia	21.2%	26.3%	8.5%	4.67***	36.9%	46.7%	12.6%	4.16***	85.6%	111.2%	22.9%	3.59***

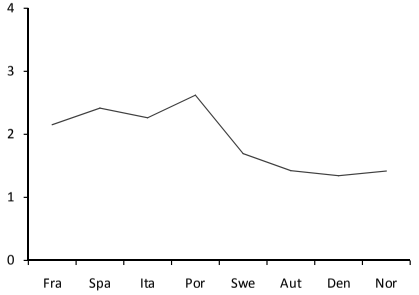
Figure 4.1: Quantiles before and after financial liberalization.
This figure plots the empirical quantiles at $1/0.5n$ for the developed (0.04%) and emerging (0.1%) countries. The countries have been ordered according to their estimated quantile in the liberalized period (lowest on the left, highest on the right). The solid line plots the quantile post liberalization and the dashed line the quantiles pre liberalization. The lower panel plots the ratio between the two quantile, with values above 1 indicating higher quantiles pre liberalization. The left panel includes the European countries: France (FRA), Spain(SPA), Italy (ITA), Portugal (POR), Sweden (SWE), Austria (AUT), Denmark (DEN), and Norway (NOR). The right panels include the emerging economies: Jordan (JOR), El Salvador (ESD), Chile (CHI), Egypt (EGY), Jamaica (JAM), Indonesia (IND), Malaysia (MAL), Guyana (GUY), Trinidad and Tobago (TRT), Gambia (GAM), Zambia (ZAM), Uruguay (URU), Ecuador (ECU), Venezuela (VEN), Honduras (HON), Mexico (MEX), and Lebanon (LEB).



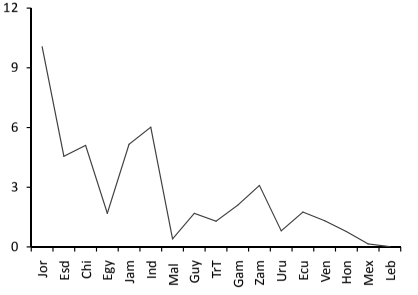
(a) Quantiles, developed



(b) Quantiles, emerging



(c) Ratio q_{con}/q_{lib}, developed



(d) Ratio q_{con}/q_{lib}, emerging

heterogeneous, making it more difficult to pick probabilities that lie close to the historical sample boundary. The emerging country significance levels are set to $\frac{1}{1,000}$ (0.1%), $\frac{1}{2,500}$(0.04%), and $\frac{1}{10,000}$ (0.01%)[8].

The full sample and subsample quantile estimates for developed and emerging currencies are given in tables 4.3 and 4.4, respectively. Table 4.6 in the appendix reports estimate developed currency quantiles using two alternative liberalization dates[9]. As an example how to interpret the numbers, consider the quantiles estimated for Austria. Given a probability of 0.04%, the quantile of Austria is 3.97% for the whole sample. That is, a daily (log) depreciation *larger* than 3.97% is observed with a probability of only 0.04%, i.e., once every $(1/0.0004)/360 \approx 7$ years.[10] Unsurprisingly the (full sample) quantiles for the emerging countries (table 4.4) are much larger than those of the European countries. For the full sample and $p = 0.04\%$ the developing currency quantiles fluctuate between 7.5% (Malaysia) and 116.3% (Ecuador), while the European currency quantiles hoover in between 3.78% (Denmark) and 5.12% (Portugal).

If one compares the 'controlled' and 'liberalized' quantiles one clearly sees that most countries exhibit a stronger propensity towards extreme depreciations when capital controls are present. For all European countries, quantiles significantly drop after financial liberalization (table 4.3 and 4.6. For quantiles further in the tail, the statistical significance of the structural change test results is less striking but still present. Furthermore, the tables and figure 4.1 illustrate the economic significance of the break. First, for the European countries, the quantiles for a 0.01% probability in a liberalized period are still below the quantiles for a 0.04% probability when markets were controlled. Thus an extreme event which occurred on average only once every 28 years in liberalized markets, happens more than once every 7 years if capital controls are in place. Alternatively, if the probabilities are kept constant, a once in 7 years downward movement is slightly less than twice (1.9 on average) as large before liberalization compared to the period after liberalization. This ratio only becomes larger as we move further in the tail, as the tails are fatter pre liberalization. Interestingly enough, it seems that the countries that have the highest exchange rate risk before liberalization, such as Portugal, Spain, and Sweden, are amongst those with the lowest risk after liberalization, i.e., financial liberalization does not seem to have the same effects on all countries.

For the sample of emerging countries (given in table 4.4 and figure 4.1) more than half of the countries show significant lower quantiles when the capital controls are liberalized. This result is somewhat tempered when we move further in the tail, but for most countries the drop in quantiles remains significant at the 1% level. The extent to which the risk drops after liberalization is remarkable. Looking

[8]The first probability is a proxy for $1/n$ for the smallest samples (2 samples have $n < 1,000$), while $\frac{1}{10,000}$ proxies for $1/n$ for the largest sample ($n = 7306$). In addition, two of the three probabilities chosen correspond to those chosen for the developed countries in order to facilitate comparisons between the two samples.

[9]As for emerging countries, there was only one proxy available for capital controls.

[10]As for the emerging currency quantiles, the reported quantile estimates are extreme events that are expected to occur once every 3.5(0.1%), 14(0.02%), and 28(0.01%) years.

at an event happening with an 0.1% probability (roughly speaking: once every 3 years) the expected depreciation decreases (on average) from 12.7% to 9.5%, or roughly 25%. Mexico and Lebanon stand out from the other countries and remain puzzling. These two countries have significantly higher quantiles after liberalization. In comparison to the other developing countries they show both very low quantiles before liberalization and amongst the highest quantiles after liberalization.

4.5 Conclusion

This chapter investigates the effect of financial liberalization on exchange rate risk. As many investors and regulators are particularly worried about sudden large exchange rate depreciations, we decided to exploit extreme value analyis (EVT) to proxy exchange rate risk by extreme depreciation quantiles that reflect small probability events. This study applies the EVT methodology to a wide cross-section of countries, spanning both European (developed) markets and emerging markets covering all continents.

The use of extreme value analysis (EVT) in empirical finance has steadily gained in popularity because it requires no distributional assumptions other than that the return tails contain more probability mass than the normal distribution, i.e., the 'heavy tail' feature. The performed quantile analysis enables one to distinguish between appreciations and depreciations, i.e., one does not need to impose tail symmetry as with the standard deviation. Moreover, foreign exchange return tails can contain so much probability mass that the variance is no longer defined (finite). In the latter case, an extreme depreciation quantile provides a proper alternative as a forex risk measure[11].

The results suggest that financial liberalization is associated with lower extreme depreciation quantiles and this for both developed and emerging economies. As a matter of fact, extreme quantiles are almost twice as high under capital controls as compared to the liberalized capital account regime. Not surprisingly, the drop in tail risk after liberalization is more spectacular for those countries that exhibited the fattest tails when capital control restrictions were still in place. The results are robust to different definitions of financial liberalization.

The results corroborate with previous empirical studies. Capital controls have been found to increase the probability of a currency crisis (Glick and Hutchison, 2005), which typically coincide with the most extreme currency fluctuations. Other forms of exchange rate control are also associated with thicker tails. Koedijk, Stork, and De Vries (1992) find that any degree of 'fixity' of the exchange rate is associated with lower values of α.

Thus, although many countries exhibit a fear of floating, their control over the exchange rate market does not decrease the incidence of big depreciations (or deval-

[11] More specifically, if the tail index α falls below 2, the variance is no longer defined but the quantiles calculated with EVT are still valid. Estimates of α for emerging currencies were often found to lie below 2, i.e., the reported standard deviation analysis is suspect and needed to be complemented with a methodology that explicitly takes into account the fat tailness of foreign exchange rate returns.

uations) of their currency. Even worse, the likelihood for large depreciations seems to increase. It is true that capital controls can be implemented to achieve other goals than curbing exchange rate risk. However, this study shows that capital controls are not a good instrument to decrease the risk of extreme depreciations.

4.A Appendix

Table 4.5: The impact of capital controls on the tail index, alternative proxy.
This table reports the tail index estimates α based on the Hill-estimator. Panel A contains the results with the liberalization dates based on the Miniane index, while panel B reports the results for the liberalization dates based on the Kaminsky & Schmukler index. The complete sample is split into the part with capital controls — *con* —, and the liberalized sample — *lib*. Sample sizes n and the number of order statistics m used to calculate the Hill-estimator are reported in the first four columns. m is set at 2.5% of the sample size. The t-statistic $\tau_{\alpha_{con}=\alpha_{lib}}$ tests for the equality of the tail index in both samples. A *, **, or *** refers to the rejection of the null at a 10, 5, or 1 percent significance level respectively.

Panel A: Miniane Index

Country	n_{con}	m_{con}	n_{lib}	m_{lib}	α	α_{con}	α_{lib}	$\tau_{\alpha_{con}=\alpha_{lib}}$
Austria	4695	116	4393	60	3.73	3.61	4.97	-1.88 **
Denmark	3913	63	5175	148	3.86	3.72	4.51	-1.33 *
France	4174	100	4914	118	3.45	3.08	4.69	-3.03 ***
Italy	3913	125	5175	160	3.50	3.15	3.69	-1.32 *
Norway	4174	266	4914	232	3.09	2.65	3.58	-3.23 ***
Portugal	4695	295	4393	127	3.02	2.34	3.96	-4.30 ***
Spain	4956	263	4132	136	3.19	2.75	3.92	-3.13 ***
Sweden	4174	283	4914	112	3.80	3.09	4.98	-3.75 ***

Panel B: Kaminsky & Schmukler Index

Country	n_{con}	m_{con}	n_{lib}	m_{lib}	α	α_{con}	α_{lib}	$\tau_{\alpha_{con}=\alpha_{lib}}$
Denmark	4109	68	4979	141	3.80	3.69	4.65	-1.62 *
France	4434	103	4654	112	3.45	3.17	4.74	-2.88 ***
Italy	4956	146	4132	125	3.50	3.24	3.75	-1.18
Norway	3913	249	5175	124	3.09	2.63	4.00	-3.45 ***
Portugal	5109	344	3979	101	3.02	2.37	3.96	-3.82 ***
Spain	2999	124	6089	154	3.19	2.18	4.39	-5.46 ***
Sweden	4174	283	4914	112	3.80	3.09	4.98	-3.75 ***

Table 4.6: The impact of capital controls on quantiles, alternative proxy.
This table reports the quantile estimates q based on different exceedance probabilities p. These exceedance probabilities roughly correspond to $1/0.5n$, $1/n$, and $1/2n$. Panel A reports the results with the liberalization dates based on the Miniane index, while panel B gives the results based on the Kamisnky & Schmukler index. The complete sample is split into the part with capital controls – *con* –, and the liberalized sample – *lib*. The t-statistic $\tau_{q_{con}=q_{lib}}$ tests for the equality of the quantiles in both samples. A *, **, or *** refers to the rejection of the null at a 10, 5, or 1 percent significance level respectively. Sample sizes and the number of order statistics are equal to those reported in table 4.5.

Panel A: Miniane index

	p = 0.04%				p = 0.02%				p = 0.01%			
Country	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$
Austria	3.97%	4.34%	3.05%	2.40 ***	4.78%	5.26%	3.51%	2.32 **	5.76%	6.37%	4.03%	2.25 **
Denmark	3.78%	4.24%	3.16%	1.85 **	4.52%	5.11%	3.68%	1.72 **	5.41%	6.16%	4.29%	1.62 *
France	4.20%	5.26%	2.98%	3.10 ***	5.14%	6.59%	3.45%	2.93 ***	6.28%	8.25%	4.00%	2.78 ***
Italy	4.20%	5.01%	3.77%	1.73 **	5.12%	6.24%	4.55%	1.65 **	6.24%	7.77%	5.49%	1.58 *
Norway	4.46%	5.19%	3.88%	1.88 **	5.58%	6.73%	4.71%	2.00 **	6.98%	8.74%	5.72%	2.08 **
Portugal	5.12%	7.54%	3.67%	3.83 ***	6.44%	10.14%	4.37%	3.77 ***	8.10%	13.64%	5.20%	3.69 **
Spain	4.45%	5.36%	3.58%	2.60 ***	5.53%	6.90%	4.28%	2.65 ***	6.87%	8.88%	5.10%	2.68 ***
Sweden	4.60%	6.21%	3.45%	4.13 ***	5.52%	7.78%	3.97%	4.04 ***	6.63%	9.73%	4.56%	3.95 ***

Panel B: Kaminsky & Schmukler index

	p = 0.04%				p = 0.02%				p = 0.01%			
Country	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$	q	q_{con}	q_{lib}	$\tau_{q_{con}=q_{lib}}$
Denmark	3.81%	4.29%	3.07%	2.13 **	4.57%	5.18%	3.56%	1.98 **	5.49%	6.25%	4.13%	1.87 **
France	4.20%	5.08%	2.94%	3.13 ***	5.14%	6.33%	3.40%	2.96 ***	6.28%	7.87%	3.93%	2.81 ***
Italy	4.20%	4.79%	3.68%	1.70 **	5.12%	5.93%	4.43%	1.62 *	6.24%	7.34%	5.34%	1.55 *
Norway	4.46%	5.26%	3.52%	2.41 ***	5.58%	6.85%	4.19%	2.53 ***	6.98%	8.91%	4.99%	2.59 ***
Portugal	5.12%	7.62%	3.48%	4.32 ***	6.44%	10.21%	4.14%	4.21 ***	8.10%	13.68%	4.94%	4.09 ***
Spain	4.45%	7.79%	3.21%	3.04 ***	5.53%	10.70%	3.76%	2.93 ***	6.87%	14.70%	4.40%	2.81 ***
Sweden	4.60%	6.21%	3.45%	4.13 ***	5.52%	7.78%	3.97%	4.04 ***	6.63%	9.73%	4.56%	3.95 ***

Part III

Financial Liberalization and Economic Development

Chapter 5

Capital Controls and Economic Growth: How Controls on Inflows and Outflows are Different*

5.1 Introduction

The spate of financial crises that hallmarked the 1990's has brought about a revival of the literature investigating the effect of financial liberalization. Many of the countries that were hit by crises, had just recently liberalized their capital account, casting a shade on the presumption that open capital markets were the way to go for emerging economies. At the same time several other countries showed good economic performance in the presence of or, in part, thanks to capital controls. This has caused many academics to take a more cautious stance on financial liberalization, and has brought

Out of many countries that use capital controls, two examples stand out. Following the onset of the Asia crisis, Malaysia took the bold step to implement capital controls on outflows. Rather than stepping to the International Monetary Fund (IMF; like Indonesia, South Korea, and Thailand), and engaging in a policy of austerity, Malaysia chose to take an unorthodox path. In September 1998, it fixed its exchange rate and forced down interest rates to reflate the economy. To prevent a flight of capital the country imposed sweeping controls on outflows of portfolio capital and put a halt to all off-shore currency trading in the Ringgit. In effect, the capital controls bought Malaysia time to stabilize its economy and prevent it from gliding from a 'good' equilibrium to a 'bad' equilibrium, much like described in the third generation crisis model by Krugman (1999a). Indeed, after the country

*Part of this chapter is based on Versteeg (2008)

recovered, Malaysia removed most of the controls in 1999 and 2001, leaving only the imposed ban on offshore trading in place.The evidence shows that the controls were indeed effective in sharply reducing off-shore trading in the Ringgit, and reducing the domestic interest rates (Doraisami, 2004) . Moreover, Kaplan and Rodrik (2002) provide some evidence that the Malaysian controls were effective in recovering the economy faster from the financial crisis than would have otherwise been the case.

At the other end of the spectrum, Chile imposed controls on capital inflows from 1991 to 1998, in the form of an unremunerated reserve requirement (URR). Rather than fearing capital outflows, Chile was faced with large amounts of capital flowing into the country in the late 80's and early 90's. Chile formed an attractive destination as it maintained high interest rates as part of a disinflation program. Faced with these large flows, Chile introduce the URR and through time continued to tweak these controls to close loopholes that were exploited by investors. The controls were imposed with the objective to decrease capital inflows and increase the maturity structure of these inflows; through this altered inflow of capital, the government aspired to create monetary autonomy and to limit the real appreciation of the currency. Although the controls were not effective in reducing the flow of capital, they did help the government to tilt maturity structure of the flow and affect the real exchange rate and interest rate differentials (De Gregorio, Edwards, and Valdes, 2000).

Besides these two examples, what does theory predict for financial liberalization and economic growth? From a neoclassical perspective, in a world with perfect capital markets, the case for international financial integration is clear. Free capital markets allow for a larger scope of diversification and thus lower portfolio risk for investors (Voth, 2003). In addition they lower the cost of capital for domestic firms and thus stimulate higher levels of investment (Bekaert and Harvey, 2000a)[1]. Moreover, most emerging economies have relatively low stocks of physical capital. The increase in capital — and subsequent increase in output — following financial liberalization, should make liberalization even more attractive to them.

However, the few papers that try to measure the welfare effects of the inflow of capital following liberalization find that the effects are rather modest at best. Mendoza and Tesar (1998a) report that for developed countries the welfare benefits of integration are less than 0.5% of permanent consumption. Even for emerging countries, which stand to gain most by financial integration, the effects are reported to lie around only 1% (Gourinchas and Tornell, 2004). When adding market distortions to the model, such as credit imperfections, the gains are even smaller (Matsuyama, 2004) or are even completely reversed (Boyd and Smith, 1997a).

The implication is that the *indirect* effects of liberalization are much more important for welfare creation than the increase in capital itself; it is the efficiency with which the capital is used that drives welfare, not the level of the capital stocks

[1]Combined with the simple observation that almost all of the developed world underwent financial liberalization, it is also not surprising that there are very little studies that postulate that capital controls are a first-best policy. One exception would be the paper by Brecher and Diaz-Alejandro (1977).

itself[2]. If this holds true, it makes sense for a country stimulate those types capital streams that can be allocated efficiently, whilst at the same time discouraging the types of capital that are deemed destabilizing to the economy.

However, the empirical literature has fared poor in trying to determine the effect of capital controls. Most of the studies that have investigated the effect of capital controls on economic growth have yielded inconclusive results[4]. In many cases the inclusion of capital controls yielded no significant results at all, while at other times different papers led to contradictory results. This has resulted in a situation where both proponents and opponents of capital controls cannot be satisfied with the results.

A lot of academics blame the lack of empirical results on the difficulty to get good data proxies available to measure capital controls. Many believe that the lacklustre results that have been obtained so far are not in itself a sign that capital controls have neither positive or negative effects, but rather that the current proxies fail to measure the capital controls that matter. Not surprisingly many academics have voiced the need for better measures to test the relationship between capital controls and growth.

This study addresses the problem by constructing a more precise measure of capital controls based on the new IMF annual report on exchange arrangements and exchange restrictions (AREAER). The measure developed in this chapter improves over older measures by specifically distinguishing between controls designated to deter capital inflows and those designed to deter capital outflows. Moreover, the capital control index can distinguish between capital controls on different types of capital, such as equity flows. The results show that the effect of capital controls on economic growth is dependent on the type of controls used by a country. Capital controls on capital inflows, such as used by Chile, have on average a positive effect on economic growth, while controls on outflows and equity markets are detrimental to economic growth. As previous studies did not disaggregate between these different types of controls, this is an explanation why they were not able to find significant effects.

The rest of the chapter is structured as follows. Section 5.2 describes the methodology used, while section 5.3 expands on the construction of the capital control variable as well as the rest of the data. section 5.4 reports on the results, and section 5.5 concludes .

[2]In the words of the debate on international growth convergence, it is total factor productivity that drives income differences rather than factor accumulation. This also leads to the conclusion that capital account liberalization fits into a bigger program of financial market reforms which should be 'sequenced'[3], and capital markets are generally seen as the last market that should be liberalized (Mishkin, 2001). Capital markets can only efficiently allocate capital if first fiscal imbalances are removed (Edwards, 1999), an efficient tax system is created (Drazen, 1989), trade markets are liberalized (McKinnon, 1973, 1991), corruption is brought under control (Bai and Wei, 2000), and a sound institutions are established (Mishkin, 2001).

[4]For a survey see Edison and Warnock (2003) and Eichengreen (2004)

5.2 Methodology

The growth effects of capital controls are tested within a neo-classical framework, based on the Swan-Solow and Ramsey-Cass-Koopmans models. In a pinch, the neo-classical growth framework predicts that the (log of) effective per capita output,$y^E_{i,t}$, of all economies converges from their initial states $y^E_{i,0}$ to the equilibrium level $y^E_{i,\infty}$.

$$y^E_{i,t} = (1 - e^{-\lambda t})y^E_{i,\infty} + e^{-\lambda t}y^E_{i,0}, \tag{5.1}$$

where λ is the rate of convergence across countries towards the equilibrium, and $y^E_{i,t}$ (and by analogy $y^E_{i,t}$ is defined as $(y_{i,t} - a_{i,t})$, the GDP per capita $(y_{i,t})$ per unit of technology $(a_{i,t})$.

By replacing $y^E_{i,t}$ by $(y_t - a_{i,t})$ and subtracting y_0, the specification changes to:

$$y_{i,t} - y_{i,0} = (a_t - a_0) + (1 - e^{-\lambda})a_0 + (1 - e^{-\lambda})y_{i,\infty} - (1 - e^{-\lambda})y_{i,0}, \tag{5.2}$$

$$\gamma_i = \alpha - \beta_i y_{i,\infty} + \beta_i y_{i,0}, \tag{5.3}$$

where the second equation is the reduced form of the structural model. The growth of technology $(a_t - a_0)$ and initial level of technology a_0 are subsumed in the intercept α and β equals $-(1 - e^{-\lambda})$. Classical models assumed that $y_{i,\infty}$ was equal across countries, as production factors would shift from country to country until marginal productivity per unit of labor and thus growth converges to the equilibrium, i.e. absolute convergence. The implication that λ is positive, and β negative, lies at the center of the economic growth literature.

Under the assumption that output follows a three sector Cobb-Douglas function involving, next to labor, also physical (K) and human (H) capital, $\beta_i y_{i,\infty}$ can be proven (see Durlauf, Johnson, and Temple, 2005) to be a loglinear function of $s_{K,i}$ and $s_{H,i}$, leading to the reduced form for the basic growth equation, with error term appended:

$$\gamma_i = \alpha + \gamma y_{i,0} + \phi_1 s_{K,i} + \phi_2 s_{H,i} + \epsilon_i. \tag{5.4}$$

However, there are more factors that influence economic growth due to their impact on the g_i. In other words, not every country is expected to grow at the same rate, even when they are growing at their equilibrium level. There are a number of factors, say Z_i, that can have an influence both on the equilibrium growth rate, but also on the initial level of production technology in a country. This extends the model further to:

$$\gamma_{i,t} = \alpha + \beta y_{i,0} + \phi X_i + \pi Z_i + \epsilon_i, \tag{5.5}$$

with X_i the vector containing $s_{K,i}$ and $s_{H,i}$

Barro (1991), amongst others, has done a lot of work in exploring the factors that lead to differences in the equilibrium growth path, including geographical, political, and economical factors into the standard neoclassical framework. The inclusion of these factors can help to bridge the discrepancy between the theory that countries should converge to each other and the empirical fact that many developing countries have lower growth rates than rich countries. In addition to using secondary school

enrollment as a proxy for human capital, he also introduced the regional dummies for Latin America ,South-East Asia, and Sub-Saharan Africa. We follow this convention by also including those variables. Of the other variables that have been introduced in the growth literature, one is of extra importance to this study: institutional development. As low levels of institutional development are likely to coincide with high levels of capital controls, this variable is also added to the list of controls. The different types of capital controls are added to this specification to test for their effect on economic growth, leading to the following general specification, with CAP_i being the vector containing the capital control variables:

$$\gamma_{i,t} = \alpha + \beta y_{i,0} + \Phi X_i + \pi Z_i + \psi CAP_i + \epsilon_i. \tag{5.6}$$

In the sequencing literature the focus lies on the reasons why capital cannot be efficiently allocated by the domestic financial system. Thus it is primarily the *inflow* of foreign capital into the country that will be affected by the distortions present. Capital controls on inflows can help a country to protect its domestic capital market from the building up of lending booms associated with the inefficient allocation of capital and excessive risk taking of underregulated banks (Mishkin, 2001).

Controls on outflows on the other hand do not help a country to sequence its reforms, nor does it protect the domestic market against the misallocation of resources due to the distortions. On the other hand, they do foster corruption and limit the risk diversification of domestic investors. Also, controls on outflows are not very effective in stopping financial crises (Edwards, 1999)[5].

Next to the clear distinction between the effects of controls on inflows and outflows, there has been a consensus in the literature that long-term capital is preferable to short term capital. Additionally, large capital flows to the banking sector also lead to financial fragilities and increased probabilities of financial crises (Bordo, Eichengreen, Klingebiel, and Martinez-Peria, 2001). As Bekaert, Harvey, and Lundblad (2005) point out, equity markets do not suffer from these drawbacks. Combined with the positive effects developed equity markets have on economic development, controls on equity markets are much more likely to have negative effects on economic welfare than other capital controls.

It is possible, however, that the causation is not only running from capital controls to growth but also vice versa. It is not implausible that emerging countries adjust their capital account policies towards the economic growth they experience in a country. Generally it can be stated that countries seem to open up their capital accounts when experiencing high growth and closing them when experiencing low growth. For example prior to the Asian crisis, when most East Asian countries were experiencing economic booms, many of those economies decided to liberalize. Conversely, Argentina activated new restrictions on their capital account following both the economic problems in the eighties and again after the 2001 crisis. To address this possible endogeneity problem the equation will be estimated using a two stage least

[5]Even here, controls on capital inflows are probably more effective in preventing financial crises as they slow the buildup of lending booms and thus the very financial fragility that might trigger a financial crisis

square estimator, with the lagged levels of the controls as instruments, together with the lagged values of initial GDP, schooling, investments, institutions, as well as four location dummies. These lagged values are highly correlated with the initial levels of the controls, whilst predetermined with respect to current economic growth[6].

Secondly, cross-sectional growth regressions have been criticized for suffering from possible multicollinearity (e.g. Mankiw, 1995). Therefore, for each model the variance inflation factor (VIF) of the variables is calculated. The VIF is a measure of multicollinearity and expresses the extent to which collinearity amongst the regressors leads to imprecision of the parameter estimates. VIF in excess of 10 are normally seen as indications of multicollinearity (Myers, 1990). As the VIF of the estimations stays below this threshold of 10, we conclude that multicollinearity is not a serious issue in the models used.

5.3 Data

Up until now there is little consensus about the best way to measure capital controls. Although several data sets have been developed, none of them has thus far succeeded in creating a proxy that is both complete and available over a wide range of countries for a prolonged period of time. The data seem to be falling short in two areas.

Firstly, the old indexes used were binary in nature and could not measure the intensity of controls in place. Yet there are large dispersions in the extent to which countries employ capital controls. Even most developed countries keep some minimal controls in place, designed to lock foreigners out of strategic sectors. Italy for instance has long tried, like many other countries, to prevent foreigners in taking a majority stake in national banks, and most European countries keep a strong control over foreign ownership in utilities and aviation companies. On the other hand, countries like China have an extensive range of capital controls in place that covers almost all capital transactions, ranging from differential equity classes to completely forbidding transactions in some classes of derivatives.

Secondly, most of the older proxies of capital controls do not fully account for controls on inflows (Magud and Reinhart, 2006). More specifically the old IMF binary variable focuses mainly on capital controls on outflows. At the same time the policy debate focuses more and more on the differences in effects between controls on inflows and outflows. Especially in relation to institutional development.

Even though the IMF dummy is limited and often criticized, it has been used extensively in the literature[7]. In response to the dummy several authors have tried to extend the IMF dummy to measure the intensity of the controls. The most notable extensions are the works of Quinn (1997), Kaminsky and Schmukler (2003), Miniane (2004), and Abiad and Mody (2005). These data sets form a huge improvement over the simple IMF dummy. Not only do they succeed in creating the

[6]The idea of using lagged controls to instrument the growth regression against endogeneity problems is described in Barro and Sala-i Martin (2004)

[7]for example Alesina, Grilli, and Milesi-Ferretti (1994), Chanda (2001), Epstein and Schor (1992),Garret (1995), Grilli and Milesi-Ferretti (1995), Leblang (1995), Milner (1996), Razin and Rose (1994), and Rodrik (1998) all use the IMF dummy in their studies

first step to measuring the intensity of the capital controls, they also make an explicit distinction between different types of financial repression. However, with the exception of Miniane (2004), these different types of financial repression do not all refer to capital controls. Quinn (1997) bases half of his proxies on restrictions on the current account (i.e. trade restrictions), whilst Kaminsky and Schmukler (2003) and Abiad and Mody (2005) focus predominantly on domestic financial repression such as interest rate ceilings, rather than international financial repression (capital controls). Moreover, as mentioned before, these data sets also make no distinction between controls on inflows and outflows.

There are also several authors that try to proxy for capital controls by looking at outcome variables. For instance Frankel and MacArthur (1988) propose to use on- and off-shore interest differentials or covered interest (CIP) deviations; Kraay (1998) and Swank (1998) use proportions of capital inflows and outflows to GDP; Bekaert (1995) proposes stock return differences between markets. The problem with such *de facto* measures is that it is uncertain that they actually capture the presence of capital controls. It is equally likely that the perceived deviations are caused by other factors, or that the capital controls are simply ineffective and do not show any deviation in the proxy, even though controls are present. (Straetmans, Versteeg, and Wolff, 2008) report for instance that the presence of capital controls has very little bearing on the uncovered interest parity or speculative efficiency hypothesis. The latest and best *de facto* proxy of capital controls, measures the proportion of stocks that is unavailable to non-residents, such as reported by the International Finance Corporation and used by, amongst others, Ahearne, Griever, and Warnock (2004), Bekaert, Harvey, and Lundblad (2005), and Edison and Warnock (2003). This study extends the coverage of the previous studies by, in addition to equity markets, looking at other types of capital controls as well. As Bekaert, Harvey, and Lundblad (2005) make a strong case that the liberalization of equity markets is of paramount importance for the development of a country, it will be interesting to see how the effects of these controls compare to other controls.

The only studies that were able to investigate capital account liberalization in great detail were case studies of specific countries. Although these case studies have shed much light on the process of capital account liberalization, they are lacking in the sense that they cover only a very limited number of countries. Only a handful of the most well-known countries that use capital controls are covered, such as Malaysia (Johnson and Mitton, 2003; Kaplan and Rodrik, 2002), Chile (De Gregorio, Edwards, and Valdes, 2000; Edwards, 1998, 1999), or Brazil (Miles, 2004). Given their limited scope, it might be difficult to extrapolate these findings to other countries as noted by (Magud and Reinhart, 2006). The data sets relaxes this constraint by taking into account a wide range of countries.

Actually the data set can be seen as a natural evolution out of the other data sets that have been developed in other studies as it is also based on the AREAER, but is to the knowledge of the author the first to make the overt distinction between controls on inflows and controls on outflows in addition to distinguishing between several types of capital streams, for a large cross-section of countries.

For a total of 26 categories, we have coded the absence or presence of controls.

The capital control variables are then constructed as the proportion of categories that have capital controls in place.

$$CON_i = \frac{\sum_{k=1}^{K} CON_{i,k}}{K}, \tag{5.7}$$

Where CON_i is the capital control variable for country i, $CON_{i,k}$ the dummy indicating the presence of capital controls for country i and category k and K the total number of categories. This creates variables on the interval [0, 1]with completely liberalized market scoring a 0 and completely closed markets scoring a 1. The variables measuring controls on inflows (CON. IN.) and outflows(CON. OUT) are each composed of 13 categories, while the control on equity markets (CON. STOCK) is composed of 4 categories. The exact details of how the variables are constructed can be found in the appendix.

The core of the rest of the data for the growth regression comes from the Penn World Tables 6.2, compiled by Heston, Summers, and Aten (2006). More specifically the real per capita growth rates, geographic location and investment rates. This data set on economic growth is the most commonly used in the economic growth literature. The other standard control variables are obtained from the Barro-Lee data set.

Additional to the standard controls institutional quality is added. The measure of institutional quality is retrieved from the International Country Risk Guide (ICRG) that is published each year by Political Risk Services (PRS) . Their 'Law and Order' index was found to be the best indicator of institutional quality (Knack and Keefer, 1995) and is most prevalent as institutional measure in studies on capital controls (for instance Arteta, Eichengreen, and Wyplosz, 2001; Chanda, 2001; Kraay, 1998). The law and order index of the ICRG measures to what extent a rule of law is present in a country and is scored from zero to six, with high scores indicating a better rule of law and low scores indicating a malfunctioning rule of law.

5.4 Results

To assess the effects of capital controls on growth a baseline regression is performed to compare the results of this data set with other cross-sectional growth studies. The results are given in table 5.2. This specification includes the (log of) the initial level of GDP, A schooling variable proxying for human capital, the Investment ratio, a dummy separating developed countries from emerging countries and the variable proxying for institutional quality. The two leftmost columns give the results which are instrumented through two stage least square, while the two rightmost columns give the ordinary least square(OLS) results. An additional split is made between the full sample, consisting of 63 countries, and the sample consisting only of emerging countries, consisting of 44 countries. In general it can be seen that the regressions that are performed on only the emerging countries seem to have a better explanatory power, as portrayed by the R^2, than the complete sample.

The results are as expected in line with previous growth research. The initial level of GDP enters with a negative sign, indicating growth convergence. At the

Table 5.1: Descriptive Statistics.
This table reports the descriptive statistics of the variables used in the growth regressions. 'Initial GDP' is the initial real GDP per capita in 1998, 'Schooling' the ratio of upper secondary schooling attainment in 1999, 'Investment' the Investment share of GDP, 'Institutions' the ICRG measure of rule of law, and 'Cap. In','Cap. Out', and 'Cap. Stock' the capital controls on inflows,outflows, and equity markets respectively, with 0 being fully open and 1 fully closed.

Variable	Complete Sample				Emerging				Developed			
	Mean	S.D.	Max.	Min.	Mean	S.D.	Max.	Min.	Mean	S.D.	Max.	Min.
Growth	4%	2%	11%	-6%	4%	3%	11%	-6%	4%	1%	6%	2%
Initial GDP	10,960	8,896	31,235	829	5,602	3,838	18,724	829	22,747	4,038	31,235	12,677
Schooling	34%	17%	79%	6%	29%	17%	79%	6%	43%	13%	65%	16%
Investment	18%	8%	36%	4%	14%	6%	29%	4%	25%	4%	36%	20%
Institions	4.42	1.26	6	2	3.86	1.05	6	2	5.65	0.67	6	4
Capcon	0.40	0.36	1	0	0.54	0.34	1	0	0.09	0.10	0.35	0
Cap. In	0.38	0.34	1	0	0.51	0.33	1	0	0.08	0.09	0.31	0
Cap. Out	0.42	0.39	1	0	0.57	0.38	1	0	0.10	0.13	0.38	0

Table 5.2: Baseline growth regression.
Neoclassical growth model, with as dependent variable real GDP growth per capital from 1998 to 2004. 'Ln GDP' is the log of initial real GDP per capita in 1998, 'Schooling' the ratio of upper secondary schooling attainment in 1999, 'Investment' the Investment share of GDP, and 'Institutions' the ICRG measure of rule of law. Models (1) and (2) portray the 2SLS results with the lagged 1996 levels as well as geographical dummies (Developed, Latin America, Sub-Saharan Africa, and South East Asia) as instruments. models (3) and (4) give the OLS results. The standard errors are given in brackets below the point estimates. *(10%), **(5%), and ***(1%) indicate significance at their respective levels.

	Reg 1	Reg 2	Reg 3	Reg 4
	2SLS		OLS	
	Complete	Emerging	Complete	Emerging
Constant	5.66	5.12	1.92	2.56
	(4.78)	(4.88)	(3.77)	(3.82)
Ln GDP	−0.95	−0.95	−0.33	−0.53
	(0.72)	(0.74)	(0.56)	(0.57)
Schooling	6.21***	7.86***	5.73***	7.29***
	(1.77)	(2.12)	(1.87)	(2.24)
Investment	5.02	7.40	3.96	6.20
	(6.73)	(7.59)	(6.35)	(6.91)
Developed	−0.56		−0.82	
	(0.92)		(0.91)	
Institutions	0.40	0.31	0.08	0.15
	(0.33)	(0.32)	(0.24)	(0.25)
N	63	44	63	44
R^2	9.81%	17.38%	12.93%	18.53%

same time, schooling, investment and law & order enter with positive signs. This implies that better institutions and better investment in human and physical capital does lead to a higher balanced growth path. Also, schooling is by far the most significant contributor to a higher economic growth, something that is witnessed by several other studies as well. Moreover, the results do not seem to change a lot between the complete sample and the emerging sample, as well as between the OLS and 2SLS results. All the signs remain the same, and statistical significance remains unchanged as well. The point estimates seem to be more pronounced in case of the 2SLS, with both the level of convergence and the impact of schooling portrayed to be larger in the case of the 2SLS.

5.4.1 Capital Controls and Growth

The next step in the analysis consists of adding the new capital control variable to the growth specification. The results are given in table 5.3. Firstly, as expected, the inclusion of the capital control variable does not qualitatively change the results of the baseline regression (table 5.2). The evidence for growth convergence is slightly more marked, and the effects of schooling and institutions remain at the same order of magnitude, only the level of investment shows little robustness.

Table 5.3: The impact of capital controls on economic growth.
This table shows the effects of capital controls on economic growth. The dependent variable is the real GDP growth per capital from 1998 to 2004. 'Ln GDP' is the log of initial real GDP per capita in 1998, 'Schooling' the ratio of upper secondary schooling attainment in 1999, 'Investment' the Investment share of GDP, 'Institutions' the ICRG measure of rule of law, and 'Capcon' the capital control variable, with 0 being fully open and 1 fully closed. Models (1) and (2) portray the 2SLS results with the lagged 1996 levels as well as geographical dummies (Developed, Latin America, Sub-Saharan Africa, and South East Asia) as instruments. models (3) and (4) give the OLS results. The standard errors are given in brackets below the point estimates. *(10%), **(5%), and ***(1%) indicate significance at their respective levels.

	Reg 1	Reg 2	Reg 3	Reg 4
	2SLS		OLS	
	Complete	Emerging	Complete	Emerging
Constant	8.08*	8.16*	6.29*	6.79*
	(4.19)	(4.17)	(3.69)	(3.83)
Ln GDP	−1.49**	−1.61***	−1.00*	−1.19**
	(0.60)	(0.58)	(0.52)	(0.54)
Schooling	6.63***	8.29***	6.51***	8.15***
	(1.86)	(2.29)	(1.83)	(2.21)
Investment	2.68	6.41	−0.38	1.55
	(7.08)	(7.39)	(6.08)	(6.74)
Developed	2.04*		1.89*	
	(1.06)		(1.01)	
Institutions	0.49*	0.48*	0.11	0.22
	(0.29)	(0.27)	(0.21)	(0.21)
Capcon	3.87***	3.80***	3.12***	3.01***
	(1.21)	(1.24)	(0.88)	(0.92)
N	63	44	63	44
R^2	33.81%	42.61%	39.09%	46.86%

The addition of the capital control variable suggests that there is a significant positive effect of capital controls on economic growth, present in all four specifications. The coefficients indicates that a country with a fully closed capital account experiences, ceteris paribus, between 3.01% and 3.87% percent higher growth than a country that is fully open. Although it is in theory possible that a country does liberalize from a fully closed capital account (1) to a fully open capital account (0), in reality the coefficient might overestimate the effect. This because the vast majority of countries does not have a fully open or closed economy; rather it is more reasonable to state that 'open' economies have controls of say around 0.2, whilst closed economies tend to have a capital control index of around 0.8. Taking those numbers as an example, the average difference would lie around 0.8 - 0.2 = 0.6, implying a difference in growth of between 1.8% and 2.3% (calculated as 0.6 times the parameter estimates).

The finding of significant positive effects of capital controls is somewhat surprising, given that most previous studies fail to find significant effects of capital controls on economic growth or find mixed effects at best. This can be interpreted as a first

sign that a better and more detailed measurement of the capital control index does indeed lead to a clearer outcome. Indeed as stated before, data quality of capital controls has been a constantly mentioned limitation in previous literature on the topic. Bekaert, Harvey, and Lundblad (2005) also describe that the effects of capital controls become more pronounced in growth regression, when the index is more finely measured.

As stated, most of the previous indicators failed to take into account controls on capital inflows, and focused mainly on capital outflows. Taking into account that this new capital controls index does explicitly take into account controls on capital inflows, this can be seen as tentative evidence that capital controls on inflows do indeed have larger (positive) effects than controls on outflows[8].

The next step involves splitting the capital control index into the part that constitutes controls on inflows and the part that measures controls on outflows to directly measure the effect of both types of controls. Table 5.4 shows that the effects of controls on inflows and controls outflows are different from each other and both have their hypothesized signs.

Controls on outflows have a negative, albeit insignificant, effect. This supports the literature in two aspects. On the one hand the negative sign is an indication that controls on capital outflows are detrimental to the welfare of the economy. Even more so for the emerging sample than for the complete sample. Tentatively it is in line with the thesis that controls on outflows are inducing corruption and bribery, especially in societies with heterogenous ethnic groups (Chanda, 2001). Arguably, the scourge of corruption is larger in emerging countries than in most developed countries. On the other hand, the fact that the magnitude of the effect of controls on outflows is much smaller than that of controls on inflows, combined with the fact that the coefficient itself is insignificant is supporting of the argument of Edwards (1999) that especially controls on outflows tend to be ineffective. Especially non-residents can be assumed to be much more willing to spend effort to get their money back out of the country than to force their way into a country when they can also invest in other countries.

At the same time, the controls on inflows show a positive effect on long-run economic growth, thus driving the overall positive effect of capital controls as found in table 5.3. Again, the positive effect is larger in the emerging sample compared to the complete sample. This finding lends support to the theory of the second best; as the direct effects of capital account liberalization are relatively small, opening up the capital account is only useful if the domestic conditions are good enough for the indirect effects to kick in. Arguably these conditions are more likely to be found in developed countries versus emerging countries, explaining the larger effects of capital controls in the pure emerging sample.

[8] Another explanation could be sought in the fact that China is included in the sample. It is well known that not only does China exhibit phenomenal growth rates, they are also employing a wide array of capital controls, thereby possibly distorting the results as an outlier. However, removing China from the sample does not significantly change the results. This also holds true for the results given in the other tables. As the results remain qualitatively unchanged by removing China, the output has been suppressed for brevity.

Table 5.4: The impact of inflow- and outflow-controls on economic growth.
Neoclassical growth model, with as dependent variable real GDP growth per capital from 1998 to 2004. 'Ln GDP' is the log of initial real GDP per capita in 1998, 'Schooling' the ratio of upper secondary schooling attainment in 1999, 'Investment' the Investment share of GDP, 'Institutions' the ICRG measure of rule of law, and 'Cap. In' and 'Cap. Out' the capital controls in inflows and outflows respectively, with 0 being fully open and 1 fully closed. Models (1) and (2) portray the 2SLS results with the lagged 1996 levels as well as geographical dummies (Developed, Latin America, Sub-Saharan Africa, and South East Asia) as instruments. models (3) and (4) give the OLS results. The standard errors are given in brackets below the point estimates. *(10%), **(5%), and ***(1%) indicate significance at their respective levels.

	Reg 1	Reg 2	Reg 3	Reg 4
	2SLS		OLS	
	Complete	Emerging	Complete	Emerging
Constant	7.86	8.78	5.69	6.16
	(4.96)	(5.27)	(3.84)	(4.02)
Ln GDP	−1.49**	−1.71*	−0.94*	−1.13*
	(0.70)	(0.74)	(0.53)	(0.56)
Schooling	6.38***	8.64***	6.25***	7.99***
	(2.25)	(2.90)	(1.84)	(2.24)
Investment	2.77	7.02	−0.94	0.74
	(8.14)	(9.53)	(6.21)	(7.02)
Developed	2.23**		1.88*	
	(1.09)		(1.04)	
Institutions	0.50	0.45	0.15	0.27
	(0.31)	(0.30)	(0.21)	(0.21)
Cap. In	8.12*	9.82*	3.61*	3.83*
	(4.36)	(4.99)	(1.85)	(2.00)
Cap. Out	−3.34	−5.03	−0.18	−0.49
	(3.71)	(4.24)	(1.69)	(1.90)
N	63	44	63	44
R^2	29.69%	34.24%	39.91%	48.18%

5.4.2 Stock Market Liberalization and Growth

Another type of capital controls that deserve specific attention are controls on equity markets. Bekaert, Harvey, and Lundblad (2005) report that equity market liberalizations tend to lead to a robust average increase in growth of over 1%. At the same time they repeat the known fact that all other, older, capital control measures do not turn up with significant effects on economic growth. Indeed, Kaminsky and Schmukler (2003) show in one of their tables that the majority of countries tend to liberalize the stock market before the other sectors considered in their studies[9]. As the data set used here also contains an indicator of stock market controls (taking the values 0, 0.25, 0.5, 0.75, 1), it is useful to compare the results to those of Bekaert, Harvey, and Lundblad (2005)

[9]Both do not differentiate between investments by nonresidents into the stock market and issuance of stocks in foreign markets by domestic firms.

Table 5.5: The impact of stock market controls on economic growth.
Neoclassical growth model, with as dependent variable real GDP growth per capital from 1998 to 2004. 'Ln GDP' is the log of initial real GDP per capita in 1998, 'Schooling' the ratio of upper secondary schooling attainment in 1999, 'Investment' the Investment share of GDP, 'Institutions' the ICRG measure of rule of law, and 'Capcon' and 'Cap. Stock' the overall capital controls variable and the variable measuring controls on equity markets respectively, with 0 being fully open and 1 fully closed. Models (1) and (2) portray the 2SLS results with the lagged 1996 levels as well as geographical dummies (Developed, Latin America, Sub-Saharan Africa, and South East Asia) as instruments. models (3) and (4) give the OLS results. The standard errors are given in brackets below the point estimates.
*(10%), **(5%), and ***(1%) indicate significance at their respective levels.

	Reg 1	Reg 2	Reg 3	Reg 4
	2SLS		OLS	
	Complete	Emerging	Complete	Emerging
Constant	6.83	7.45*	6.12*	6.71*
	(4.47)	(4.34)	(3.64)	(3.79)
Ln GDP	−1.29	−1.50**	−0.98*	−1.18**
	(0.65)	(0.62)	(0.51)	(0.54)
Schooling	5.59***	7.61***	6.21***	7.98***
	(1.85)	(2.35)	(1.88)	(2.29)
Investment	1.24	5.35	−0.23	1.62
	(7.26)	(7.51)	(6.27)	(6.96)
Developed	0.47		1.88*	
	(0.31)		(0.99)	
Institutions	2.11**	0.48	0.12	0.21
	(1.04)	(0.28)	(0.21)	(0.22)
Capcon	6.96***	5.63**	3.87**	3.41*
	(2.13)	(2.22)	(1.59)	(1.71)
Con. Stock	−3.12	−1.82	−0.79	−0.42
	(1.97)	(1.78)	(1.38)	(1.53)
N	63	44	63	44
R^2	31.64%	41.80%	39.09%	46.86%

Tables 5.5 and 5.6 report the results of the inclusion of the stock market controls into the growth regressions. Again the results are supportive of the arguments put forward. Indeed, equity market liberalization seems to have a positive effect on economic growth; or, more correctly in the context of this specification, controls on equity markets are detrimental to economic growth. Moreover, controls on outflows seems to have a less negative effect on growth when controlled for controls on equity markets.

5.5 Conclusion

This chapter uses new data to investigate the effect of capital controls on economic growth and to assess the hypothesis that different types of controls have differential effects. We contribute to the literature by creating a new capital control measure

Table 5.6: The impact of stock market controls on economic growth, cont'd
Neoclassical growth model, with as dependent variable real GDP growth per capital from 1998 to 2004. 'Ln GDP' is the log of initial real GDP per capita in 1998, 'Schooling' the ratio of upper secondary schooling attainment in 1999, 'Investment' the Investment share of GDP, 'Institutions' the ICRG measure of rule of law, and 'Cap. In','Cap. Out', and 'Cap. Stock' the capital controls on inflows,outflows, and equity markets respectively, with 0 being fully open and 1 fully closed. Models (1) and (2) portray the 2SLS results with the lagged 1996 levels as well as geographical dummies (Developed, Latin America, Sub-Saharan Africa, and South East Asia) as instruments. models (3) and (4) give the OLS results. The standard errors are given in brackets below the point estimates. *(10%), **(5%), and ***(1%) indicate significance at their respective levels.

	Reg 1	Reg 2	Reg 3	Reg 4
	2SLS		OLS	
	Complete	Emerging	Complete	Emerging
Constant	6.48	7.81	5.46	6.01
	(5.28)	(5.28)	(3.74)	(3.93)
Ln GDP	-1.27^{*}	-1.55^{**}	-0.91^{*}	-1.11^{*}
	(0.75)	(0.74)	(0.52)	(0.55)
Schooling	5.15^{**}	7.55^{**}	5.89^{***}	7.73^{***}
	(2.51)	(3.24)	(1.83)	(2.26)
Investment	1.20	5.56	−0.80	0.81
	(8.17)	(9.11)	(6.41)	(7.26)
Developed	2.35^{**}		1.86^{*}	
	(1.07)		(1.02)	
Institutions	0.48	0.44	0.16	0.27
	(0.32)	(0.30)	(0.21)	(0.22)
Cap. In	10.00^{*}	10.89^{*}	4.16^{**}	4.22^{*}
	(5.44)	(5.80)	(1.96)	(2.23)
Cap. Out	−1.46	−3.14	0.16	−0.29
	(3.91)	(4.03)	(1.87)	(2.04)
Cap. Stock	-3.77^{*}	−2.99	−0.91	−0.60
	(2.14)	(2.05)	(1.40)	(1.56)
N	63	44	63	44
R^2	27.11%	34.47%	40.43%	48.39%

that covers a much larger scope of controls than previous measurements, allowing to (i) measure the intensity of existing controls and (ii) differentiate into controls on inflows and outflows, and (iii) using recent econometric techniques to deal with some of the statistical problems that were present in older studies.

This study shows that the improved measure of capital controls is indeed better able to pick up the effects on economic growth. In the sample of 63 countries investigated with several econometric techniques, the results show a robust positive effect of capital controls on economic growth. Moreover, splitting the capital control index shows that this positive effect is driven by the controls on inflows that are in place. Especially in the samples with only emerging countries, the effects are surprisingly large.

Additionally this study is able to confirm the results of Bekaert, Harvey, and Lundblad (2005), who postulate that controls on equity markets have a detrimental effect on financial development and economic growth. The negative effect of equity controls is larger than that of all other controls on outflows. This corroborates and supports the stylized fact that countries tend to liberalize their equity markets before opening up the other capital markets.

Still the results of this chapter should be interpreted with some caution. As the time span under investigation is limited, this study was not able to utilize panel techniques to further eliminate some of the statistical problems, such as the possible presence of unobserved heterogeneity and cross-sectional dependence. Moreover, although we find that this capital control measure is much more informative than older *de jure* measures of capital controls, it is still an approximation of the real policies in place. Although it is unlikely that capital account policies can be measured completely without error, it is important to at least approximate them as good as possible. Further study on the difference between controls on inflows and outflow on other aspects of economic and financial development, needs to be undertaken to further validate the hypothesis that controls on inflows are more effective.

5.A Appendix

5.A.1 Construction of the Capital Control Variable

The capital control variables used in this chapter are based on the IMF Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The information on capital controls in the AREAER is structured in a tabular format, with each entry describing the capital controls present in a specific category. Table 5.7 outlines all the categories that are used in constructing the variables; these categories cover a wide array of controls both on inflows and outflows. Although information is also available on the controls On banks and institutional investors, these controls cannot be properly split into controls on inflows and controls on outflows and have been excluded from the construction of the capital control indexes in this chapter.

Each category is coded either '1' if the IMF AREAER reports capital controls were present and '0' otherwise. During the coding no attention was paid to the motivation of the controls, whether these controls were restrictive or not or what type of controls were employed (e.g. direct or indirect controls). Although these factors would be very valuable for research, the IMF yearbooks do not always provide enough information on those factors to draw meaningful conclusions for the whole cross-section of countries. In general any mention in the AREAER of a control in a specific category is coded as a 1.

However, certain exceptions have been made to this rule. Specifically a limited set of regulations were not counted as capital controls for the purpose of this measure, namely: (i) reporting requirements, specified to be for statistical purposes only, (ii) regulations that are specifically stated never to have been actually enforced, (iii) inward controls on real estate and foreign direct investment that meet the following criterium: those that are specifically aimed at strategic (border) locations and strategic sectors (transportation, utilities, and media) were excluded, and (iiii) equity controls limiting participation in sectors, if already counted as a control on inward FDI.

Entries that showed either to be not regulated (n.r.) or not available (n.a.) were coded according to the information in the adjoining years. If no information is available for these years either, the category is deemed to be free of capital controls and coded with a 0. Categories for which all transactions, including domestic, are forbidden, are deemed closed and coded with a 1. This last rule had to be applied for a limited number of cases, mainly for derivatives markets in Middle Eastern countries as well as some money market instruments in China.

The indices for controls are calculated as the number of controls in place on the specific type of controls divided by the total number of possible controls of that specific type. For instance, if a country has controls on inflows in 7 out of 13 categories, the variable for that country will be $7/13 = 0.54$. This creates variables which are scaled between 0 (completely open) and 1 (completely closed capital account).

Table 5.7: The definition of the capital control variables.
This table reports on the categories of capital controls that are reported in the IMF AREAER. Bold and Italic lines indicate the sectors; the other lines indicate the categories of controls for each sector. The left column refers to controls that are classified as controls on inflows, while the right column indicates controls that are classified as controls on outflows. In total this study measures 26 types of controls measured(13 on inflows and 13 on outflows). Each individual category of control is classified as either present(1) or liberalized(0).

Inflows	Outflows
Capital and Money Markets	
Capital Markets	
Purchase locally by nonresidents	Sale or issue locally by nonresidents
Sale or issue abroad by residents	Purchase abroad by residents
Money market instruments	
Purchase locally by nonresidents	Sale or issue locally by nonresidents
Sale or issue abroad by residents	Purchase abroad by residents
Collective investment securities	
Purchase locally by nonresidents	Sale or issue locally by nonresidents
Sale or issue abroad by residents	Purchase abroad by residents
Derivatives and Other Instruments	
Purchase locally by nonresidents	Sale or issue locally by nonresidents
Sale or issue abroad by residents	Purchase abroad by residents
Credit Operations	
Commercial credits	
To residents from nonresidents	By residents to nonresidents
Financial credits	
To residents from nonresidents	By residents to nonresidents
Guarantees, sureties, and financial backup facilities	
To residents from nonresidents	By residents to nonresidents
Direct Investment	
Inward direct investment	Outward direct investment or Liquidation
Real Estate Transactions	
Purchase locally by nonresidents	Sale or issue locally by nonresidents or Purchase abroad by residents[10]

5.A.2 Capital Controls Variables

Capital Controls on Equity markets, CON. STOCK: This variable consists of the 4 categories that are classified 'capital markets' table 5.7. For the 1998 data, the AREAER reports separately on equity and bond markets. To keep the consistency of the CON. STOCK variable over time, these two are aggregated again into capital markets. For each of the 4 categories (2 on inflows, 2 on outflows) in table 5.7, the maximum of the two values for the corresponding categories in equity markets and bond markets is taken.

Capital Controls on inflows, CON. IN: The index measuring capital controls on inflows comprises all 13 categories in the left column of table 5.7, including 2 categories on capital markets, 6 on other financial markets, 3 on credit operations, and 2 on direct and real estate investment. The 2 categories that comprise capital markets are constructed in the way described under CON. STOCK.

Capital Controls on outflows, CON. OUT: The index measuring capital controls on outflows comprises all 13 categories in the right column of table 5.7, including 2 categories on capital markets, 6 on other financial markets, 3 on credit operations, and 2 on direct and real estate investment. The 2 categories that comprise capital markets are constructed in the way described under CON. STOCK. For real estate, the two AREAER categories 'Sale or issue locally by nonresidents' and 'Purchase abroad by residents' have been combined as one category in this measure to give equal weight to real estate in the CON. OUT variable as in the CON. IN variable

Capital Controls, CON: This index comprises of both the 13 categories measuring controls on inflows and the 13 categories measuring controls on outflows.

Chapter 6

Project Finance as a Driver of Economic Growth in Low-Income Countries*

6.1 Introduction

Which type of finance is the optimal driver of economic development in developing countries? Already as early as 1911 Schumpeter stressed the importance of financial markets in understanding economic development. Ever after countless studies have been undertaken to exactly understand the link between finance, economic development and growth. According to one school of thought, financial development is an "overstressed determinant of economic growth" (Lucas, 1988, p.6). Miller (1998, p.14), voicing the opinion of the second school of thought, counteracts the statement "that financial markets contribute to economic growth is a proposition too obvious for serious discussion". To the supporters of the latter view, the correct question should not be if, but how financial development can affect economic growth. Financial development leads not only to an increase in the quantity of capital but, more importantly, also to an improvement in the quality of capital. It is through the quality of capital that finance contributes to growth.

In this study we provide new insights regarding whether and how financial development can affect economic growth by focusing on one specific financial instrument: project finance. Project finance is unique in its contractual structure which can substitute for underdeveloped financial markets. We thus perceive project finance as a high-quality financial instrument that leads to better investment management and governance and, ultimately, to more economic growth. The use of project finance has grown dramatically over the years from $ 12.5 billion (bn) per annum in 1991 to $ 113.4 bn in 2005[1]. Financing almost 4,000 projects in 113 countries

*Part of this chapter is based on Kleimeier and Versteeg (2009)

[1]As reported by LPC Dealscan. The dollar amounts are nominal and reflect the debt portion

the total amount of project finance raised between 1991 and 2005 amounts to $ 1,077 bn. While the US with $ 186.4 bn accounts for most project finance (followed by Australia and the UK), this form of financing has also been used extensively in emerging economies: such as in Taiwan ($ 64.2 bn), China ($ 58.9 bn) and Malaysia ($ 46.5 bn). Compared to other regions, Asia Pacific attracts most project finance (combined: $ 459.8 bn). As this region is also characterized by strong economic growth, it is surprising that no study has yet investigated project finance as a driver of economic growth.

Project finance is designed to reduce of transaction costs, in particular those arising from a lack of information on possible investments and capital allocation, insufficient monitoring and exertion of corporate governance, risk management, and the inability to mobilize and pool savings. The impact of project finance should therefore be especially clear in low-income countries, where financial development is shallow. The empirical analysis of 90 countries from 1991 to 2005 confirms this hypothesis. Project finance is found to be a strong driver of economic growth in low-income countries where transaction costs are particularly high but not in mid- or high-income countries where financial markets are more developed. Controlling for initial conditions and other economic factors, a move from the 25^{th} to the 75^{th} percentile in project finance will increase annual growth by 0.67 percentage points for low income countries. The remainder of this chapter is structured as follows: Section 2 reviews the existing theoretical and empirical evidence of financial development as a driver of economic growth and motivates why project finance should be particularly effective in low-income countries as a driver of growth. Section 3 presents the data and methodology while section 4 discusses the results of the empirical analysis. Section 5 concludes.

6.2 Financial Development, Project finance, and Economic Growth

6.2.1 Theory and Evidence on the Finance-Growth Nexus

In the classical literature the link between finance and growth is through capital accumulation or the quantity of capital: economic growth is the result of increases in innovation, human capital and physical capital. As finance develops, it increases the quantity of capital and thereby creates economic growth. However, as Schumpeter (1911) pointed out, this view ignores a very important channel. In his perception, finance stimulates growth not by creating more savings and thus increasing the quantity of capital, but rather by allocation savings better and stimulating technological innovation: increasing total factor productivity (TFP), e.g. improving the quality of the capital. Confirmation of Schumpeter's view is provided in a recent study by Hasan, Koetter, and Wedow (2009), who measure the relative importance of the quality of finance and the quantity of finance in Europe. An increase in the effi-

in the financing of the projects.

ciency (i.e. quality) of bank finance creates up to five times more growth than a corresponding increase in the quantity of bank finance.

In theory, financial markets can stimulate the quality of capital in several ways (Levine, 1997). Firstly, well-developed markets improve resource allocation and allow easier access to capital for entrepreneurs, thus lowering their financial constraints and financing costs (Tobin and Brainard, 1963; Boyd and Prescott, 1986). Secondly, financial markets play a vital role in corporate governance by dealing with agency costs and informational asymmetries (Bernanke and Gertler, 1989). Thirdly, markets facilitate the pooling and sharing of risks. Through financial markets, investors can diversify their portfolios and minimize idiosyncratic risk. In addition, markets allow not only for the insurance of liquidity risk through banks but even for intergenerational consumption smoothing through pension funds. Fourthly, markets mobilize and pool savings. Fifthly they ease the exchange of goods and services. Empirical evidence supports the view that financial markets stimulate economic growth. King and Levine (1993a,b) show that economic growth increases as the financial system develops and deepens while Levine and Zervos (1996, 1998) document that larger and better developed stock markets contribute directly to economic growth.

There are, however, few guidelines on how to develop financial markets when they are still nascent. This gives cold comfort to the large group of emerging economies that have yet to develop their financial markets. One solution is to import the capital from abroad. International capital can provide many of the advantages of a domestic market: it can supplement (low levels of) domestic capital stocks, lower the costs of capital (Bekaert and Harvey, 2000b) and increase the scope of risk diversification (Voth, 2003).

For international capital, like for domestic financial markets, it is the quality that matters, not the quantity. The direct quantity-effects of internationalization itself are quite small[2].At the same time financial liberalization often leads to financial crises, which can severely destabilize the local economy (Allen and Gale, 1999; Krugman, 1999a). In this respect, not all capital is equal. 'Hot money' in the form of short-term foreign currency denominated debt, for instance, is far more risky than long-term local currency denominated equity[3].Liberalization should therefore be carefully sequenced (McKinnon, 1991; Edwards, 1990) Therefore, an economy should first focus on those relatively safe capital flows. Only when its domestic markets are developed enough can it benefit from other riskier types of capital.

The question remains, however, which types of 'safe' capital are suitable for emerging economies when domestic financial markets are nascent and international capital flows are risky. Two candidates have been put forward in the literature: Portfolio equity investments and foreign direct investment (FDI). International equity inflows are known to reduce the cost of capital for domestic firms, increase risk

[2]Benefits are approximated to amount to only a 0.5% permanent increase in consumption for developed economies (Mendoza and Tesar, 1998b) and a 1% increase for emerging economies (Gourinchas and Jeanne, 2006). If markets are distorted this benefit is further reduced (Matsuyama, 2004) or can even become negative (Boyd and Smith, 1997b).

[3]Short-term foreign debt relative to foreign exchange reserves has actually been identified as the single most important predictor to financial crises by Rodrik and Velasco (1999).

sharing and stimulate the improvement of corporate governance (Claessens, Dooley, and Warner, 1995). However, a country can only receive equity inflows if the domestic stock market is well developed. As most developing countries have at best a fledgling and still illiquid equity market (Knight, 1998), this puts severe limitations on the use of international equity financing. FDI, like equity, is long-term in nature and minimizes currency- and maturity-mismatches. It is also beneficial in terms of transfers of technology, managerial skills and labor practices, access to new markets and production networks and the import of corporate governance. Importantly, FDI does not rely on the existence of a well-developed domestic financial market and firms can in part substitute the domestic financial market through FDI (Hausmann and Fernández-Arias, 2000). Through FDI a firm exerts direct control over the operations, reduces informational asymmetries and can thus alleviate some of the problems associated with inadequate contract enforcement and poor protection of intellectual property rights.

Given the long list of benefits, it is not very surprising that FDI has been found to have a positive effect on economic growth (see e.g. Reisen and Soto, 2001). However, most studies do not find an unambiguously positive relation between FDI and growth. The effectiveness of FDI appears to be contingent on the economic and financial development of the domestic country indicating that even FDI is only beneficial if a certain threshold of development has been reached. Lack of human capital (Borensztein, De Gregorio, and Lee, 1998), underdevelopment of financial markets (Alfaro, Chanda, Kalemli-Ozcan, and Sayek, 2004), lack of institutions (Durham, 2004) and trade restrictions (Balasubramanyam, Salisu, and Sapsford, 1996) can all prevent the positive effects of FDI to be disseminated to the local economy.

One of the positive quality effects of FDI, for example, is that FDI can stimulate the 'import' of good corporate governance. However, FDI can only do so when certain legal standards are present in the host country. During the Asian crisis, countries with better disclosure requirements had better stock price performance (Mitton, 2002) and the countries with the weakest outsider investor protection experienced the largest stock market and currency crashes (Johnson, Boone, Breach, and Friedman, 2000).

In general, Blömstrom, Lipsey, and Zejan (1994) show that FDI provides positive growth effects only for high-income countries but not for low-income countries. Similarly, De Mello (1999) shows that only OECD countries are able to benefit from positive spillover effects of FDI as measured by TFP gains. In contrast, the gains of FDI to developing countries are limited to quantity effects. The potentially more substantial quality effects do not materialize in these countries.

In sum, it is the quality and not the quantity of finance that matters. Finance creates spillover effects in terms of TFP gains that foster economic development and growth. Foreign sources of capital such as portfolio equity finance or FDI can also create positive spillovers, in the best case compensating for the absence of well-functioning domestic markets. Yet even FDI, though generally considered one of the safest and most beneficial types of foreign capital, is not very effective in the least developed markets. In the next section we set out to argue that the unique properties

of project finance make it well suited to underdeveloped domestic financial markets, where other types of finance fail. Project finance succeeds because it can — at least to some degree — substitute for the lack of local financial development

6.2.2 The Growth-Enhancing Properties of Project Finance

Project finance can be defined as "the creation of a legally independent project company financed with equity from one or more sponsoring firms and non-recourse debt for the purpose of investing in a capital asset" (Esty, 2007). Project finance is generally used for new, stand-alone, complex projects with large risks and massive informational asymmetries. Nevertheless, sponsors' equity contributions are small and the bulk of the financing is provided in form of non-recourse, syndicated loan tranches. The lead banks become project insiders through working with the project sponsors during the initial screening and structuring phase and are responsible for funding the loan in the global syndicated loan market by attracting other banks to become members of a loan syndicate (Gatti, Kleimeier, Megginson, and Steffanoni, 2008). As these loans are non-recourse — e.g. they finance the project company with no or only limited support from the sponsors — the syndicate bears much of the project's business risk. Given the project's high leverage, business risk must be reduced to a feasible level. Here lies one of the key comparative advantages of project finance: It allows the allocation of specific project risks (i.e., completion and operating risk, revenue and price risk, and the risk of political interference or expropriation) to those parties best able to manage them (Brealey, Cooper, and Habib, 1996). Thus, project finance comprises not only financial arrangements dominated by non-recourse debt funded in the global syndicated loan market but also a large set of contractual arrangements aimed at risk management.

These specific characteristics of project finance enable it to substitute underdeveloped financial markets and emulate, in part, the desirable features of a well-developed market. Like any other type of finance, project finance is of course most successful in a transparent environment where contracts are respected because adjusting the structure of project finance to deal with market failures will be costly and imperfect (Ahmed, 1999). The important point is, however, that project finance still functions relatively well in the least developed countries (LDCs). Most other types of capital, such as FDI, are not very effective in substituting the market, making project finance an attractive choice for LDCs.

As stated earlier, the five main functions of a financial market are: (1) ex-ante information production and efficient allocation of capital, (2) ex-post monitoring of investments and exerting corporate governance, (3) facilitation of diversification and management of risk, (4) mobilization and pooling of savings and (5) facilitation of transactions (Levine, 1997). If markets are underdeveloped and do not function well in these areas the transaction costs of capital increase. For each of the five functions, we will show how the structure of project finance allows it to substitute the domestic market and control transaction costs. The advantages are especially pronounced in the fields of information production and corporate governance[4].

[4]In contrast, Esty, Lysy, and Ferman (2003) develop a framework for assessing the development

First, consider transaction costs arising from a lack of information on possible investments and inefficient capital allocation. Ex-ante evaluation of investments is costly for individual investors. Financial intermediaries reduce the costs of acquiring and processing information and thereby improve resource allocation (Boyd and Prescott, 1986). Project finance reduces these costs as a syndicate of banks provides the majority of the funds and delegates the major screening and arranging tasks to the syndicate's lead banks. The project is separated from the sponsoring firm or firms and only a single investment rather than the overall sponsor(s) needs to be evaluated. Shah and Thakor (1987) provide the theoretical evidence that information production is cheaper under project finance. In addition, they show that the riskiest projects have most to gain from the use of project finance.

Furthermore, project finance can improve the efficiency of capital allocation as it targets sectors that are bottlenecks in LDCs. Take the example of an infrastructure investment structured as build-operate-transfer project finance. While most free cash flows are paid to the syndicate lenders and thus not reinvested locally during the operations phase of the project, the assets will ultimately be transferred to the government thereby putting technology and revenues into local hands. The newly acquired infrastructure itself can lead to improved economic growth (Sanchez-Robles, 1998). Generally, funds for large capital investments in developing countries are often only available from the public sector. While these institutions fund the initial investment, financing repair and maintenance during the project's operation can be problematic leading to temporary or even permanent shutdown of the facility (Buljevich and Park, 1999). Project finance can overcome this problem by explicitly taking these financing needs into account and can thus lead to a more effective allocation of capital.

These specific traits of project finance are very useful when information acquisition is costly and the market is opaque. The separation of the project from sponsor improves the transparency of the investment, thereby making it easier to screen. The unambiguous assignment of screening responsibilities to the lead banks limits free-riding on the information acquisition internalizes the costs of the screening and thus creates the appropriate incentives to screen. These lead banks can be expected to have superior screening skills due to their standing as sophisticated multinational banks[5], their repeated entry into the project finance market and in some cases their regional specialization in developing countries.

Second, consider transaction costs arising from insufficient monitoring and exer-

impact of investment projects. This framework takes a micro-level view and visualizes the impact of a project on each of its stakeholders. It applies to investment projects in general and is thus applicable but not limited to project finance. Due to its more macro-oriented economic focus, we decide to follow Levine's (1997) framework instead.

[5]Leading banks in the project finance markets are typically headquartered in industrialized countries with a developed financial sector. Based on project finance league tables provided by LPC Dealscan (considering all project finance deals arranged from 1991 to 2005), the top-10 project finance banks are RBS (UK), JP Morgan, Citibank, Bank of America (US), Mizuho Financial Group, Mitsubishi UFJ Financial Group (Japan), Calyon Corporate & Investment Bank (part of Credit Agricole), BNP Parisbas (France), HSBC (Hong Kong) and Credit Swiss (Switzerland). Banks are listed by nationality and not by league-table ranking.

tion of corporate governance. Effective monitoring induces managers to maximize firm value which in turn improves the efficiency of the firm's resource allocation (Levine, 2006). The explicit corporate governance and risk management structure of project finance is well suited to serve as a substitute for domestic structures and institutions[6].Brealey, Cooper, and Habib (1996), using the example of infrastructure projects, show that project finance has several characteristics specifically designed to deal with agency problems. These characteristics are largely independent of the legal framework and are thus likely to work when general corporate governance frameworks are not well developed: (1) Project finance lenders have a strong incentive to monitor due to high leverage and the non-recourse nature of their claim (Hainz and Kleimeier, 2008). (2) The separation of the project from the sponsoring firm improves corporate governance as management is decentralized and project-specific incentives are created for managers (Laux, 2001) (3) Furthermore, the focus of the project company on a single investment reduces the risk of misallocation of funds regarding the initial investment (Brealey, Cooper, and Habib, 1996)[7]while (4) the waste of free-cash flows during operation is reduced due to high leverage and the inclusion of a cash-waterfall as part of the contractual structure. (5) Finally, the extensive contractual structure increases transparency about the project, thereby improving governance.

The flexibility of project finance also allows the choice of a corporate structure which best suits the market conditions. The involved parties are to some extent free to choose the law that regulates the project (Ahmed, 1999; Harries, 1989). A logical choice is the law of the country where the major tangible assets are located. However, in the case of an emerging country it is possible to choose, for example, the US or UK to circumvent the problems association with a possibly not well developed local legal system.

Another problem that can arise in LDCs is political (or sovereign) risk, a cost that is especially difficult to deal with. As discussed above, even international capital like FDI that can substitute corporate governance on a firm level has difficulties when dealing with political risk on a national level. Although project finance also cannot fully mitigate this risk, there is some evidence it may at least reduce it. Hainz and Kleimeier (2008) show that development banks are particularly effective in reducing political risk and can act as political umbrellas when included in the syndicate. Indeed, they find that project finance is the preferred financing tool in countries with high political risk and poor corporate governance. Similarly, Esty and Megginson (2003) show that syndicates adjust their concentration to deal with sovereign risk and economic risk. In countries with low protection and high risk, syndicates are large to prevent strategic defaults; this at the cost of monitoring incentives that come with more concentrated debt ownership.

[6]It has been suggested that project finance can also stimulate reform in a country (Ahmed, 1999), thereby paving the way for other types of finance. Although this offers many interesting avenues, it is not within the scope of this chapter to pursue and test this implication.

[7]The inclusion of debt covenants is a more general way to eliminate or reduce the misallocation of funds (Smith and Warner, 1979). Jensen and Meckling (1976) argue however, that firms can engage in asset substitution to circumvent these covenants subsequent to issuance of the debt.

Third, consider transaction costs associated with cross-sectional risk diversification: when capital is scarce and investors are risk averse, investors will avoid risky high-return projects and seek out safe low-return projects. Thus, if investors cannot diversify cross-sectional risk, then savings will not flow towards high-return investments which can boost growth (Acemoglu and Zilibotti, 1997). Project finance will not alter the risk appetite of the local investors, but as international capital it is not limited by the same constraints and therefore more likely than domestic capital to flow to the above mentioned growth-enhancing projects.

Fourth and fifth, consider the transaction costs arising from the inability to mobilize and pool savings and to facilitate transactions. In many cases the required sums for an investment are larger than those offered by a single investor. The inability of the market to pool savings and link them to investments can lead to severe financing constraints. Closely related is the function of the market to facilitate transactions by acting as a middle man between individual investors and potential borrowers, reducing searching and screening costs. The absence of this function hampers financing (Ang, 2008). Project finance is specifically designed to deal with large investments and the syndicates normally consist of large (international) banks. Therefore it should not be hindered much by the inability to pool savings, nor by the inability to facilitate transactions. However, it has to be noted that the savings pooled and the transactions facilitated are those of the lenders' home countries, not those of the project's host country. Project finance can do very little to help improve the market's ability to pool domestic savings and facilitate domestic transactions. It can only help in meeting the need for large sums of money for single investments which cannot be met by domestically pooled savings.

In sum we conclude that project finance is very flexible and can easily be adapted to different economic and political environments. This flexibility allows project finance to substitute for underdeveloped financial markets. Its structure enhances ex-ante screening and ex-post corporate governance. Moreover, project finance is well suited to deal with political risk and suffers only minimally from the market's inability to manage risk, pool savings or facilitate transactions. These characteristics provide it comparative advantages in underdeveloped markets over most other types of capital. These advantages are, in our eyes, likely to stimulate growth in LDCs, as will be tested formally in the next sections.

6.3 Data and Methodology

We will answer the question whether or not project finance is a driver of economic growth within a neo-classical growth framework, first developed in the Swan-Solow and Ramsey-Cass-Koopmans models. In summary, these models presume that the GDP per capita of each country converges towards its equilibrium. In two seminal papers Barro (1991) and Mankiw, Romer, and Weill (1992) derive an empirical specification for these models, based on the assumption that it is unlikely that a country is already at its steady state. In such a setting where countries are not already at their steady states, transitional dynamics, such as financial development,

are an important determinant for economic growth. The starting model is based on this empirical specification and visualizes growth in country i as a function of the log of initial GDP ($y_{i,0}$), project finance (PF) and a set of further control variables denoted by X:

$$GROWTH_{i,t} = \beta_0 + \beta_1 y_{i,0} + \beta_2 PF + \Sigma_j \beta_{2+j} X_{i,j} + \epsilon_i. \tag{6.1}$$

We estimate equation (6.1) in two specifications: in the baseline specification the selected control variables X include schooling, population growth, and government consumption. A dummy is included for the sub-Saharan countries in the sample to account for the stylized finding that growth rates are systematically lower in this region, even after controlling for all other variables. In the extended specification, a larger set of control variables will be used measuring economics, population and institutional characteristics in addition. The set of chosen controls follows Alfaro, Chanda, Kalemli-Ozcan, and Sayek (2004) and comprises the most common variables used in the literature. In a refinement of the model, we will also (1) consider FDI and contrast its effect on growth with that of project finance and (2) investigate the effect of project finance on growth dependent on the economic development of the recipient countries. These refinements will be motivated in more detail in section 4. As a consequence of the choice of control variables, the data is split into two sets of countries. The first data set, consisting of 90 countries, includes the variables used in the baseline specification. The second data set reduces to 71 countries, due to limited data availability of some the variables in the extended specification[8].Growth is measured as the log-change in real GDP per capita in constant US dollar and obtained from the World Bank's (2008) World Development Indicators (WDI) database. Correspondingly, initial GDP reflects the log of the level of constant US dollar GDP per capita at the beginning of the growth period.

Until now we have not addressed the potential problem of endogeneity. As has been pointed out in previous literature[9]it is quite likely that project finance, or foreign capital in general, flows mainly to those countries that experience high growth rates. If this is the case, the results of Table 6.3 will overstate the true effect of project finance on economic growth. In the worst case, the results are caused by reverse causality. Robinson (1952) argues for instance that growth is not caused by financial development but that finance simply develops because the economy grows. Instrumental variables(IV) analysis provides a solution to this problem. Thus, valid instruments for both the financial variables have to be constructed.

The first logical candidates are the lagged values of project finance and FDI. By construction these variables are predetermined with respect to current growth, preventing reverse causality. And as flows of capital, like project finance and FDI, are quite persistent over time, lagged values are good predictors for future capital flows. Wheeler and Mody (1992), for example, show that FDI is self-propagating:

[8]The appendix contains a complete overview of the countries in both datasets. Note that all countries for which data are available are included in the dataset, no further selection is imposed. In particular, countries with no project finance are included if data for the independent variables are available.

[9]See for example Nair-Reichert and Weinhold (2001) and Li and Liu (2005).

large existing stocks of capital stimulate further FDI flows into that country. As an additional instrument we include the real exchange rate. All of FDI and much of project finance comes from abroad. A low real exchange rate decreases the relative local costs while increasing the relative foreign wealth, making investments in the local economy more attractive for foreigners (Bloningen, 1997; Froot and Stein, 1991). Klein and Rosengren (1994) provide empirical support that the real exchange rate is a determinant of investment flows. The instruments prove to be jointly significant in the first stage in all cases[10], indicating that the chosen instruments are indeed valid.

We obtain data on project finance from the Loan Pricing Corporation's Dealscan database. We select all deals with the purpose 'project finance' and obtain the total volume of project finance deals from the 'Totals & Averages Report'. The deals are converted to US dollar and aggregated by borrower country and year of deal signing. Note that the deal volume reflects only the debt financing raised for the project but not the equity investment. We focus on project finance deals signed between January 1, 1991 and December 31, 2005 as Dealscan's coverage in earlier years is limited to a few countries and thus not representative.

The measure of net FDI inflows comes from the WDI. Thus, for both project finance and FDI, we relate the cumulate volume of financing to the growth over the same period to limit the measurement error of the data (Lane and Milesi-Ferretti, 2001). The schooling variable is measured as the average total years of schooling in the adult population and comes from Barro and Lee (1996, 2001); the law variable refers to the 'rule of law' as measured by the International Country Risk Guide (ICRG); the black market premium is the difference between the parallel and official exchange rate, retrieved from the Global Development Network database at New York University. The other variables come from the WDI: government consumption measures the central government's total government expenditures to GDP; openness is defined as imports plus exports over GDP; inflation is calculated as the percentage change in the deflator; population growth is defined as annual percentage growth. Income and location dummies follow the World Bank's country classification.

The variables used in the regressions are defined in the following manner. Missing initial values are substituted by the adjoining year if possible. Averages are calculated if at least 3 out of 5 data points are available in the respective 5-year period. Project finance and FDI are the cumulative net inflows over the regression period as a share of GDP. Likewise, population growth is the average growth rate for the regression period. The schooling variable is defined as the log of (1 + total years of schooling). The black market variable is the log of (1 + black market premium). The inflation variable is the log of (1 + average inflation). Openness is defined as the log of (average exports plus imports as a share of GDP).

We estimate equation (1) by 3SLS for a panel of three 5-year periods of 1991 to 1995, 1996 to 2000 and 2001 to 2005.

[10]Results not reported for brevity.

6.4 Results

6.4.1 Growth and Project Finance

Table 6.1 provides a first impression about the link between project finance and economic growth. In the 90 countries contained in the baseline sample, $ 908 bn of funds were raised in the form of project finance between 1991 and 2005. Covering 84% of the total of $ 1,077 bn raised worldwide, the sample can be said to be representative for the global project finance market. When comparing the annual volume of newly signed project finance deals in real US$ (2005), it becomes clear that the use of project finance has increased over time from $ 16 bn in 1991 to just under $ 69 bn in 2005. The volume of project finance loans is highest just before the Asian crisis in 1997 and 1998 with $ 108 bn and $ 110 bn per year, respectively. While the total numbers are substantial, project finance is relatively small in comparison to the GDP of the recipient country. The size of new project finance deals amounts in most years to less than 0.01% of GDP. Even in countries where the use of project finance is highest, new project finance deals do not amount to more than 0.2% of GDP. For comparison, FDI inflows are typically in the range of 1% to 5% of GDP. Nevertheless table 6.1 shows a remarkable trend. High-growth countries, as measured by the top growth-quartile, raise substantially more funds in form of project finance than low-growth countries, the bottom growth-quartile: $ 259.5 bn versus $ 16.5 bn in total from 1991 to 2005. Also in relative terms high-growth countries have more project finance inflows than both low-growth countries and the average country in the sample. Although it is too early at this point to postulate any causal relations, it does appear from the data that more project finance is associated with higher growth. In the remainder of this section, we will investigate whether this initial finding is robust.

Table 6.2 presents detailed descriptive statistics of the dependent and independent variables as used in the panel regressions with three 5-year growth periods of 1991-1995, 1996-2000 and 2001-2005. Comparing the baseline sample of 90 countries in Panel A to the reduced sample of 71 countries in Panel B, we find that both samples are remarkably similar in terms of average growth, project finance and FDI stocks, schooling, population growth, government consumption and regional coverage of SSA countries. The reduced sample contains, however, somewhat larger countries in terms of initial GDP. Panel A shows that the 90 countries typically grow at 1.66% annually. However, there is considerable variation in the growth rates across different countries, ranging from −11.03% average annual growth between 1991 and 1995 for Congo to 10.38% average annual growth between 1991 and 1995 in China. Cumulative inflows — e.g. stocks — of project finance amount to 0.02% of GDP on average while cumulative FDI flows are far more substantial with more than 14.57% of GDP for the average country. But these averages can be misleading as stocks of project finance and inward FDI also vary widely over the sample. Malaysia (0.34% for 1996 to 2000) and the Philippines (0.27% for 1996 to 2000) have the most project finance to GDP, while Belgium (168% for 1996 to 2000), Lesotho (118% for 1996 to 2000) and Guyana (91% for 1991 to 1995) lead in terms of FDI. A comparison of

Table 6.1: Project finance in high- and low-growth countries:
This table shows annual data for new project finance (PF) deals for the sample of 90 countries as well as those 23 and 22 countries with the highest and lowest growth rate over the period 1991 to 2005, respectively. These countries represent the top and bottom quartile in terms of economic growth. All percentages are shown such that 1.0 reflects 1%. All US$ volumes reflect real 2005 values.

	all countries				high-growth countries		low-growth countries	
year	PF volume (real $ mio)	PF in % of GDP mean	st.dev.	max.	PF volume (real $ mio)	PF in % of GDP (mean)	PF volume (real $ mio)	PF in % of GDP (mean)
1991	16,106	0.0001	0.0004	0.0027	1,065	0.0001	0	0.0000
1992	18,653	0.0004	0.0013	0.0069	1,599	0.0007	0	0.0000
1993	18,829	0.0011	0.0034	0.0191	5,121	0.0021	1,929	0.0010
1994	36,063	0.0016	0.0061	0.0386	7,880	0.0035	306	0.0002
1995	40,842	0.0018	0.0052	0.0256	13,064	0.0034	1,567	0.0008
1996	46,656	0.0025	0.0067	0.0384	18,465	0.0061	865	0.0004
1997	108,062	0.0103	0.0351	0.2179	47,384	0.0196	1,949	0.0008
1998	110,050	0.0043	0.0102	0.0761	33,827	0.0085	2,884	0.0009
1999	93,954	0.0036	0.0076	0.0465	18,654	0.0056	2,846	0.0008
2000	86,146	0.0043	0.0136	0.1125	17,409	0.0071	372	0.0002
2001	91,112	0.0044	0.0116	0.0614	34,559	0.0088	1,566	0.0027
2002	59,926	0.0038	0.0099	0.0670	13,553	0.0065	1,388	0.0022
2003	58,306	0.0028	0.0067	0.0353	16,813	0.0073	68	0.0000
2004	53,468	0.0032	0.0079	0.0481	12,998	0.0046	303	0.0009
2005	69,403	0.0027	0.0067	0.0415	17,157	0.0024	481	0.0003

table 6.1 and 6.2 lays bare a general trend in the data. Although the total project finance flows are substantial and the large growth notwithstanding, flows of project finance remain rather small relative to the GDP of the recipient country. The descriptive statistics of the other variables are in line with those of previous studies and — as they only serve as control variables in the analysis — will not be explicitly discussed here.

Table 6.3 shows the results of an OLS estimation of equation (1) for a panel of three 5-year growth periods of 1991-1995, 1996-2000 and 2001-2005. Regressions 1, 3, 5 and 7 show the baseline specification for a sample of 90 countries with the selected control variables which include schooling, population growth, government consumption, and a dummy for the SSA countries. In regressions 2, 4, 6 and 8, institutional quality (law), the black market premium, inflation, and the trade volume (openness) have been added and the sample drops to 71 countries.

First consider regressions 1 and 2 which exclude project finance and thus allow us to compare the results to those generally reported in the empirical growth literature. Initial income has a significant negative impact on growth, indicating that (conditional) convergence is present. Furthermore, sub-Saharan countries and countries that experience high inflation or high population growth face lower GDP growth, while more schooling and a better rule of law have a significant positive effect on economic growth. These results are in line with the existing evidence in the economic growth literature.

Turning to project finance, the main results reveal that project finance is not unambiguously correlated with economic growth. Regressions 3 and 4 include the project finance measure and show that, although positive, project finance is not significantly correlated with growth. As we postulate above that the special characteristics of project finance will be most beneficial in LDCs with a weak domestic financial system, this result is not surprising. It is likely that project finance is only significant contingent on the host country's economic development, e.g. its income level. Therefore, regression 5 and 6 interact project finance with the country's income level, identifying the effect of project finance on low-, middle- and high-income countries. The results corroborate our argument. In general project finance is shown to have a positive impact on growth, but the effect is only significant for the low-income countries and not in the middle- and high-income countries.

To assess the quantitative impact of project finance on economic growth in a low-income country, consider the examples of Uruguay, Ghana, and India. Uruguay currently has no project finance, ranking it around the 25^{th} percentile[11], Ghana, with 0.014% project finance to GDP (the average over the three five year panels), is very close to the average; and India, with 0.019% project finance to GDP, is located at the 75^{th} percentile. Using the coefficient of regression 8 of table 6.3 (73.547), one can calculate the potential increase in growth when a country moves from low levels

[11] Uruguay is used here for illustrative purposes. Any other country that does not currently use project finance can be substituted for Uruguay. The countries in the sample that did not use project finance over the sample period are (by WDI acronym): BDI, BEN, BTN, GOC, GMB, GTM, GUY, HTI, LSO, MRT, MUS, MWI, NER, NIC, RWA, SEN, SLE, SLV, SWZ, SYR, TGO, URY, ZAR, and ZWE.

Table 6.2: Descriptive statistics: This table shows descriptive statistics for the dependent and independent variables for the three 5-year growth periods used in the regressions. We report statistics for the baseline sample of 270 observations for 90 countries in Panel A as well as for the reduced sample of 213 observations for 71 countries in Panel B. While we use the logged values of many variables in the regressions, we show percentages and $ values here for illustration. All percentages are shown such that 1.0 reflects 1%. All US$ volumes reflect real 2000 values. For the definition of all variables see the appendix.

Panel A: Characteristics of 90 countries from 1991 to 2005

				percentiles			
	mean	st.dev.	min.	25^{th}	50^{th}	75^{th}	max.
growth (%)	1.658	1.829	−5.354	1.006	1.699	2.453	8.721
initial GDP per capita (real $)	6,351.920	8,855.120	131.405	461.402	1,590.050	11,346.180	33,279.510
PF (% of GDP)	0.047	0.082	0.000	0.000	0.023	0.057	0.549
FDI (% of GDP)	43.697	44.257	1.526	16.220	34.631	53.967	260.356
schooling (years)	5.160	2.874	0.547	2.983	4.792	7.138	11.999
population growth (%)	1.526	1.111	−4.295	0.727	1.638	2.322	3.659
gov. consumption (% of GDP)	15.053	5.160	4.776	11.370	13.647	18.563	31.583
D_{SSA}	0.267	0.445	0.000	0.000	0.000	1.000	1.000

Panel B: Characteristics of 71 countries from 1991 to 2005

				percentiles			
	mean	st.dev.	min.	25^{th}	50^{th}	75^{th}	max.
growth (%)	1.748	1.767	−5.354	1.044	1.701	2.453	8.721
initial GDP per capita (real $)	6878.390	9175.310	131.405	637.366	1659.060	11551.980	33279.510
PF (% of GDP)	0.050	0.086	0.000	0.006	0.027	0.057	0.549
FDI (% of GDP)	41.649	37.146	1.526	17.876	35.987	53.808	260.356
schooling (years)	5.585	2.836	0.614	3.361	5.234	8.218	11.999
population growth (%)	1.539	0.920	−0.187	0.684	1.513	2.257	3.659
gov. consumption (% of GDP)	14.618	4.711	4.776	11.261	13.402	17.977	27.623
D_{SSA}	0.211	0.411	0.000	0.000	0.000	0.000	1.000
law	6.441	3.598	0.830	4.000	6.000	10.000	12.000
black market premium (%)	7.544	25.650	−0.233	0.493	1.291	3.422	193.150
inflation (%)	52.049	275.524	0.411	2.949	7.158	15.137	2302.040
openness (% of GDP)	68.195	33.557	18.753	46.478	60.390	84.294	201.646

Table 6.3: The impact of project finance on economic growth:
The dependent variable is the growth rate. We report the analysis of the project finance-growth nexus based on panel regressions using three 5-year growth periods from 1991 to 1995, 1996 to 2000 and 2001 to 2005 estimated with 3SLS. All regressions instrument PF and FDI with the real exchange rate and lagged values of PF and FDI (standard errors between brackets). ***, ** and * indicate significance at 1%, 5% and 10% level respectively. The subscript D indicates a dummy variable. For the definition of all variables see the appendix.

Variable	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8
constant	0.045 ***	0.094 ***	0.077 ***	0.097 ***	0.046	0.078 ***	0.033	0.062 **
	(0.012)	(0.015)	(0.026)	(0.023)	(0.029)	(0.024)	(0.024)	(0.025)
GDP	-0.005 ***	-0.009 ***	-0.007 ***	-0.010 ***	-0.006 **	-0.008 ***	-0.006 **	-0.009 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
PF			3.925	0.934				
			(6.330)	(4.914)				
PF * D_{low}					128.335 ***	70.452 ***	67.309 ***	73.547 ***
					(28.519)	(19.249)	(21.509)	(20.161)
PF * D_{middle}					-5.473	-3.838	-9.083	-3.883
					(6.928)	(5.258)	(9.312)	(5.871)
PF * D_{high}					15.812	12.607	2.200	-0.885
					(23.252)	(19.396)	(24.688)	(21.772)
FDI							0.093 ***	0.072 ***
							(0.023)	(0.018)
schooling	0.011 *	0.003	0.005	0.005	0.010	0.007	0.010	0.009
	(0.006)	(0.006)	(0.008)	(0.006)	(0.008)	(0.006)	(0.008)	(0.007)
pop. growth	-0.119	-0.678 ***	-0.753 ***	-0.748 ***	-0.621 **	-0.707 ***	-0.122	-0.508 **
	(0.092)	(0.217)	(0.259)	(0.220)	(0.269)	(0.226)	(0.101)	(0.236)
gov. cons.	0.003	0.000	0.000	0.000	-0.004	-0.003	-0.002	-0.005
	(0.002)	(0.000)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)
D_{SSA}	-0.021 ***	-0.024 ***	-0.023 ***	-0.022 ***	-0.027 ***	-0.024 ***	-0.025 ***	-0.027 ***
	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
law		0.001 *		0.001		0.001		0.001
		(0.001)		(0.001)		(0.001)		(0.001)
bl. m. premium		0.004		0.006		0.009		0.013
		(0.009)		(0.010)		(0.010)		(0.010)
inflation		-0.025 ***		-0.029 ***		-0.024 ***		-0.025 ***
		(0.004)		(0.004)		(0.004)		(0.004)
openness		0.001		0.001		0.004		-0.004
		(0.002)		(0.003)		(0.003)		(0.004)
observations	270	213	270	213	270	213	270	213
adjusted R^2	0.135	0.371	0.292	0.586	0.3060	0.582	0.3340	0.524

of project finance to higher levels of project finance. If a country had increased its project finance from the minimum (Uruguay) to the average level (Ghana) in the sample period, it would have raised annual growth by 1.03 percentage points. If it had raised project finance equal to the 75^{th} percentile (India), it would have even increased growth by 1.40 percentage points. When this is compared to the average realized growth rate of 1.66 percentage points, it becomes clear how substantial the gains from project to growth can be.

These growth-effects of project finance might be driven by benefits unique to project finance. Alternatively, the growth-effects might be driven by more general spill overs of project finance as foreign capital. In order to distinguish these two alternatives, we include a measure of FDI in regressions 7 and 8. Note that in low-income countries, project finance will generally constitute part of FDI. As pointed out in section 2 above, the most prominent lead banks in the project finance market are headquartered in industrialized countries. Thus, while a project in a high-income country might well be financed by a syndicate of domestic banks, in low-income countries the syndicate will likely be dominated by foreign banks[12].By including FDI as an additional variable in the regressions we control for the fact the foreign capital can in general be beneficial for growth. Any remaining growth-effects of project finance are probably driven by features that are unique to its structure. We find that FDI is highly significant for all income levels and that project finance remains significant for low-income countries. This indicates that in low-income countries it is indeed project finance with its unique features that is beneficial to the country's growth.

6.4.2 Robustness Checks

To check whether a few outliers drive the results, the regressions are re-estimated based on a sample that excludes countries with extremely high levels of project finance. More specifically, we exclude all observations which belong to the top-5% in terms of project finance to GDP[13]. Results are reported in Table 6.4 and we confirm the finding of project finance as a driver of economic growth. In terms of the significance of the project finance variables, the results are even stronger now that outliers are excluded. We now even find evidence that project finance is unconditionally associated with higher economic growth. Regressions 3 to 6 confirm that this overall effect is mainly driven by low-income countries. The size of the coefficients for project finance is similar to those reported in table 6.3 indicating that outliers do not drive our main results.

[12]Ahmed (1999) shows that 77% of the total costs of IFC-supported projects are financed by international sources and that this share declines as domestic financial markets improve.

[13]The distribution of project finance is skewed with several countries having no project finance. We therefore focus only on outliers in the right tail of the distribution.

Table 6.4: The outlier-robust impact of project finance on economic growth:
The dependent variable is the growth rate. We report the analysis of the project finance-growth nexus based on panel regressions using three 5-year growth periods from 1991 to 1995, 1996 to 2000 and 2001 to 2005 estimated with 3SLS. All regressions instrument PF and FDI with the real exchange rate and lagged values of PF and FDI. Observations which fall in the top-5% quantile with respect to project finance are considered outliers and have been excluded (standard errors between brackets). ***, ** and * indicate significance at 1%, 5% and 10% level respectively. The subscript D indicates a dummy variable. For the definition of all variables see the appendix.

Variable	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6
constant	0.036	0.079 ***	0.029	0.077 ***	0.027	0.068 ***
	(0.024)	(0.023)	(0.023)	(0.023)	(0.024)	(0.024)
GDP	-0.006 ***	-0.009 ***	-0.005 **	-0.009 ***	-0.004 *	-0.009 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
PF	84.732 ***	33.175 ***				
	(19.751)	(10.400)				
PF * D_{low}			111.112 ***	51.841 ***	104.217 ***	45.633 ***
			(28.935)	(16.000)	(30.384)	(15.900)
PF * D_{middle}			35.559	18.124	25.789	9.176
			(23.394)	(13.525)	(26.049)	(13.494)
PF * D_{high}			58.034 ***	22.190	22.811	11.366
			(21.574)	(18.189)	(23.516)	(19.264)
FDI					0.072 ***	0.050 ***
					(0.021)	(0.016)
schooling	0.014 **	0.005	0.012 *	0.006	0.008	0.007
	(0.007)	(0.007)	(0.007)	(0.006)	(0.008)	(0.006)
pop. growth	-0.066	-0.737 ***	-0.111	-0.749 ***	-0.116	-0.611 ***
	(0.102)	(0.220)	(0.096)	(0.224)	(0.097)	(0.224)
gov. cons.	0.000	-0.004	-0.001	-0.004	-0.002	-0.004
	(0.000)	(0.006)	(0.005)	(0.006)	(0.007)	(0.005)
D_{SSA}	-0.015 ***	-0.019 ***	-0.018 ***	-0.021 ***	-0.022 ***	-0.023 ***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
law		0.001		0.001		0.001
		(0.005)		(0.005)		(0.005)
bl. m. premium		0.008		0.008		0.012
		(0.005)		(0.005)		(0.005)
inflation		-0.026 ***		-0.025 ***		-0.026 ***
		(0.005)		(0.005)		(0.005)
openness		0.001		0.002		-0.005
		(0.005)		(0.005)		(0.005)
observations	270	213	270	213	270	213
adjusted R^2	0.253	0.446	0.284	0.467	0.337	0.501

6.5 Conclusion

In this study we examine the finance-growth nexus with specific focus on project finance. Based on the existing theoretical and empirical evidence on the impact of finance and growth, we hypothesize that project finance has the right features to stimulate growth. The benefits of foreign capital are known to depend on the development of the domestic financial sector. Countries receiving foreign capital inflows should realize that the quality of capital matters more than its quantity. In this sense, not all capital is equal. Countries with underdeveloped financial sectors should therefore focus on safe long-term capital before encouraging more advanced forms of capital inflows. We argue that project finance can adjust to less-than-favorable environments in least developed countries and might even substitute for the lack of institutional and financial development. Results show that project finance promotes growth in particular in low-income countries. Moving from the 25^{th} to the 75^{th} per-

centile in the use of project finance reveals that these countries can gain an up to 1.40 percentage points increase in annual economic growth, ceteris paribus. This result is robust to outliers as well as possible reverse causality[14]. The evidence of this study is consistent with the view that project finance has a superior ability to facility information production and good project governance. The structure of project finance leads to extensive and effective screening and project finance is also likely to flow to growth-enhancing industries. With regards to corporate governance, project finance creates transparency combined with strong monitoring incentives for the investment which are independent of any external corporate governance environment. Overall, project finance is an effective tool to deal with high-risk environments. Our results lead us to wonder whether project finance can also stimulate financial development itself, paving the way for other sources of international finance. More evidence is required to answer this question, opening up new avenues for future research.

[14]Further refinement of the econometric methods could include a closer attention to unobserved heterogeneity and cross-sectional dependence.

6.A Appendix

6.A.1 Countries Included in Samples

Algeria, Australia, Austria, Bangladesh, Belgium, Benin*, Bhutan*, Bolivia, Brazil, Burundi*, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Democratic Republic of Congo, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, France, Gambia, Germany, Ghana, Greece, Guatemala, Guyana*, Haiti*, Honduras, Hungary, Iceland*, India, Indonesia, Iran, Ireland, Israel*, Italy, Jamaica*, Japan, Jordan, Kenya, Kuwait*, Lesotho*, Malawi, Malaysia, Mali, Mauritania*, Mauritius*, Mexico, Mozambique, Nepal*, Netherlands, New Zealand, Nicaragua, Niger*, Norway, Pakistan, Panama*, Paraguay, Peru, Philippines, Poland, Portugal, Republic of Congo, Rwanda*, Senegal, Sierra Leone*, Singapore*, South Africa, Spain, Sri Lanka, Swaziland*, Sweden, Switzerland, Syrian Arab Republic, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Kingdom, USA, Uruguay, Venezuela, Zambia, Zimbabwe.

* indicates that a country is only included in the baseline regression sample but not in the extended regression sample.

6.A.2 Data Sources and Variable Definitions

PF: Volume of all project finance deals signed per country. Source: Loan Pricing Corporation's Dealscan database. For the lagged values of PF used as instruments, we revert to data provided in 2003 by Euromoney, the previous provider of the Dealscan database. Whereas the coverage in later years is consistent in terms of PF volume with Dealscan, Euromoney's coverage prior to 1990s is far more complete.

GDP and GDP growth: Real GDP per capita (growth) in constant 2000 US$. Source: World Development Indicators (WDI), Worldbank (2008).

Income dummies: Dummies indicating if a country belongs to the low-, middle-, or high-income group according to the World Bank's country classification. Source: World Bank.

SSA_D: Dummy indicating countries geographically located in sub-Saharan Africa according to the World Bank's country classification. Source: World Bank.

Schooling: Average years of total schooling of the adult population. Source: Barro and Lee (1996, 2001), http://www.cid.harvard.edu/ciddata/ciddata.html.

Population growth: Annual population growth in percent. Source: WDI, World Bank.

Government consumption: Total expenditure of the central government as a share of GDP; including both current and capital expenditures, excluding net financing. Source: WDI, World Bank.

Law: Average level of law and order. The variable ranges from 0 to 12 with higher values indicating better law and order. Source: International Country Risk Guide.

Black market premium: Calculated as the parallel exchange market relative to the official market; (parallel exchange rate / official exchange rate – 1) * 100. Source: New York University's Global Development Network Growth Database, http://www.nyu.edu/fas/institute

Inflation: Inflation as a percentage, measured as the change in the GDP deflator. Source: WDI, World Bank.

Openness: Calculated as the sum of the volume of imports and exports relative to GDP; (imports + exports)/GDP. Source: WDI, World Bank.

FDI: Net foreign direct investment inflows. Source: WDI, World Bank.

Chapter 7

Conclusions

This dissertation has shed new light on the effects of capital controls on exchange rate dynamics and economic development. The main finding of the second part is that capital controls are largely counterproductive in controlling exchange rates. Observed deviations from parity conditions are not induced by capital controls, while exchange rate risk increases when capital controls are in place. However, in the third part it is shown that the selective use of capital controls can be beneficial to low-income countries. Inflow controls are found to have a positive effect on growth, confirming the view that many forms of foreign capital are only beneficial to a country if its financial markets are well developed. In addition it is shown that project finance is one type of capital which is suitable in the least-developed countries. The rest of the findings are summarized below.

Chapter 2 presents stylized facts of survey exchange rate expectations. These stylized facts can be seen as a set of general constraints to which good exchange rate models should adhere. It is shown that, like spot and forward exchange rates, survey exchange rate expectations are characterized by unit roots, volatility clusters and fat tails.

Moreover, it is argued that the expectations formation of market participants may provide a possible explanation for some of the other characteristics of expected returns. Expectations are formed on with the use of a mixture of chartist and fundamentalist techniques. Chartist techniques are based on realized spot returns, while fundamental models share, arguably, many characteristics with the forward premia. This could explain why, when the characteristics of realized spot returns and forward premia diverge from one another, those of expected returns lie between these two poles. This is the case for the properties of excess volatility, serial correlation, and conditional fat-tailedness: expected spot returns are shown to be less volatile than realized spot returns, but more so than forward premia; unlike realized spot returns, expected spot returns exhibit serial correlation, yet they are less persistent than forward premia; the conditional fat-tailedness of expected spot returns is lower than that of forward premia but more than that of realized spot rates.

In the second part, chapter 3 investigates the link between capital controls and

parity conditions. The results show that capital controls are not able to drive interest rates and forward rates (further) away from parity conditions. There is even some evidence that capital controls may be counter-productive. One of the possible motives for using capital controls is to create more monetary freedom. The results imply, however, that governments may even have less room to set monetary policy if capital controls are employed. Moreover, the results show that there is little to no difference between developing countries and developed countries with regard to the effects of capital controls on parity conditions.

The link between financial liberalization and exchange rate risk is the focus of chapter 4. The results suggest that liberalized financial markets are associated with lower extreme depreciation quantiles compared to the periods where capital controls were in place. In fact, extreme quantiles are almost twice as high in the presence of capital controls as compared to the liberalized capital account regime. This result holds for both developed and emerging economies and for different capital control proxies. The drop in tail risk after liberalization is larger for those countries that experienced relatively more extreme events when capital controls were still in place. These results confirm earlier studies, which found that other forms of exchange rate control, such as pegs, also increase the tail risk of currencies. Chapters 3 and 4 thus both find that capital controls are found to be ineffective in the foreign exchange market: they neither decrease the exchange rate risk present in currencies, nor do they provide extra monetary freedom to governments. On the contrary, the evidence would suggest that capital controls increase exchange rate risk.

Chapter 5, in the third part, studies the effects different types of capital controls have on economic growth. In order to gauge these effects, a new measure of capital controls is constructed. This measure covers a much larger range of controls than previous measurements and makes it possible to differentiate controls on inflows from controls on outflows. Moreover this proxy can measure the intensity of the controls in place, in contrast to the dichotomous nature of older measures. Controls on inflows are found to have a robust positive effect on economic growth, while outflow controls tend to deter economic growth. Equity market controls, furthermore, also have negative effects on economic growth. This latter finding fits nicely with the observed fact that countries tend to liberalize their equity markets before opening up other capital markets.

Chapter 6 continues with the examination of the finance-growth nexus, looking at the specific case of project finance. It is well known that the benefits of foreign capital to the domestic economies are contingent on the development of the domestic financial sector. Most foreign capital tend to be ineffective if local markets have e.g. bad corporate governance or bad protection of property rights. Therefore the least developed countries are better off with relatively 'safe' forms of capital. This chapter argues that project finance is an example of such 'safe' capital: it can adjust relatively well to less-than-favorable environments in least developed countries and may even partially substitute for the lack of institutional and financial development. The empirical results are in line with this hypothesis: it is shown that project finance promotes growth, in particular in low-income countries. This result is robust to outliers as well as possible reverse causality. The evidence is consistent with the

view that project finance has a superior ability to facilitate information production and good project governance. The structure of project finance leads to extensive and effective screening, and it is also likely to flow to growth-enhancing industries. With regard to corporate governance, project finance creates transparency combined with strong monitoring incentives for investments, both of which are independent of any external corporate governance environment. Overall, project finance is advocated as an effective tool to deal with high-risk environments.

This thesis raises a number of new research questions. The results of chapter 4 can be extended to a multivariate framework to compare capital controls with other determinants of exchange rate risk. The results of the third part also deserve more attention; a more detailed analysis of which types of controls are most effective adds to the literature on the sequencing of capital account liberalizations. In addition, the effectiveness of project finance in the least-developed countries can serve as a starting point from which to investigate other types of capital which are effective in dealing with suboptimal allocation of capital. Lastly, the results of the chapter on exchange rate expectations in chapter 3 can be used to investigate the role that foreign investors play in currency crises. The current exchange rate literature has raised several issues regarding the existence of 'peso bubbles'—apparent irrationalities present in the forward foreign exchange—and the self-fulfilling nature of currency crises. Survey exchange rate expectations offer an interesting angle from which to study these issues.

With the recent turmoil in financial markets as a backdrop, the results of this thesis and the proposals for future research which it advances are relevant not only to academics, but also to policymakers. The results highlight how important it is for developing countries to carefully think through the process of financial liberalization. A country should only open up its financial markets when its domestic financial sectors are in a position to handle international capital: the current credit crisis has shown how tumultuous global financial markets can be. At the same time, the results of this thesis constitute a warning: capital controls come at a cost and are in many cases not an effective policy tool. At this moment in time, policy makers are facing the difficult task of revising the international financial architecture. As for my two cents, I believe the risk for industrialized countries lies more in the danger of overregulation than in the free flow of capital.

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Nederlandse Samenvatting

De aanname dat vrije markten superieur zijn aan andere alternatieven is één van de hoekstenen van economisch onderzoek. De theorie is duidelijk: vrije goederenmarkten stellen consumenten in staat om die goederen te kopen die ze het liefst willen hebben en brengen ook een gezonde competitie onder producenten teweeg. Op een soortgelijke manier zorgen vrije kapitaalmarkten voor de meest efficinte allocatie van kapitaal. Rijke landen, die relatief veel kapitaal hebben, kunnen dit geld uitlenen aan arme landen die te kampen hebben met een kapitaalschaarste. Beiden landen halen hier voordeel bij: de investeerder incasseert een hogere rente dan welke hij in zijn thuisland had kunnen ontvangen en de ontvangende landen kunnen het kapitaal goed gebruiken. Bovendien bevordert kapitaalmobiliteit de diversificatie van risico. Vanuit die optiek is het niet verbazingwekkend dat de meeste ontwikkelde landen hun kapitaalmarkten hebben geliberaliseerd. In de jaren negentig was er inderdaad een brede consensus onder de meeste landen dat kapitaalcontrolesweinig of geen rol meer speelden in het bevorderen van financiële stabiliteit. Bretton Woods (1944–1971), gekenmerkt door vaste wisselkoersen en sterke monetaire controle, leek ver weg.

Hoewel de werking van kapitaalcontroles duidelijk beschreven zijn in de economische theorie, is de praktijk echter weerbarstiger omdat de theorie veelal uitgaat van perfecte kapitaalmarkten of een *first best* wereld. In de praktijk zijn er echter vele imperfecties in de kapitaalmarkten: markten zijn niet compleet, informatie is niet symmetrisch, en binnenlandse kredietmarkten imperfect, om maar een paar voorbeelden te nemen. Bovendien wijst de recente literatuur op het gebied van financiële crises op de mogelijkheid van meerdere evenwichten en zelfvoltrekkende voorspellingen, beide welke een mogelijke instabiliteit van de financiële markt inhouden. In deze *second best* wereld van marktverstoringen zijn de effecten van kapitaalcontroles moeilijker te bepalen. De Aziatische financiële crisis van 1997 legde de zwaktes van de huidige internationale financiële wereld pijnlijk bloot en plaatste kapitaalcontroles terug op de agenda. De Aziatische landen die hun kapitaalmarkten het meest verregaand geliberaliseerd hadden, zoals Thailand en Indonesi, werden het hardst getroffen door de crisis, terwijl China en Maleisi, die terugvielen op het gebruik van kapitaalcontroles, relatief ongeschonden uit de crisis leken te komen. De kredietcrisis in 2008 laat zien dat ook de westerse landen niet immuun zijn . Het huidige debat trekt de aanname van marktefficiëntie sterk in twijfel, en veel mensen roepen om meer en strengere regulering. Er zijn zelfs stemmen om een tweede 'Bretton Woods'

te creëren.

Met het oog op deze ontwikkelingen is gedegen onderzoek naar de effecten van kapitaalcontroles belangrijk. Hoewel het niet aannemelijk is dat de ontwikkelde landen hun kapitaalmarkten zullen afsluiten voor buitenlands kapitaal, is het niet ondenkbaar dat de huidige ontwikkelingen een belangrijke factor spelen in de beslissing van ontwikkelingslanden om hun kapitaalmarkten al dan niet te liberaliseren. Een evenwichtige kijk op de voor- en nadelen van kapitaalcontroles is belangrijk om te bepalen of men al al dan niet moet overgaan tot liberalisatie. De doelstelling van deze dissertatie is daarom nieuwe inzichten te verkrijgen in de rol van controles op internationale kapitaalbewegingen. De dissertatie is opgezet rondom drie kernvragen:

1. Wat zijn de karakteristieke eigenschappen van wisselkoersvoorspellingen?
2. Hoe benvloedt financiële liberalisatie wisselkoersrisico en de relatie tussen rentes en wisselkoersen?
3. Hoe wordt economische groei beïnvloed door financiële liberalisatie en welke vormen van kapitaal zijn effectief als financiële markten slecht ontwikkeld zijn?

Het eerste deel van deze dissertatie bekijkt wisselkoersverwachtingen van marktparticipanten verkregen door enquêtes. Het voordeel van deze enquêtes is dat ze wisselkoersverwachtingen observeerbaar maken. Hoewel wisselkoersverwachtingen niet direct te maken hebben met financiële liberalisatie, bieden ze een interessante invalshoek om naar financiële liberalisatie te kijken. Hoewel veel onderzoek gedaan is met verwachtingsdata van wisselkoersen, heeft men nog nooit de karakteristieken van deze enquête data zelf in kaart gebracht. Hoofdstuk 2 vult dit gat in de literatuur met een bespreking van de belangrijkste empirische tijdreekseigenschappen van wisselkoersverwachtingen. . Het hoofdstuk laat zien dat de eigenschappen van verwachte wisselkoersen erg gelijklopend zijn met de eigenschapppen van gerealiseerde contanten termijnkoersen. Hieruit volgt tevens dat de eigenschappen van verwachte wisselkoersrendementen ook moeten lijken op de eigenschappen van gerealiseerde wisselkoersrendementen en termijnpremies. Verwachte wisselkoersen worden, net zoals de gerealiseerde contant- en termijnkoers, ook gekenmerkt door eenheidswortels. Verwachte wisselkoersrendementen worden, net zoals de gerealiseerde rendementen en de termijnpremies, gekenmerkt doorvolatiliteitsclusters en vette staarten. Waar de eigenschappen van gerealiseerde wisselkoersrendementen en termijnpremies van elkaar verschillen, schijnen de eigenschappen van verwachte wisselkoersrendementen een tussenliggende positie in te nemen. Dit is het geval voor eigenschappen zoals exces volatiliteit, autocorrelatie, en conditionele dikstaartigheid.

Deel twee van deze dissertatie onderzoekt het verband tussen kapitaalcontroles en de dynamiek van wisselkoersen. Hoofdstuk 3 onderzoekt het effect van kapitaalcontroles op het verband tussen renteverschillen en wisselkoersen, ofwel de zogenaamde ongedekte rentepariteitsconditie. Het afsluiten van de binnenlandse economievoor buitenlandse invloeden vormt een belangrijk motief voor overheden om kapitaalcontroles in te stellen. Deze studie toont echter aan dat kapitaalcontroles geen goed middel zijn om deze doelstelling te bereiken: de resultaten laten zien dat kapitaalcontroles geen effect hebben op de voornoemde relatie tussen rentes en wisselkoersen

Het terugdringen van wisselkoersvolatiliteit is een ander belangrijk motief voor overheden om kapitaalcontroles in te stellen. De vraag die in hoofdstuk 4 wordt bekeken, is echter of controles daar daadwerkelijk bij helpen. Grote depreciaties van de eigen valuta vormen meestal de belangrijkste bron van zorg voor beleidsmakers. Dit hoofdstuk gebruikt statistische extreme waardentheorie om de waarschijnlijkheid van optreden van deze extreme neerwaartse bewegingen te meten. In een eerste stap wordt bepaald hoe vet de staarten van de distributie van wisselkoersrendementen zijn. Des te vetter de staarten , des te groter de kans dat zich een extreem grote neerwaartse (of opwaartse) beweging voordoet. In een tweede stap wordt met behulp van een zogenaamde kwantielschatter berekend—voor een gegeven kleine overschrijdingskans— hoe groot deze extreme bewegingen precies zijn. De resultaten laten zien dat voor de meeste landen de staartdikte en de grootte van de extreme kwantielen afnemen na liberalisatie. . Geliberaliseerde markten vertonen dus minder extreme depreciaties dan gecontroleerde markten en dit geldt voor zowel ontwikkelingslanden als voor ontwikkelde landen. Op basis van de resultaten in hoofdstuk 3 en hoofdstuk 4 kan men dus concluderen dat kapitaalcontroles contraproductief zijn in het reguleren van wisselmarkten.

Het laatste deel van dit proefschrift neemt het bredere vraagstuk van economische ontwikkeling onder de loep. Er bestaat een grote literatuur over hoe ontwikkelingslanden hun gesloten en onderontwikkelde kapitaalmarkten kunnen transformeren naar open en hoogontwikkelde kapitaalmarkten Dit deel van de dissertatie sluit aan bij die literatuur. In hoofdstuk 5 wordt gekeken naar de positieve en negatieve effecten van verschillende types van kapitaalcontroles op economische groei, terwijl 6 beargumenteert dat projectfinanciering een geschikte vorm van kapitaal is en groeibevorderend functioneert in laag ontwikkelde kapitaalmarkten.

Om de effecten van verschillende types van kapitaalcontroles van elkaar te onderscheiden, wordt in hoofdstuk 5 een nieuwe maatstaf ontwikkeld die een grotere variteit aan verschillende controles omvat dan tot nog toe het geval was in empirisch groeistudies. . Bovendien geeft deze maatstaf een indicatie van de intensiteit van de controles, waar voorgaande maatstaven dit veelal niet deden. De resultaten van dit hoofdstuk laten zien dat in ontwikkelingslandencontroles op de instroom van kapitaal wel een positieve invloed hebben op economische groei en dit in tegenstelling tot controles op de uitstroom van kapitaal. Ook wordt aangetoond dat controles op de in- en uitstroom van kapitaal in de aandelenmarkten een negatief effect hebben op economische groei. Dit fenomeen kan ook verklaren waarom veel landen hun aandelenmarkten relatief vroeg liberaliseren.

Projectfinanciering en het effect op economische groei staan centraal in hoofdstuk 6. In deze vorm van financiering wordt een project, bijvoorbeeld een energiecentrale, opgezet binnen een'projectbedrijf' dat als een onafhankelijke rechtspersoon opereert en dat voornamelijk gefinancieerd wordt door syndicaatsleningen. De vorm van financiering wordt voornamelijk gebruikt voor complexe projecten met veel assymetrische informatie en een hoog risico. Wij argumenteren dat projectfinanciering erg geschikt is voor gebruik in ontwikkelingslanden omdat de unieke structuur van deze vorm van kapitaal goed om kan gaan met slecht ontwikkelde financiële markten. In de empirische sectie wordt aangetoond dat dit inderdaad het geval is.

Deze dissertatie werpt een aantal onderzoeksvragen op voor vervolgonderzoek. Ten eerste is er de mogelijkheid om de verwachtingsdata (besproken in hoofdstuk 2) te gebruiken om te kijken naar de rol van buitenlandse investeerders in financiële crises. Ten tweede kunnen de resultaten van hoofdstuk 4 uitgebreid worden naar een multivariate analyseom kapitaal controles te vergelijken met andere determinanten van wisselkoersrisico. Ten derde kan de constatering van hoofdstuk 6 dat projectfinanciering bijdraagt aan economische groei dienen als een startpunt om andere vormen van kapitaal te vinden die geschikt zijn om economieën met slecht ontwikkelde financiële markten te ontwikkelen.

De resultaten en de suggesties voor toekomstig onderzoek in deze dissertatie zijn zowel relevant voor academici als beleidsmakers. De resultaten onderstrepen het belang voor ontwikkelingslanden om goed na te denken over hoe en wanneer hun kapitaalmarkten te liberaliseren: financiële liberalisatie is een proces dat alleen ondernomen moet worden als binnenlandse kapitaalmarkten daar klaar voor zijn. Tegelijkertijd bevat deze dissertatie ook een waarschuwing: kapitaalcontroles zijn niet kosteloos en zijn in veel gevallen niet het juiste middel voor beleidsmakers.

Curriculum Vitae

Roald Versteeg was born on April 14, 1981 in Harmelen, the Netherlands. He has studied international business and econometrics at Maastricht University and graduated in 2004 with a master's degree in international business studies, with a specialization in finance.

In 2005 Roald joined the department of finance at Maastricht University to write his doctoral dissertation on the effects of financial liberalization on exchange rates and economic development, under the supervision of prof. dr. Christian C.P. Wolff and dr. Stefan T.M. Straetmans. During this period he has taught various courses in the field of international finance, corporate finance, and financial crises. He has also been a visiting researcher at the University of California Berkeley, the Christian-Albrechts-Universität zu Kiel (2007) and the European University Institute in Florence (2008). He has completed his dissertation in 2009. Roald's work has been presented at leading international conferences, including the annual meetings of the European Economic Association and the American and European Financial Management Associations.

In the academic year 2009-2010 he is a visiting postdoctoral fellow at the Max Weber Programme of the European University Institute at Florence. His current research interests include financial economics and international macroeconomics.