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Economic Effects of Financial Integration for Developing Countries

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Economic Effects of Financial Integration for Developing Countries

ACADEMISCH PROEFSCHRIFT

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aan de Universiteit van Amsterdam

op gezag van de Rector Magnificus

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Faculteit der Economische Wetenschappen en Econometrie

Voor papa

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Neeltje van Horen

Amsterdam, June 2005

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Chapter 1

Introduction and Outline

1.1 Introduction and Motivation

The last few decades have been characterized by a rapid integration of the world's financial markets. For example the global issuance of bonds has risen rapidly in the last decade even as capital raised with cross-listed stocks. Furthermore, the international trade of financial assets has increased substantially. A key factor underlying this process has been the increased globalization of investments seeking higher rates of return and the opportunity to diversify risk internationally. At the same time, many countries have encouraged capital inflows by lifting capital account restrictions and other barriers to investment in combination with improvements in the economic environment and the introduction of market-oriented reforms.

Developing countries can potentially benefit a great deal from increased integration with world financial markets. In most developing countries saving rates are low and as such internal resource mobilization is constrained. This makes it difficult for investors to find adequate resources for projects with high rates of return. Integrating the domestic financial market with the world has a positive impact on the development of the domestic financial market and improves access to the international capital market. This increases the pool of potential resources and makes it more likely that high return investments can be financed, which can bring about economic growth.

However, events over the past decade, such as the Tequila Crisis, the Asian financial crisis, and the collapse of the Argentine currency board, have focused attention on the risks of integration of financial markets, especially for developing countries. Being

highly dependent on externally generated funds to generate growth, the resilience of the economies in times of sudden stops is low. Once linked to other financial markets, developing countries may suffer not only from volatility in their own financial markets but also from the contagion effects of volatility occurring elsewhere.

This thesis contains four essays in which several aspects of the impact that financial markets have on developing countries' economies are analyzed. As for developing countries access to international financial markets can potentially have large benefits but the risks to the economy can be equally large, it is vital to understand well how international financial integration affects developing countries. The purpose of this thesis is to contribute to our understanding of how financial integration and financial market development affect developing countries, both from a macroeconomic as well as a microeconomic perspective.

This thesis starts with the introduction of a novel methodology to measure financial market integration. It demonstrates that international financial integration of a number of emerging markets with the United States is high compared to goods market integration. This integration increases with market liquidity. We find that capital controls, when binding, contribute to a segmentation of financial markets. However, financial crisis although associated with higher volatility do not seem to lead to weaker market integration.

International financial integration positively affects the development of the financial sector, which in turn affects the behavior of agents in the economy. In Chapter 3 we show that the development of the financial system influences the choice firms make whether to sell their goods on credit. The chapter demonstrates that firms use trade credit as a competitiveness tool and that this motive to sell goods on credit is stronger in countries with an underdeveloped financial system.

The last two chapters specifically investigate the potential downside of financial market integration: financial crises. In Chapter 4 an explanation is provided for the 'boom' in the stock market that characterized the Argentine crisis. It argues that the capital controls introduced at the start of the crisis were effective at curbing the massive capital outflow that took place in the months preceding this crisis. The effectiveness of the capital controls in combination with deposit inconvertibility provided an incentive for

investors to get their money out of the banking system and into the domestic stock market, creating a boom in stock prices.

Chapter 5 analyzes whether contagion took place during the Asian crisis. It examines whether the effect of the exchange market pressure (EMP) of Thailand on the EMP of four crisis countries increased during the crisis. Applying regression analysis, instead of the commonly used correlation coefficients, we find evidence of contagion from Thailand to Indonesia and Malaysia, but not to Korea and the Philippines.

Finally, Chapter 6 concludes this thesis by summarizing the main conclusions of the separate chapters and providing suggestions for further research.

1.2 How Integrated are Developing Countries' Financial Markets?

1.2.1 Factors Driving Financial Integration of Developing Countries

International financial integration can be defined as the integration of the domestic financial system with international financial markets. The concept itself is not new, in the late nineteenth century financial markets were already highly integrated. However, a clear difference between then and now is that in the late nineteenth century only a few countries and sectors participated in the global economy. Furthermore, capital flows in that period tended to follow labor migration and were mostly directed towards supporting trade, whereas nowadays a large proportion of capital is crossing borders for pure investment purposes (i.e. portfolio and FDI flows).

Although then developing countries did receive substantial amounts of foreign capital in the late nineteenth century, these flows, in conjecture with all international capital flows, completely dried up in the period 1914-1945. Both World Wars and the Great Depression of the 1930s provoked a turnaround from a globalized economy to an almost autarkic one. In this period many countries introduced capital controls and international investment was regarded with suspicion.

In the Bretton Woods era (1945-1971) the rebuilding of the global economy took shape and international capital flows slowly increased. Starting in the early 1970s capital flows to developing countries regained momentum. Before the Debt crisis of the 1980s

these capital flows were mainly driven by the need for governments of non-oil exporting countries to finance their current account deficits. The large windfalls of OPEC countries due to the oil price shocks of the 1970s led to a recycling of petrodollars by banks in industrial countries which found their way to developing countries in need of capital. This expansion of government debt came to an end in 1982 with a rapid withdrawal of bank lending, resulting in a generalized Debt crisis in the developing countries. During the rest of the 1980s capital inflows to developing countries remained virtually stagnant.

The decade of the 1990s witnessed a strong expansion in capital inflows to developing countries, resulting from a surge in private capital flows. This was the result of on the one hand push factors like business cycle conditions and macroeconomic policy changes in industrial countries, and on the other hand pull factors like liberalization of capital accounts and domestic stock markets, privatization programs and economic reforms reducing transaction costs and risks of foreign investments.

A number of actors were involved in this process of increased financial integration: government, borrowers and investors, and financial institutions. Governments in developing countries started to recognize their need for foreign capital, especially in the aftermath of a crisis, to finance budget deficits and to capitalize troubled banks. This pushed them into lifting restrictions on the domestic financial sector and the capital account of the balance of payments. The fact that capital controls became increasingly costly and difficult to maintain served as an additional motivation to remove them.[1] Furthermore, governments became more aware of the failure of government-led financial systems and non-market approaches and realized that a more efficient and robust domestic financial system could have a beneficial impact on growth and stability. In addition, the privatization of government enterprises expanded investment opportunities in these countries.

The opportunity to borrow abroad allowed firms and consumers, in addition to governments, to lessen their financial constraints, and as such to smooth out investment and consumption. From the perspective of international investors, the inclusion of developing countries' stocks and bonds in their portfolios allowed improvements in

[1] Kaminsky and Schmukler (2003) show that there has been a gradual lifting of restrictions, sometimes temporarily reversed, in developing countries from the 1970s onwards.

international risk diversification. This type of risk diversification was facilitated by the introduction of international mutual funds, depositary receipts, cross-listed shares of international companies and international corporate and sovereign bonds. In addition, technical advances contributed to the development of financial instruments that improved the effectiveness of risk management.

Also international financial institutions could benefit from major improvements in information technology. As evaluating and monitoring investments around the globe has become much easier, it is now possible to service several markets from one location. In developed countries the increase in competition led banks and non-bank financial firms to explore opportunities in new businesses and markets (for example the insurance market). While in developing countries the liberalization of the regulatory system allowed international firms to participate in local markets.

Abovementioned factors resulted in an increase of net financial flows to developing countries from $10.5 billion (or less than 2 percent of developing countries' GDP) in 1970 to $324 billion (or 4.4 percent of developing countries' GDP) in 2004 (World Bank (2005)). The composition of these flows has changed drastically over time. First these flows mainly consisted of bank and trade-related lending, but after the Debt crisis of the 1980s FDI and portfolio flows became increasingly more important. Nowadays private equity flows take into account 59 percent of total net flows to developing countries (World Bank (2005)).

1.2.2 How to Measure Financial Integration?

But how well integrated are these developing countries nowadays with the world economy? Several measures have been identified in the literature to determine the extent of international financial integration. Obstfeld and Taylor (2002) provide a comprehensive overview of the main measures introduced in the literature. Broadly these measures can be divided into two strands, the stock-based measures and the price-based measures.[2]

[2] It is also possible to make a distinction between de facto integration based on actual flows and stocks and de jure intergration which is associated with policies on capital account liberalization. Prasad, Rogoff, Wei, and Rose (2004) emphasize the distinction between these two types of measures.

A well-known example of a stock-based measure of financial integration is the Feldstein-Horioka condition (Feldstein and Horioka (1980)). This measure applies the idea that when a country is integrated with the rest of the world its domestic investment is no longer constrained by its level of domestic savings. In a country that is highly integrated the Feldstein-Horioka coefficient, obtained by regressing investment on savings, should be close to zero. However, testing for this in a sample of 16 OECD countries, Feldstein and Horioka (1980) found that gross domestic savings and investment rates are in fact highly correlated, invalidating the common sense of existence of capital mobility. This finding is known in the literature as the Feldstein-Horioka paradox. In an attempt to solve this paradox, a large literature has developed proposing modifications of the original model and alternative estimation methods (see for example Sachs (1981); Dooley, Frankel, and Mathieson (1987); and Tesar (1991)).

A more recent stock-based measure of financial integration is the gross foreign asset and liability position with respect to the rest of the world. Lane and Milessi-Ferretti (2003), for example, construct estimates of foreign assets and liabilities relative to GDP for a sample of industrial countries. They document that this ratio has increased with 250 percent in the period 1983-2001, with a marked increase during the 1990s.

Price-based measures of international financial integration can broadly be put into two categories. The first category analyzes integration by estimating return correlations across markets. For example, Bekeart and Harvey (1995) employ a Capital Asset-Pricing model (CAPM) that allows for the degree of integration to change through time. Using the model on data from several industrial and emerging economies they find evidence of the existence of time-varying integration for a number of countries. A number of other studies apply the CAPM methodology to examine the correlations of returns using various specifications of the model (see for example Bekaert, Harvey, and Ng (2003); Carrieri, Errunza, and Hogan (2001); and Flood and Rose (2003)). Others use, for example, Vector Autoregression (VAR) models to study the correlation of returns. For example, Soydemir (2000) studies international stock market interdependence between the US and Latin American countries and Masih and Masih (2001) between a number of OECD and Asian countries.

This literature is very useful in understanding the possibilities of international risk diversification. However, the work is based on the comparison of price indexes and as such is subjected to two problems. On the one hand the composition of the indexes across countries might be different, which can bias the results. Furthermore, recent results of Imbs, Mumtaz, Ravn, and Rey (2004a) indicate that the persistence of price deviations from purchasing power parity (PPP) are significantly understated in the previous literature due to an aggregation bias. This aggregation bias is also likely to affect measures of financial integration based on price indexes. In addition, when based on Capital Asset-Pricing models these studies test simultaneously the extent of integration as well as the applicability of a particular model.

In the second group of studies the measure of financial integration is based on the most basic definition of international financial integration: the Law of one price (LOOP). Different tests for the Law of one price to hold have been performed.[3] Flood and Rose (2004), for instance, estimate expected intertemporal marginal rates of substitution for different markets, which they then compare to test for (domestic and international) asset market integration. Another group of papers, in response to the composition problem associated with price indexes, specifically focuses on the evolution of the premium of emerging market closed-end country funds over the value of the underlying portfolio (see Frankel and Schmukler (1998 and 2000); and Levy Yeyati and Uribe (2000)). While free from the composition bias, these attempts however fall short of comparing identical assets, as the restrictions and management of closed-end funds distinguishes them from their underlying portfolio.

In Chapter 2 a new price-based measure that reflects the idea that the Law of one price must hold when markets are fully financially integrated is introduced. Using the idea that two markets are integrated when identical goods or assets are priced identically across borders, we construct the cross-market premium. This is the percentage price difference between depositary receipts in international markets and their underlying shares in domestic markets.

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[3]Criteria such as the (covered and uncovered) interest rate parity, and the real interest rate parity conditions, are related to this group to the extent that they focus on the analysis of onshore-offshore return differentials (see, among many others, Meese and Rogoff (1988), MacDonald and Nagayasu (2000); and Chortareas and Driver (2001)). Strictly speaking, however, these conditions are not LOOP tests, as they abstract from the potentially relevant role played by exchange rate risk.

Depositary receipts (also known as American Depositary Receipts or ADRs) are shares of non-U.S. corporations traded in the U.S. (and denominated in dollars), while the underlying shares trade in the domestic market of the issuer. A depositary receipt represents a specific number of underlying shares remaining on deposit in a so-called custodian bank in the issuer's home market. A new DR can be created by depositing the required number of shares in the custodial account in the market and this process can simply be reversed by canceling or redeeming the DR. Thus, an underlying stock can easily be transformed into a DR and vice versa implying that the two assets are identical.

Using the cross-market premium as a measure to determine the financial integration of countries has a number of advantages. First, as it is based on two truly identical assets it allows testing for the law of one price while avoiding the composition and aggregation biases as well as the need to control for idiosyncratic risk. Second, because it is a market-based variable no model needs to be opposed on the data. Third, the measure is continuous and it can incorporate the area between complete segmentation and complete integration, while it can also capture reversals in the process of integration that can arise from the introduction or the lifting of investment barriers. Finally, it is amendable to the use of TAR models.

Similar to recent work done in the purchasing power parity (PPP) literature, which examines whether the law of one price holds in the goods market, we employ a threshold autoregressive (TAR) model to test for the presence of transaction-cost based segmentation in financial markets. The TAR model is a piecewise linear autoregressive model that allows for regime switching parameters depending on the distance of an observation from the mean. The model can capture non-linearities in the data and estimate the width of no-arbitrage bands (that is, zones where deviations between the price of the depositary receipt and the underlying stock are not quickly arbitraged away), a good thermometer of financial integration.

As in the PPP literature, we use the TAR model to estimate the bands of no-arbitrage and convergence speeds. We interpret both the bandwidth and the convergence speed once outside the band of no arbitrage as (inverse) measures of integration. To test

the consistency of the results of the TAR model we also estimate autoregressive (AR) models.

For the nine emerging markets in our sample we find evidence of strong financial integration: the cross-market premium remains close to zero, with very narrow no-arbitrage bands and rapid convergence back to the band when outside the no-arbitrage zone. Compared to estimates previously found for goods market integration (Obstfeld and Taylor (1997)), we find that, as expected, the band of inaction is smaller in our case. In addition, arbitrage takes place much more quickly in the financial market than in the goods market.

Furthermore, we find that liquidity affects the degree of financial integration. When stocks are liquid the no-arbitrage bands are narrower and convergence more rapid. The presence of capital controls, when binding, is directly reflected in the cross-market premium. When controls are introduced the bands of no-arbitrage widen and the premium diverges from its zero mean. In addition, once outside the band of no-arbitrage the persistence of a shock is longer. By contrast, the incidence of a financial crisis, while increasing the volatility of the cross-market premium, does not seem to have an impact on the degree of financial integration.

1.3 International Financial Integration and Financial Sector Development

1.3.1 International Financial Integration, Financial Sector Development and Growth

The trend of increased financial integration witnessed among developing countries can be explained by a number of benefits that this process can generate. For example, financial integration can bring about growth in domestic savings as the increased investment reduces the risk-free rate. In addition, the better allocation of risk in general causes a reduction in the cost of capital. As profit-maximizing firms will drive down the marginal product of capital to this new lower cost, the reduction in cost of capital will increase investment and as such foster growth (Henry (2003)). Furthermore, FDI can prove to be beneficial as it, besides bringing capital and employment inflows, potentially enables the

transfer of technologies and managerial know-how and increases competition. These spillovers can raise aggregate productivity and in turn boost economic growth (Borensztein, De Gregorio, and Lee (1998); Grossman and Helpman (1991)). Financial integration can also lead to an improvement in policies and institutions. For example as negative consequences of predatory policies like taxes on physical capital are far more severe in a country that is financially open, governments are less likely to engage in these policies (Gourinchas and Jeanne (2002)).

But likely the main potential benefit of international financial integration for developing countries is that it may have a positive impact on the development of the financial system. In a country with a more developed financial system the financial sector is more efficient at converting funds into productive investments and better able to allocate them to the most productive investment projects. This generates growth. Furthermore, because of this increase in efficiency the impact of a rise in savings and investment due to financial integration will be much larger.

There exists much empirical evidence on the link between financial sector development and economic growth.[4] Love (2003) finds that a deepening of the financial sector reduces financing constraints firms face. As a result it will be easier for firms with good investment opportunities to find external capital, which generates growth. Demirguc-Kunt and Maksimovic (1998) find that there exists a positive relation between financial sector development and the proportion of firms that are growing faster than they could have when using only internally generated funds. Rajan and Zingales (1998) show that industries that require more external finance grow faster in more developed financial markets. On a country level King and Levine (1993), Levine and Zervos (1998) and Beck, Levine, and Loayza (2000)) find that the development of the banking sector has a positive impact on economic growth.

A number of mechanisms can be identified through which financial integration promotes the development of the domestic financial system. First, more and new type of capital becomes available due to an increased number of sources of finance, and increased availability of products, instruments and services to nationals. As a result better

[4] See Levine (2004) for an extensive overview.

risk diversification both within and across countries is possible. At the same time foreign capital enforces market discipline as it can easily shift from one country to another.

Second, openness to international capital flows can bring about improvements in the financial infrastructure. For example, the use of international accounting standards can increase transparency and new shareholders can provoke the improvement of corporate governance. Furthermore, the entry of foreign banks can lead to more efficiency and improved quality of the domestic banking sector. On the one hand due to increased competitive pressure and managerial and technological know-how spillovers from foreign to domestic banks. On the other hand because the presence of foreign banks can stimulate the development of the underlying bank supervisory and legal framework and increases the access of the country to international capital (Levine (1996) and Claessens, Demirguc-Kunt, and Huizinga (1998)).

Furthermore, to the extent that foreign capital flows are intermediated by domestic financial institutions they can help make the banking sector in the local economy more efficient and/or better at selecting productive investment projects. After all, increased financial intermediation improves the efficiency with which savings are allocated to investment, increasing the overall productivity of capital. As financial intermediation increases, banks are assumed to gain experience in evaluating alternative investment projects and are thus better able to shield high-yielding projects. In addition, they can channel a larger proportion of funds to projects where the marginal product of capital is higher, because they are also able to provide risk-sharing and can thus induce individuals to invest in riskier but more productive investments.

1.3.2 Financial Sector Development and the Use of Trade Credit

Besides the fact that a well-developed domestic financial system fosters growth of firms, empirical evidence indicates that variation in the development of the financial system can also impact other aspects of firm behavior. For example Demirguc-Kunt and Maksimovic (2002) find that the development of a country's banking system positively affects the provision and use of trade credit by firms. This result suggests that the provision of trade credit is complementary to the development of financial intermediaries. Chapter 3 of this thesis complements the study of Demirguc-Kunt and Maksimovic. It provides a motive

why firms provide trade credit: the use of trade credit as a competitiveness tool. It subsequently investigates, among other things, whether this motive is stronger or weaker when the financial sector is well developed.

Many firms in developing countries, especially the small and medium enterprises, are severely constrained by the lack of access to external finance (Beck, Demirguc-Kunt and Maksimovic (2004)). As a result they often have to rely on internally generated funds to fund their business. An alternative method to obtain necessary resources is through trade credit. Trade credit is generated when the supplier allows its customer to defer payment until some pre-established date after the goods are received. As a result, trade credit in effect functions as a loan for firms that have (more) problems getting finance from financial intermediaries. So through the use of trade credit firms with access to external sources of finance can function as financial intermediaries for firms that lack this access (see for example Smith (1987); Mian and Smith (1992); Biais and Gollier (1997); and Cunat (2000))

The empirical literature provides evidence that firms that have access to finance indeed sell a larger proportion of their goods on credit (see for example Petersen and Rajan (1997)). However, evidence also shows that trade credit is not only provided by firms that have access to capital but also to a large extent by small and young firms that are in general more financially constrained. For example, a survey of the Central Bank of Mexico shows that in the first half of 2004 on average 73.3 percent of the large firms and 81.1 percent of the small firms provided trade credit to their customers.

Chapter 3 provides a potential explanation for this phenomenon. It argues that especially firms in developing countries that lack a solid reputation (proxied by their size, age and their access to external sources of finance) use trade credit as an instrument to increase market share, in other words they use trade credit as a competitiveness tool. The smaller the market power of the supplier and the larger the market power of its customers, the more trade credit will be provided by the supplier, especially when it has not been able to build a strong reputation.

This chapter then examines the impact of both financial as well as legal development on the usage of trade credit as a competitiveness tool. We find that the development of the legal system, while negatively correlated with the provision of trade

credit, hardly affects the use of trade credit as a competitiveness tool. In contrast, we find that the development of the financial sector does have an impact on the use of trade credit as an instrument to be more competitive. If the financial system is well developed, customers are less likely to exert their market power. We argue that this result is caused by the fact that in countries with a well-developed financial system information about firms is more widely available and this information can serve as a guarantee for product quality. Hence, under these circumstances the need to exert market power through demand of trade credit is more limited.

1.4 International Financial Integration, Financial Crises and Contagion

1.4.1 International Financial Integration and Financial Crises

Financial markets can function as the vehicle through which resources can flow to places where they are most productive. This eases constraints facing capital-starved nations and fosters a more efficient allocation of investment across countries. However, events like the Tequila crisis, the Asian financial crisis and the collapse of the Argentine currency board have directed attention towards the potential drawbacks of financial integration for developing countries.

Different channels can be identified through which financial integration can affect exchange rate instability, possibly culminating in a full-blown financial crisis. In an open economy both domestic as well as foreign investors can enforce market discipline. As foreign capital can quickly switch from one country to another, the market discipline enforced by foreign investors is especially effective. It is expected that this improved market discipline aids the country in pursuing sound economic policies and as such will lead to improvements in the country's macroeconomic fundamentals in the long run. However, when domestic fundamentals are weak, especially after financial liberalization, the stringent market discipline enforced by foreign investors can make countries more fragile and prone to financial crises in the short run.

Another channel that links financial integration to financial crises is the currency composition of capital flows to developing countries, which is mostly if not entirely

foreign currency denominated. As a result currency mismatches in bank's balance sheets can emerge and can potentially become very large, creating a situation of high vulnerability. Furthermore, the large capital inflows often result in more risk-taking by the domestic banking sector fueling a credit boom. In the absence of adequate supervision and regulation, this risk-taking may easily become excessive creating vulnerabilities in banks portfolios and amplifying the business cycle.

Capital inflows to developing countries are furthermore often of a short-term nature creating maturity mismatches in banks' balance sheets. For example, the percentage of short-term debt relative to total debt was very high for the private sectors in Indonesia, South Korea and Thailand when the Asian crisis hit. When reliance on short-term capital is high compared to the ability to generate loans on a short-term notice countries become vulnerable to sudden reversals of capital and as such to a crisis. Nowadays there is broad consensus that countries should not rely excessively on short-term debt. However, as pointed out by Broner, Lorenzoni, and Schmukler (2004) lengthening the maturity structure of liabilities is expensive for developing countries as they are subject to a high risk premium charged by international capital markets on long-term debt.

Empirical evidence suggests that financial liberalization is indeed a contributing factor to financial crises. Studying developed countries, Eichengreen, Rose, and Wyplosz (1995) find that the presence of capital controls reduces the probability of a currency crisis. Rossi (1999) tests the same hypothesis on a sample including developing countries and confirms the results found by Eichengreen, Rose, and Wyplosz (1995). Studying a sample of 53 developed and developing countries, Demirgüç-Kunt and Detragiache (1998) find a strong effect of financial liberalization on banking crises. Glick and Hutchinson (1999) investigating a large number of banking, currency and twin crises find that the latter are mainly concentrated in financially liberalized emerging economies.

However, the relationship between financial liberalization and crisis seems to be dependent on country characteristics. Mehrez and Kaufmann (2000) using data on 56 countries from 1977 to 1997 find evidence that the probability of a crisis is higher in the period following financial liberalization in countries with poor transparency. Rossi (1999) finds that the regulatory and supervisory framework affects the financial fragility

of countries. And Demirgüç-Kunt and Detragiache (1998) conclude that a strong institutional environment, characterized by effective law enforcement, an efficient bureaucracy and little corruption can curb the adverse effects of financial liberalization.

While crises can be associated with financial liberalization, the literature also stresses the importance of domestic factors as key determinants of crises. Kaminsky and Reinhart (1999) show that both currency and banking crisis, albeit often fuelled by a credit boom related to financial opening, are in general accompanied by a number of weak and deteriorating domestic fundamentals. Using a sample of more than 100 developing countries Frankel and Rose (1996) find that currency crashes are associated with a number of domestic fundamentals like low output growth and high growth in domestic credit. In addition, Burnside, Eichenbaum and Rebelo (2001) argue that the 1997 Asian currency crisis was to a large extent caused by large prospective deficits associated with implicit bailout guarantees to failing banking systems.

Chapter 4 of this thesis looks at one particular crisis that was for a substantial part caused by domestic factors: the Argentine crisis. Starting end 2001 the Argentine economy became engulfed in a crisis of massive proportions. This crisis led to the collapse of the peg of the peso against the dollar established in 1991, the introduction of stringent capital controls that remained in effect until late 2002, the suspension of convertibility of bank deposits (the so-called 'corralito'), and the largest debt default in history. The Argentine crisis was the result of a combination of factors, including a fixed exchange rate, unsustainable fiscal policy causing an excessive amount of dollar denominated debt, an inflexible labor market and some foreign shocks, in particular the appreciation of the dollar in combination with the depreciation of the Brazilian real, and the Russian crisis which caused a sudden and persistent change in investors' risk perception with regard to emerging markets.

Amidst complete economic disarray and social unrest the Argentine stock market surprisingly witnessed a 'boom' in prices. This boom resulted in a cumulative increase of the local stock market index of 64 percent between the start of the corralito on December 3 2001 and the devaluation of the peso on January 7 2002 and a further increase of 50 percent by end-2002. This boom is in sharp contrast with the experience of other countries that recently experienced a crisis and saw substantial drops in domestic stock

market prices. For example in Mexico stock prices declined more than 40 percent between December 1994 and February 1995. The Korean stock market saw its prices drop sharply with 47 percent between the start of the Asian crisis in July 1997 and November of that year. Similarly the stock markets of the other Asian crisis countries had to take significant losses in the early phase of the crisis. Chapter 4 gives a potential explanation for this remarkable feature of the Argentine crisis.

The integration of the Argentine economy with the rest of the world implied that the risk of an emerging crisis induced a large outflow of capital resulting in a rapid decrease in foreign reserves in the second half of 2001. To curb the depletion of foreign reserves the Argentine government imposed stringent controls on capital outflows effective December 3, 2001. Chapter 4 of this thesis argues that the capital controls introduced in the beginning of the crisis were effective in curbing the massive outflows that took place in the months preceding the crisis. The effectiveness of the restrictions on capital outflows in combination with the imposition of the corralito by the Argentine government, made investments in liquid Argentine stocks a better option than keeping money in savings accounts, resulting in a boom in the Argentine stock market.

1.4.2 Transmission of Financial Crises

The 1990s can be looked back at as a period of systemic financial crises: The crisis of the European exchange rate mechanism (ERM) in 1992 and 1993, the Tequila crisis of 1994, the Asian crisis of 1997, the Russian collapse of 1998 and the devaluation of the Brazilian real in 1999. One striking feature of several of these crises was that a shock to one country did not stay contained to that country but quickly spread to other countries. This characteristic fuelled an active debate both in research as well as in policy circles on the transmission of crises between countries.

The simultaneous occurrence of financial crises in various countries can be the result of several factors. Masson (1998), Claessens, Dornbusch, and Park (2001), and Forbes and Rigobón (2001), among others, provide a taxonomy of these various causes. First, the synchronous occurrence of a crisis across countries can be the result of a common external factor. For example the rise in the U.S. interest rate can prompt capital to flow out of several countries at the same time, putting currencies under pressure. After

such a shock simultaneously affecting several economies, asset prices of these countries will (at least to some degree) move together.

Second, a crisis can spread from an infected country to other countries when real and financial linkages exist. This form of comovement, often referred to as a spillover, reflects a normal interdependency between countries but during a crisis period. For example, a major trade partner of a country where a financial crisis has caused a large currency depreciation will experience a decline in its exports to the crisis country and hence a deterioration in its trade account. Investors foresee this, which can cause a decline in asset prices and large capital outflows. In addition, a country competing with a country hit by a financial crisis in a third country loses its export competitiveness which can put pressure on its currency especially when it is not freely floating. Hence, trade links can cause a crisis to spread.

In addition, the existence of a common creditor can also bring about the transmission of a crisis. The need for banks to rebalance their overall risk when they have exposure in a country hit by a financial crisis can lead to a marked reversal in bank credit across other markets where these banks have exposure, especially markets that are most correlated with the initial crisis country.

Country reevaluation or the so-called “wake up call” effect is another channel through which a crisis can spread. A shock to the currency of one country may make market participants skeptical about the prospects for the currencies of other countries with similar macroeconomic structures and policies. The attack on one country’s currency reveals information about market sentiments regarding the viability of a particular economic strategy.

Herding behavior of investors can result in investors withdrawing funds from a group of countries irrespective of the soundness of their economic fundamentals. Calvo and Mendoza (2000) argue that especially emerging markets are susceptible to herd mentality by investors. Due to high costs of collecting information about the state of the economy of emerging markets, a large number of investors are uninformed and follow the actions undertaken by the informed investors. As a result it is possible that informed investors are forced to sell assets in order to meet margin calls, which can be misinterpreted by the uninformed investors as a signal that something is wrong.

Finally, also the existence of multiple equilibria can explain the occurrence of crisis transmission irrespective of economic fundamentals if the crisis in one country is used as a sunspot for other countries. The crisis in one country causes another economy to move from a good to a bad equilibrium as investors' expectations shift (Masson (1998); Jeanne (1997); and Botman and Jager (2002)).

The empirical literature on crisis transmission has used several approaches to identify what is driving market mayhem. Most of the earlier literature builds on the crisis prediction literature and examines whether the likelihood of a crisis in a specific country increases when another country or group of countries is hit by a crisis (Eichengreen, Rose and, Wyplosz (1996); Glick and Rose (1999); De Gregorio and Valdes (1999); and Kaminsky and Reinhart (2000)).

This literature is directed at identifying the linkages through which a crisis spreads without distinguishing between tranquil periods and crisis periods. For example Eichengreen Rose and Wyplosz (1996), using thirty years of panel data covering 20 industrialized countries, test whether crises are transmitted via trade linkages or as a result of macroeconomic similarities. They find evidence that trade links are an important channel of crisis transmission. Glick and Rose (1999) study the issue further in a broader country context and also found evidence for the significance of trade linkages in the transmission of a crisis. Kaminsky and Reinhart (2000) on the other hand find evidence of the existence of a common creditor channel.

More recent literature has specifically tested for a change in the transmission mechanisms during a crisis as compared to a tranquil period. These studies make a distinct difference between normal interdependence, the propagation of shocks due to fundamental and real linkages that were also prevalent during tranquil times and contagion which implies a regime change in the factors driving the transmission of negative shocks. For example, Calvo and Reinhart (1996) find evidence of contagion in the stock market and Brady bonds during the Mexican crisis. Forbes and Rigobón (2002) look at contagion through the stock market in the Asian and Mexican crises and the U.S. stock market crash and find, after correcting correlation coefficients for the presence of heteroskedasticity, no evidence of its occurrence. Baig and Goldfajn (1998) find evidence

of substantial contagion in the Asian crisis through the foreign exchange and debt markets but only tentative evidence of stock market contagion.

The final chapter of this thesis also analyzes the possible contagious behavior of financial crises in developing countries. Taking the Asian crisis as a case study it examines whether contagion, defined as the spread of a shock during a crisis from one country to another beyond any normal interdependencies between the countries, takes place through the foreign exchange market.

Instead of measuring contagion by the commonly used correlation coefficients, regression analysis is applied in this chapter. This method can identify a break in the transmission process during a crisis and as such seems a natural approach for studies on contagion. Furthermore, the heteroskedasticity problem prevalent in studies using correlation coefficients as pointed by Forbes and Rigobón (2003), can be easily accounted for. In addition the one-step nature of the approach allows controlling for domestic macroeconomic fundamentals and common external shocks in a straightforward manner.

We test whether exchange market pressure (a monthly indicator which combines (percentage) changes in the exchange rate, in the interest rate and in the reserve position) in Thailand (the origin country of the Asian financial crisis) is transmitted to the other Asian crisis countries. We specifically control for spillover effects, macroeconomic fundamentals, common shocks and heteroskedasticity. To control for the fundamentals we use a composite indicator based on 14 real and financial variables reflecting the fragility of the economy, a novel approach in contagion studies focusing on time series analysis.

The results of this chapter suggest that contagion did play a role in the spread of the Asian crisis. We find evidence of contagion from Thailand to Indonesia and Malaysia, with 13 and 21 percent of the pressure on the respective currencies assigned to contagion effects. For Korea and the Philippines there is no evidence of foreign exchange market contagion.

1.5 Concluding remarks

Financial markets create both opportunities for developing countries as well as challenges. The importance of the development of domestic financial markets to generate growth are nowadays acknowledged, however the financial openness that facilitates financial sector deepening is associated with the occurrence of systemic financial crises with large disruptive consequences to developing countries economies.

In order for developing countries to continue to make progress on the path of economic development, it is important to understand exactly how financial markets (both domestic as well as international) affect these countries. This thesis attempts to make a contribution to this field of research. It introduces a new market-based measure of financial integration that allows studying the effect of certain microeconomic and macroeconomic phenomena like stock liquidity, capital controls and financial crises on financial integration. Furthermore, it examines the impact of financial sector development on a firm's decision to provide trade credit as a competitiveness tool. In addition, it studies the causes of the stock market boom during the Argentine crisis and it tests for contagion during the Asian crisis.

The challenge for researchers and policy makers is to try to find ways in which developing countries can fully take advantage of the opportunities that are associated with a more integrated world, while minimizing the risks. As a result it is important that this area continues to receive ample attention both now as well as in the future.

Chapter 2

International Financial Integration through the Law of One Price

2.1 Introduction

In a context of growing globalization, the degree of effective integration of individual countries with the world economy is a topic that continues to receive extensive attention, which has already spawned a large body of empirical research that attempts to gauge the extent of international integration and the factors that affect it. The Law of one price (LOOP), which stipulates that two markets are integrated when identical goods or assets are priced identically across borders, is a natural starting point to pursue this goal.

Recently, this line of research has been particularly active in association with the literature on purchasing power parity (PPP), which examines whether LOOP holds in goods markets. This literature has provided two potentially important methodological findings. First, aggregation matters. In fact, Imbs, Mumtaz, Ravn, and Rey (2004a) argue that previous empirical work on real effective exchange rates significantly understates the persistence of price deviations from PPP due to the presence of an aggregation bias, a finding that highlights the need to test convergence to PPP based on the prices of single (identical) products.[1] Second, non-linearities matter. In this respect, Obstfeld and Taylor (1997) document the presence of non-linearities in the convergence process of

[1] Specifically, they show that the convergence speed estimated by an autoregressive specification of price index ratios (in this case, the effective real exchange rate) exhibits a downward bias that is proportional to the difference in the convergence speeds of the goods included in the indexes. This claim has been disputed by Chen and Engel (2004), and has been redressed by Imbs, Mumtaz, Ravn, and Rey (2004b). This literature has also influenced the study of the exchange rate pass-through, which has placed a new emphasis on the comparison of identical international goods (Frankel, Parsley, and Wei, 2004).

international prices using threshold autoregressive (TAR) models. They find evidence of the existence of a band of no-arbitrage where persistence is high and an arbitrage regime where prices converge. In related work based on price comparisons at the sectoral level, Imbs, Mumtaz, Ravn, and Rey (2003) show that this non-linearity leads to understate the convergence speed when estimated using linear models (the more so the wider the no-arbitrage bands).

In this paper, we measure international financial integration through the lens of LOOP, in line with the recent developments in the PPP literature. To do so, we analyze the percentage price difference displayed by depositary receipts in international markets and their underlying shares in domestic markets (henceforth, the *cross-market premium*), controlling and testing for the presence of non-linearities.[2] Since the depositary receipt and the underlying asset are two identical assets traded in two different markets, the behavior of the cross-market premium provides a powerful price-based measure of integration. If there are no restrictions to trading, the possibility of arbitrage implies that the prices of these assets should be equal, after adjusting for the exchange rate and transaction costs. It follows that, in a fully integrated market, the cross-market premium should be approximately zero. How well integrated are financial markets according to this measure? How does financial market integration compare to goods market integration? How does the cross-market premium reflect the presence of barriers that segment capital markets, delaying or inhibiting price convergence? These are the questions explored in this paper.[3]

The literature on price-based measures of international financial integration can be broadly divided into two strands.[4] A first one analyzes integration by estimating return

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[2] Depositary receipts (also known as American depositary receipts) represent shares of foreign companies traded in U.S. dollars on U.S. stock exchanges. Their underlying shares are traded in the domestic market. DRs can be easily transformed in their underlying shares and vice versa.

[3] Note that the cross-market premium is not a measure of capital mobility. On the contrary, our premise is that, *in a world of perfect capital mobility*, effective integration (price convergence) would still be affected by the intensity of transaction costs.

[4] A survey of the vast literature on financial integration far exceeds the scope of the paper. It suffices to note that alternative (stock-based) criteria that have spawned a large body of empirical work include the Feldstein-Horioka condition and, more recently, the study of gross foreign-asset positions vis-à-vis the rest of the world (Lane and Milessi-Ferretti (2001 and 2003) and Kraay, Loayza, Serven, and Ventura (2004). Obstfeld and Taylor (2002) offer a comprehensive overview of the main operational measures of de facto market integration. In addition, a related strand has focused on de jure integration, defined as the absence of legal restrictions to international capital movements or cross-country asset ownership (Kaminsky and

correlations across markets. Although very useful to understand the scope for international risk diversification, this work is typically based on a comparison of price indexes and as such is subject to the aggregation bias mentioned above. In addition, the results might be influenced by the different composition of indexes across countries. Furthermore, when based on capital asset-pricing models these studies test simultaneously the extent of integration as well as the applicability of a particular model.[5]

A second strand studies financial integration by testing LOOP in capital markets in different ways.[6] Flood and Rose (2004), for instance, estimate expected intertemporal marginal rates of substitution for different markets, which they then compare to test for (domestic and international) asset market integration. Another group of papers, in response to the composition problem associated with price indexes, specifically focuses on the evolution of the premium of emerging market closed-end country funds over the value of the underlying portfolio.[7] While free from the composition bias, these attempts fall short of comparing identical assets, as the restrictions and management of closed-end funds distinguishes them from their underlying portfolio. Alternatively, Froot and Dabora (1999) examine the price behavior of pairs of stocks of large Siamese twins (corporates that pool cashflows and fix their distribution) traded in different countries, and find that price deviations of these "nearly identical" stocks are habitat dependent.

Using the cross-market premium as a measure to determine the financial integration of countries has a number of advantages. First, it allows testing LOOP based on two truly identical assets, avoiding the composition and aggregation biases, as well as the need to control for idiosyncratic risk.[8] Second, because it is a market-based measure,

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Schmukler (2002); Chinn and Ito (2005); Edison and Warnock (2001)). The distinction between de facto and de jure integration is emphasized by Prasad, Rogoff, Wei, and Kose (2003).

[5] Studies based on stock market indexes include, among many others, Cashin, Kumar, and McDermott (1995); Soydemir (2000); Masih and Masih (2001); Scheicher (2001); and Chen, Firth, and Rui (2002). Capital asset-pricing models to test for market integration have been applied by Bekeart and Harvey (1995); Bekaert Harvey, and Ng (2003); Carrieri, Errunza, and Hogan (2003); and Flood and Rose (2003), among others.

[6] Criteria such as the (covered and uncovered) interest rate parity, and the real interest rate parity conditions, are related to this group to the extent that they focus on the analysis of onshore-offshore return differentials (see, among many others, Meese and Rogoff (1988), MacDonald and Nagayasu (2000) and Chortareas and Driver (2001)). Strictly speaking, however, these conditions are not LOOP tests, as they abstract from the potentially relevant role played by exchange rate risk.

[7] See Frankel and Schmukler (1998 and 2000); and Levy Yeyati and Uribe (2000).

[8] Depositary receipts do not involve two different issues by the same company but, rather, claims on the same stock of shares traded in the local market.

no model needs to be imposed on the data. Third, the measure is continuous and spans the range between complete segmentation and complete integration, capturing variations in the degree of integration that can arise, for example, from the introduction or lifting of investment barriers. Fourth, it is amenable to the use of TAR models. These piecewise linear autoregression models capture non-linearities in the data and estimate the width of no-arbitrage bands, a good thermometer of financial integration.[9]

Extending the work on PPP to financial integration is a natural choice for at least two reasons. First, the analogy between real and financial markets interaction is apparent, as they both ultimately entail a test of LOOP. As such, TAR models are as natural a way to test for the presence of transaction costs-based segmentation in financial markets as they are for international goods markets.[10] Second, the use of TAR models allows us to relate and compare our findings on asset markets with those reported by the PPP literature on goods markets. To the extent that (i) depositary receipts and the underlying shares are identical assets (as opposed to most pairs of similar goods analyzed by the PPP literature) and that (ii) transaction costs are smaller in financial markets than in goods markets, one would expect to find smaller and less persistent price disparities.

For our empirical estimations, we analyze systematically the distribution of daily cross-market premia from 1990 to 2004, for a large set of stocks from nine emerging economies. In choosing the sample, we are constrained in at least two ways. First, many cross-listed stocks are highly illiquid, often exhibiting infrequent trading. Including those stocks would substantially alter the behavior of the premium and the reliability of the results. Second, to estimate TAR models relative long time series are needed. Thus we are constrained to work with firms that have a relatively long history of trading data. Finally, we are particularly interested in countries that experienced crises and/or the imposition of capital controls, to evaluate whether financial integration is affected in those instances. Once we take these considerations into account, we are able to use 76 firms from Argentina, Brazil, Chile, Indonesia, South Korea, Mexico, Russia, South

[9] Return differentials between ADRs and the underlying shares in emerging economies have received increasing attention recently. See, e.g. Alaganar and Bhar (2001), and Gagnon and Karolyi (2004).

[10] The view that a minimum return differential is required to induce arbitrage (hence, the nonlinearities in cross-market premia) dates back, at least, to the work of Einzig (1937, p. 25). Einzig's point has been empirically tested by Peel and Taylor (2002), who apply the TAR methodology to the weekly dollar-sterling covered return differentials during the interwar period. Obstfeld and Taylor (2002) replicate the exercise using monthly data.

Africa, and Venezuela. In all cases, we study the integration of these emerging economies with the U.S.

Methodologically, we calibrate a TAR model to estimate no-arbitrage bands (that is, zones where deviations between depositary receipt and stock prices are not arbitraged away) and convergence speeds outside the band. As in the PPP literature, we interpret both the band width and the convergence speed as (inverse) measures of integration. In all cases, we also estimate autoregressive (AR) models as a benchmark to test the consistency of the TAR specification. We then study how the TAR and AR estimations differ with stock liquidity (as measured by the trading volume), the introduction of capital controls (explicitly intended to segment markets), and financial crises (arguably, situations where market segmentation is most likely to arise).[11]

The main results of this paper are the following. First, we find evidence of strong financial integration: the cross-market premium remains close to zero, with very narrow no-arbitrage bands and rapid convergence to zero outside the bands. Second, there is evidence of non-linearities in the behavior of the premium. Moreover, convergence speeds are slower when estimated by an AR model, and the difference with respect to the speed estimated by the TAR model is proportional to the band width, as expected. Third, liquidity deepens financial integration: no-arbitrage bands are narrower, and convergence more rapid, the more liquid the stock. Fourth, deviations from LOOP are far smaller and less persistent (even for illiquid stocks) than those reported in the literature on goods markets, reflecting the lower transaction costs in financial markets. Fifth, the presence of controls is directly reflected in the intensity of integration, in the form of wider bands and more persistent deviations (less rapid convergence when outside the band), except in the case in which controls are not binding. Finally, by contrast, crisis episodes are associated with greater volatility, but not with a higher persistence of the deviations from LOOP. However, since the limited length of crisis periods prevents the use of TAR models, this result has to be taken with caution.

[11] Depositary receipts have been used recently to assess the impact of capital controls and crises. Rabinovitch, Silva, and Susmel (2003) attribute the persistence of return differentials between ADRs and stocks in Chile to the presence of controls. Auguste, Dominguez, Kamil, and Tesar (2003) and Melvin (2003) examine the deep ADR discounts that built in the midst of the Argentine crisis in early 2002, which Levy Yeyati, Schmukler, and Van Horen (2003) interpret as a reflection of the strict controls on capital outflows and foreign exchange transactions imposed at the time (an hypothesis that we explore more in depth here). Pasquariello (2004) presents evidence of large return differentials during crises.

In sum, the cross-market premium explored here appears to be an accurate gauge of the degree of international financial market integration, reflecting accurately the factors that segment markets. On the one hand, the measure detects the presence of non-linearities in the evolution of the premium, in line with the hypothesis of a no-arbitrage band due to transaction costs. On the other, it confirms our priors that (binding) capital controls tend to weaken cross-market arbitrage, allowing for wider and more persistent deviations from LOOP. The results on crises leave some interesting questions for future research.

The remainder of the paper is organized as follows. Section 2.2 discusses the theoretical link between the cross-market premium and financial integration. Sections 2.3 and 2.4 discuss the data and methodology. Section 2.5 characterizes the empirical behavior of the cross-market premium, compares financial market integration with goods market integration, and studies how the premium is related to liquidity. Section 2.6 examines how capital controls and crises affect financial integration and to what degree the cross-market premium is a good measure of integration. Section 2.7 offers some concluding remarks.

2.2 The Cross-Market Premium

The cross-market premium is defined as the percentage difference between the dollar price of the stock in the domestic market and the price of the corresponding depositary receipt (DR). Depositary receipts (also known as American Depositary Receipts or ADRs) are shares of non-U.S. corporations traded in the U.S. (and denominated in dollars), while the underlying shares trade in the domestic market of the issuer. A depositary receipt represents a specific number of underlying shares remaining on deposit in a so-called custodian bank in the issuer's home market. A new DR can be created by depositing the required number of shares in the custodial account in the market. The dividends and other payments will be converted by this bank into U.S. dollars and provided to the holders in the U.S. The process can simply be reversed by canceling or

redeeming the DR. In this way, an underlying stock can easily be transformed into a DR and vice versa.[12]

The cross-market premium (or discount) thus reflects the deviation between the home market price of the stock and its price in New York. It can be computed by converting the local currency price of the underlying stock in dollar prices, multiplying this by the number of underlying shares one DR represents and then dividing their value by the DR price, or:

$$\pi_t = \frac{S_t r P_t^{und} - P_t^{dr}}{P_t^{dr}}, \tag{2.1}$$

with π_t representing the premium at time t, S_t the spot exchange rate expressed in U.S. dollars per local currency, r the number of underlying stocks per unit of DR, P_t^{und} the price of the underlying stock in local currency and P_t^{dr} the price of the DR in New York in U.S. dollars.

When the domestic market is fully integrated with the U.S. market, transaction costs are zero and the two markets close at the same time, arbitrage should be instantaneous and costless. If the return of the underlying stock is higher than the return of the DR, investors can make an instant profit by buying the DR, transforming it into the underlying stock and selling this stock. This will drive the price of the underlying stock down and the premium back to zero. The reverse story holds when the return of the DR is higher. In principle, the premium will be equal to zero, unless a shock occurs too late during the day to be arbitraged away. In this case, closing prices will differ, but this difference will disappear quickly the next trading day.[13]

However, in reality there does not exist instantaneous and costless arbitrage. If an investor decides to transform underlying stocks into DRs and sell them in the U.S., he has

[12] ADRs are registered with the SEC and trade like any other U.S. security. Prior to 1983, ADRs could be created without company sponsorship. These unsponsored ADRs can have multiple depositaries for any given issue. In contrast, the sponsored program has company approval and only one depositary acts as the agent. Companies have a choice of four types of ADRs, three levels of public offerings and a private placement. The least costly way for a company to cross-list is to establish a Level 1 ADR program. These ADRs trade over-the-counter as OTC bulletin board of Pink Sheet issues. In contrast, the Level 2 and Level 3 ADRs are exchange listed securities with the main difference that only the level 3 ADRs can be used to raise new equity capital. Rule 144A Depositary Receipts (RADRs) are direct private placements among qualified institutional investors that raise new equity capital.

[13] The same should apply to temporary non-zero premia due to differences in trading hours between the domestic and the U.S. stock market.

to incur transaction costs. These typically include a broker's fee and transaction fee to buy the underlying stock and transform it in the DR, and a second broker's fee to sell the DR. Additional transaction costs might be the cost of opening a bank account in the U.S. or a tax that needs to be paid in order to transfer the funds back to the domestic market. A U.S. investor would face similar transaction costs. Furthermore, since settlement in equity markets typically takes place a number of days after the transaction there is also a foreign exchange risk unless the stock trade is matched with a forward exchange rate contract. In turn, these transaction costs can generate a "no-arbitrage band" within which price deviations are not large enough to induce arbitrage.[14]

2.3 Data

To select our sample of stocks we use the following criteria. First, the countries used in the paper had to experience the introduction (or lifting) of capital controls and/or one or more financial crises during the sample period. Second, the selected stocks need to exhibit a long history of DR listings with important trading volume. For this reason, we restricted our attention to stocks that are publicly traded in the United States either on NASDAQ or the New York Stock Exchange (NYSE), and that exhibit a *minimum liquidity*. More precisely, we exclude the stock if: (i) the number of days in which *both* the stock and its DR traded over the preceding 365 days is below 200 (in addition, for qualifying stocks we exclude the observations corresponding to dates in which no trading took place);[15] (ii) shows large changes in the trading volume pattern;[16] (ii) shows irregular behavior (e.g., significantly different means in sub-periods); or (iv) has less than two years of observations.[17]

The liquidity criterion (i) is of particular importance in our case, given that most DRs originated in emerging economies display infrequent trading. This, in turn, would invalidate the use of the cross-market premium, since *it would reflect spurious price*

[14] Appendix 2.I discusses this in more detail.
[15] Note that in almost all cases firms either trade almost every day (about 250 days per year), or trade very infrequently (much less than 200 days) and are therefore excluded.
[16] As will be shown below, the behavior of the premium depends significantly on the liquidity of the stock as measured by its trading volume.
[17] The last two conditions are crucial for a reliable estimation of stock-by-stock TAR models.

divergences due to the lack of transactions. Since price quotes correspond to the latest trade, quotes recorded at different dates may not represent a price divergence but rather the evolution of the price over time. This should be reflected in a larger and more volatile premium. Indeed, the correlation between the mean and the standard deviation of the premium, on the one hand, and the number of trading days, on the other, are highly significant -0.45 and -0.57, respectively.

These rigorous selection criteria substantially reduce the number of candidate countries and stocks. We work with 76 stocks (out of 133 DRs that traded on the NYSE or the NASDAQ) from nine emerging economies: Argentina (8 stocks), Brazil (24), Chile (12), Indonesia (2), Mexico (13), South Africa (7), Korea (6), Russia (2) and Venezuela (2). Appendix Table A2.1 reports the companies that are included in the respective portfolios and the period for which the premium is calculated.

The data needed to calculate the premium (the dollar price of the stock in the domestic market, the price of the DR in New York, and the number of underlying shares per unit of the depository receipt) come from Bloomberg. For Argentina, Brazil, Chile, and Venezuela we use the closing price both in the domestic market and in New York. For Asian markets, which are already closed when New York opens, as well as for Russia and South Africa, we use instead the closing price (and the exchange rate) in the domestic market and the opening price in New York, to keep distortions due to time differences to a minimum.

2.4 Methodology

As noted, we expect higher transaction costs to lead to broader bands of no-arbitrage. To the extent that high transaction costs are associated with a lower level of financial integration, the estimated width of the no-arbitrage bands provides a measure of effective integration.

The existence of transaction costs basically implies that two different regimes exist, an arbitrage and a no-arbitrage regime. If, on the one hand, the difference between the two prices is smaller than the transaction costs, arbitrage will not take place and the difference can persist. However, when a shock in either of the two markets results in a

difference between the two prices that exceeds the transaction costs (that is, the premium is outside the no-arbitrage band), it will trigger profitable arbitrage trades that would elicit a strong pressure on the premium to revert back inside the band.[18] In other words, theoretically there will be a no-arbitrage regime where the persistence is high and an arbitrage regime where there exists pressure on the prices to converge.

The implication of the existence of transaction costs as a cause for the existence of two regimes in the data has been mostly developed by the purchasing power parity literature. For example Sercu, Uppal and, Van Hulle (1995) and Michael, Nobay, and Peel (1997) have analyzed real exchange rates and developed a theory suggesting that the larger the deviation from PPP, the stronger the tendency for real exchange rates to move back to equilibrium.

As mentioned in the Introduction, while a number of studies have recently applied TAR models to estimate no-arbitrage bands to test for relative price persistence in goods markets, applications to financial data are far more limited. However, TAR is a natural choice to model the type of regime changes that we expect to be prevalent in the DR market, as it assumes a discrete change in the AR process once a certain threshold is crossed.

TAR was first proposed by Tong (1978) and further developed by Tong and Lim (1980) and Tong (1983). Its main premise is to describe the data-generating process by a piecewise linear autoregressive model: a TAR model works by estimating regime switching parameters as a function of the distance of an observation from the mean.

As we expect a reversion back to the band and not back to the mean once outside the no-arbitrage regime, we use a so-called Band-TAR model first used by Obstfeld and Taylor (1997), to which we introduce two modifications. First, we correct for the presence of serial autocorrelation using a Band-TAR adaptation of the augmented Dickey-Fuller test. Second, the residuals are corrected for GARCH effects to correct for the heteroskedasticity prevalent in the data.

The resulting specification is the following:

[18] Note that the premium would gradually decline in absolute value but would not necessarily revert to zero, as arbitrage ceases as soon as the premium is within the band.

$$
\begin{aligned}
&\Delta x_t = (I_{in})\beta_{in} x_{t-1} + (I_{out})\beta_{out}\Phi(x_{t-1}, c) + \sum_{j=1}^{k}\phi_j \Delta x_{t-k} + \varepsilon_t \\
&\sigma_t^2 = \alpha_0 + \sum_{j=1}^{p}\alpha_j \varepsilon_{t-p}^2 + \sum_{j=1}^{q}\gamma_j \sigma_{t-q}^2 \\
&\Phi(x_{t-1}, c^{up}) = x_{t-1} - c^{up} \text{ if } x_{t-1} > c^{up} \\
&\Phi(x_{t-1}, c^{low}) = x_{t-1} + c^{low} \text{ if } x_{t-1} < c^{low} \\
&c^{up} > 0 \text{ and } c^{low} < 0 \\
&I_{out} = 1 \text{ if } x_{t-1} > c^{up} \text{ or } x_{t-1} < c^{low}; \text{ zero otherwise} \\
&I_{in} = 1 \text{ if } c^{low} < x_{t-1} < c^{up}; \text{ zero otherwise.}
\end{aligned}
\tag{2.2}
$$

This model is known as the TAR(*k*,2,*d*), where *k* reflects the arbitrary autoregressive length, 2 the number of thresholds (which, a priori, we set at 2), and *d* the arbitrary delay parameter (also referred to as the threshold lag). We assume that the thresholds are symmetric and that the dynamics of the process outside the threshold are the same regardless of whether there exists a premium or a discount. Furthermore, we set *d* equal to one. β_{in} and β_{out} reflect the convergence speed in the no-arbitrage and arbitrage regimes, respectively. We assume that the constants in both regimes are zero and that the error terms are normally distributed. For each country a different model is estimated in which *k*, *p* and *q* are set in such way that the residuals do not contain any serial correlation or heteroskedasticity up to lag 10.

The model is estimated following the procedure described in Obstfeld and Taylor (1997). The estimation proceeds via a grid search on the threshold which maximizes the log likelihood ratio LLR=2(*La*-*Ln*). This implies that for every given threshold the maximum likelihood estimation of the TAR model amounts to an OLS estimation on partitioned samples, i.e. sets of observations with x_{t-1} either inside or outside the thresholds.

La refers to the likelihood function of the above TAR model:[19]

[19] Note that in our model we implicitly assume that the residuals are the same in both regimes. As a result we can estimate the LLR of the TAR the same way as the LLR of the AR model and do not need to divide the likelihood function in two parts one using the residuals of the inner and one using the residuals of the outer regime as done by Obstfeld and Taylor (1997). In fact, using this partitioned likelihood function increases the likelihood of rejecting the AR model in favor of the TAR model when residuals are not normally distributed.

$$La = -\sum_t \frac{1}{2}(\log(2\pi) + \log(\sigma^2) + \varepsilon_t^2 / \sigma^2 .$$

The Null is an AR(1) model and Ln is its likelihood function similar to *La*.

As the threshold is not defined under the null, standard inference is invalid and LLR does not follow the usual χ^2 distribution. In order to derive the critical values of the LR test, we follow Obstfeld and Taylor and use Monte Carlo simulations. The procedure is as follows. The AR(p) null model is estimated on the actual data $(x_1,.....,x_T)$. Then 600 simulations of the model are generated. Each is started at $x_{-b} = 0$ and ends at x_T. To avoid initial value bias the first b values are discarded (we set b at 50). For each simulation the TAR model is estimated as outlined above and the simulated LLR is calculated. The empirical distribution of the LLR can then be calculated from the 600 simulations, and this is used as the basis for the inference in judging the alternative TAR model against the AR null.

It is important to make clear from the start that the significance test described above has the important limitation of low power. As shown by Johansson (2001) the probability that the AR model is mistakenly not rejected is high. The method introduced by Hansen (1997) and used, for example, by Imbs, Mumtaz, Ravn, and Rey (2003) is based on a Wald statistic and is not useful for our purpose as heteroskedasticity in our data is strong –as is common for high frequency financial data. As a result, our best approach is to use the test described above, but to take a non-rejection of the AR model with caution. Nonetheless, for robustness, we run all our estimations using a simple AR model as well, to verify that the conclusion are not model-dependent.

2.5 The Cross-Market Premium and Financial Integration

In this section, we study the behavior of the cross-market premium during 'tranquil' times, in the absence of capital controls (for ease of exposition, we leave a detailed account of the definition of control and crisis periods for section 6, where the incidence of controls and crises on integration is examined). Table 2.1 presents a first glance at the data, where we show the summary statistics of the simple average of the cross-market

Table 2.1: *Summary Statistics – Tranquil Period*

Country	Mean	Median	Std. Dev	Pc. 5	Pc. 95	Obs.
Argentina	0.06	0.00	0.72	-0.97	1.35	2,138
Brazil	0.04	0.01	1.21	-1.90	1.94	2,301
Chile	0.09	0.07	0.62	-0.85	1.13	1,587
Indonesia	0.58	0.53	1.89	-2.32	3.88	1,315
Korea	1.59	1.17	3.80	-3.76	7.87	972
Mexico	0.01	-0.02	0.89	-1.36	1.47	2,379
Russia	0.11	0.23	1.52	-2.50	2.30	1,371
South Africa	-0.31	-0.25	1.22	-2.46	1.51	2,031
Venezuela	0.09	-0.05	2.26	-3.40	4.21	1,439
Pooled	0.15	0.04	1.65	-2.10	2.73	15,533
Stocks in sample	0.16	0.08	2.12	-2.63	3.21	1,370
Stocks excluded	5.39	3.97	9.39	-4.85	20.26	673

premium of the stocks in each country's portfolio. A positive premium implies that the price of the underlying stock is higher than the DR price. The Table shows that the average premium is close to zero in all cases. For the pooled data (based on the country averages), the mean premium is 0.15 percent, with a standard deviation of 1.65. The largest average premium is in Korea, with 1.59 percent; in all other cases, this number is below 1 percent. Finally, the bottom line of the Table shows the statistics corresponding to the stocks excluded from our sample due to insufficient liquidity. As can be seen, the average price deviation is substantially larger and more volatile, confirming our priors and justifying their exclusion.

2.5.1 AR and TAR Estimates

In order to compare financial market integration with goods market integration, we estimate a TAR model for the most liquid stock in each country during tranquil periods. As a measure of liquidity we use the average of the value traded both for the underlying stock and the DR during the period under study.

We estimate the TAR model using a grid-search on the threshold as described in Section 2.4. In Table 2.2, we provide a summary of our findings on the thresholds and the convergence speed outside the no-arbitrage band. For each stock, we show the optimal threshold and the log likelihood ratio of the estimated TAR model relative to that of the

Table 2.2: *Results Most Liquid Stocks in Tranquil Period*

Country	Stock	Obs.	TAR Thres	TAR LLR	TAR Half-life	AR Half-life
Argentina	ypf	1,545	0.09	13.24	0.01	0.39
Brazil	tne	1,139	0.17	5.64	0.48	0.62
Chile	ctc	1,361	0.13	7.90	0.57	0.75
Indonesia	tlk	1,118	0.09	3.69	0.88	1.06
Korea	kb	496	0.10	5.10	0.35	0.45
Mexico	amx	556	0.18	12.29	0.95	1.66
Russia	ros	1,210	0.15	2.71	0.61	0.90
South Africa	au	1,631	0.05	3.20	0.68	0.72
Venezuela	vnt	966	0.12	3.43	0.90	0.99
Pooled		7,872	0.02	3.53	0.99	1.02
Results Obstfeld and Taylor						
Mexico		180	4.00	34.20	382.00	428.00
South Africa		180	23.00	76.90	68.00	506.00
Pooled		5,387	3.00	77.40	182.00	232.00

Thres refers to the threshold estimated by the TAR model and LLR is the accompanying log likelihood ratio of the TAR significance test. Half-life of the TAR model reflects the half-life of a shock when outside the band of no-arbitrage. Half-lives are equal to ln(0.5)/ln(1-beta). Observations are based on the TAR model (in general the observations of the AR model are the same, except in some cases where more lags were needed to correct for serial correlation). Both TAR and AR models are corrected for heteroskedasticity and serial correlation. For comparison purposes, the half-lives estimated by Obstfeld and Taylor are converted in days instead of months, assuming that one month contains on average 20 days of trading.

AR model. In addition, for this threshold, we show the implied half-life associated with β_{out}. For comparison, we also show the implied half-life for the standard AR model.

The results confirm our priors. Bands of no-arbitrage range from 0.05 percent in South Africa to 0.18 percent in Mexico. This implies, in particular, that the cross-market premium can, in the case of Mexico, move between –0.18 and 0.18 without arbitrage taking place in the market.[20] Once outside the inaction-band, arbitrage takes place very rapidly: the typical half-life is less than a day. Estimating the TAR model by pooling all stocks yields a tight no-arbitrage band of 0.02 percent, even narrower than the average band estimated country by country.[21]

For brevity we did not include all estimated parameters in Table 2.2. However, we find that, as expected, in almost all cases β_{in} is not significantly different from zero, implying that inside the band of no-arbitrage the premium follows a random walk.

[20] Note that these results do not imply that South Africa is more integrated with the U.S. than Mexico since, as we show in the next section, deviations from the law of one price are affected by the liquidity of the stock.

[21] However, this results should be taken as indicative, since pooling observations with different thresholds and half-lives may bias the results.

Furthermore, the estimated sum of the arch and garch parameters lies between 0.90 and 0.99, with a value of 0.95 or lower for the majority of stocks.

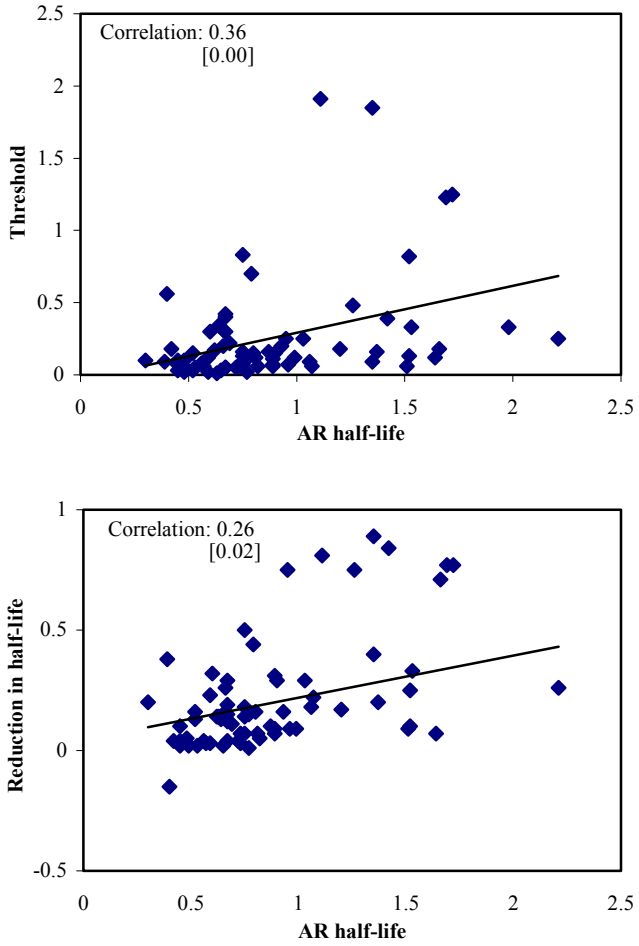
Having computed the TAR models, we can compare the estimates obtained in financial markets with those previously found in goods markets. To do so, we use the results reported in Obstfeld and Taylor (1997), who estimate a similar model for Mexico, South Africa, and a number of developed countries.[22] Comparing their results (reported at the bottom of Table 2.2), with ours shows that, as expected, the band of inaction is larger in their case. Furthermore, arbitrage takes place much more rapidly in the financial market than in the goods market. While the typical half-life as estimated by the TAR model is less than a day in the financial markets, it can be more than a year in the goods market. Similar results can be found when the half-life is based on the AR model.

If non-linearities are present in the evolution of the cross-market premium, convergence speeds should be slower when estimated by a linear (AR) model than those obtained from the TAR model, as is indeed the case for each of the stocks in the Table. Moreover, the wider the band-width, the higher the persistence estimated by the linear model, as Figure 2.1 shows. Additionally, the difference between the half-life estimated by the AR, and that obtained from TAR models outside the band, is itself proportional to the linear half-life. These results, which provide further evidence of how the presence of non-linearities influences the results from a linear estimation, are consistent with similar tests reported by Imbs, Mumtaz, Ravn, and Rey (2003) for goods markets.

One could argue that the rapid arbitrage we find is not independent from the fact that these results are based on the most liquid stocks in the sample for each country. However, while liquidity certainly plays a role in the degree of integration, the previous conclusions carry through to more illiquid stocks, as we show in the next section.

[22] They consider disaggregated as well as aggregated CPIs for a number of U.S. cities and a number of, mostly, developed countries at a monthly frequency from 1980-1995. The results reproduced in Table 2.2 refer to their results for the aggregated CPIs.

Figure 2.1: *Non-linearities in the Evolution of the Premium*



The upper scatter displays the correlation between the estimated half-lives of the AR model and the estimated thresholds. The lower scatter displays the correlation between the estimated half-lives of the AR model and the reduction in half-lives when non-linearities are taken into account. Half-lives are equal to ln(0.5)/ln(1-beta). Correlation coefficients with p-values in brackets are shown in the graphs.

2.5.2 Integration and Liquidity

One would expect the bands of no-arbitrage to widen as liquidity declines, to the extent that investors incorporate a liquidity risk premium as an additional transaction cost.[23] To see whether this is indeed the case, we examine how the band-width is affected by the liquidity of the stock. Specifically, we estimate – again, for tranquil periods without capital controls – a TAR model for each individual stock in our sample, and then regress the estimated thresholds against the liquidity of the stock. Liquidity, in turn, is measured as the log of the average of the mean value traded of the underlying stock and the DR,

[23] See Appendix 2.1 for a formalization of this result.

both computed over the same period used for the TAR. In addition, we investigate whether arbitrage outside the band takes place more quickly as liquidity increases. Finally, as a robustness check, we also regress the half-lives estimated by the AR model – which, as noted, are proportional to the band-width – on the stock liquidity. In all regressions we control for country effects.[24]

Figure 2.2 reports the regression results and the partial regression plots, revealing the presence of a significant negative correlation between band-width and liquidity. Furthermore, the Figure shows that band reversion once outside the no-arbitrage regime takes place more slowly (half-lives are longer) for illiquid stocks. The same is true for the linear model: illiquid stocks are associated with more persistence price deviations.[25] In sum, the size and persistence of the deviations from LOOP appear to be higher (integration appears to be weaker) as the liquidity of the stock declines: illiquidity adds to transaction costs and weakens financial integration.

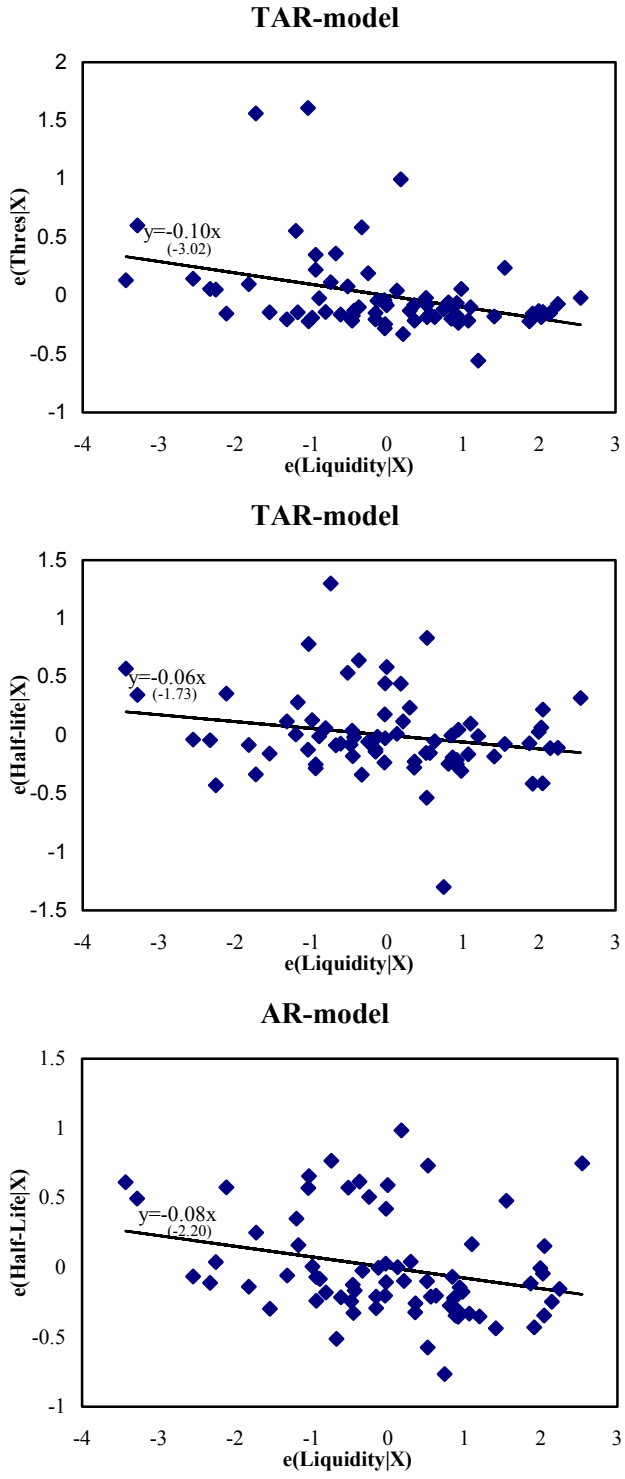
2.6 Time-Varying Financial Integration: Capital Controls and Crises

The imposition of capital controls increases transaction costs and tends to break down LOOP. For this reason, capital controls provide a natural test of the cross-market premium as a measure of the intensity of financial integration. On the other hand, to the extent that various sources of risk increase during crises, one can also expect prices to diverge more markedly. This section centers on how the behavior of the cross-market premium differs in these two particular situations. The first step consists in defining what we understand by capital controls and financial crises, and how we identify the periods in which they are in place.

[24] TAR and AR estimates for all the individual stocks in our sample are reported in Appendix Table A2.2. Note that in the case of Korea estimates are only available for two stocks. As explained in the next section this is caused by the fact that the remaining four stocks in the portfolio were subject to capital controls over the entire sample period.

[25] Measuring liquidity only by the mean value traded of the underlying stock or the mean value traded of the DR does not alter the result.

Figure 2.2: *Liquid versus Illiquid Stocks*



The upper scatter shows the partial regression plot from regressing the estimated threshold on stock liquidity and country dummies. The middle scatter displays the partial regression plot from regressing the estimated half-lives of a shock when outside the band of no-arbitrage on liquidity and country dummies. The lower scatter displays the partial regression plot from regressing the half-life estimated by an AR model on liquidity and country dummies. Half-lives are equal to ln(0.5)/ln(1-beta). The trendlines represent the regression estimates, t-values are presented in parentheses

2.6.1 Crises and Controls: What and When?

Capital controls periods are relatively easy to detect. Governments impose them through regulation and there are a number of public institutions that document them. Appendix Table A2.3 describes the capital controls imposed in each of the countries that we study. One salient feature from this Table is that capital controls differ by intensity, across countries and over time. Another relevant aspect is the difference in the *type* of control, the most notorious one being between controls on inflows (typically used to discourage short-term flows) and those on outflows (to prevent the capital flight in the midst of a crisis). During a period of controls we expect the mean of the premium to become positive when the relevant (binding) controls are on outflows, and negative, when controls are effectively restricting inflows.[26] We focus our attention solely on controls on stock market and foreign exchange market transactions that may affect the cross-market premium.

Six countries in our sample experienced a period in which capital restrictions affected the behavior of stock market: Argentina, Chile, Indonesia, Korea, South Africa, and Venezuela. In Argentina, controls on capital outflows were introduced in December 2001 together with restrictions on cash withdrawals from commercial banks (the so called 'corralito') as an attempt to stop the capital flight. The majority of these controls stayed in place until December 2002, when the corralito was lifted and the bulk of the restrictions was eliminated. However, in the first months after the corralito was abandoned, some minor controls were still in place that could potentially have affected the premium. From June 2003 onwards virtually all controls were eliminated. Chile introduced controls on inflows in the form of an Unremunerated Reserve Requirement (URR) already in 1992, but these controls only affected the DR market from July 1995 onwards. In August 1998, with the markets in turmoil and the Chilean peso under attack, the controls were finally lifted.[27]

Controls in South-East Asia took a different form, typically involving quantitative limits on foreign ownership. Indonesia had a 50 percent limit on foreign investments in

[26] See Appendix 2.1 for a more detailed discussion.
[27] Rigorously speaking, the URR was set to zero, but the mechanism was left in place until it was finally eliminated in 2002.

place when the first DR started trading and this restriction was lifted in September 1997. Also in Korea a ceiling on the share of foreign investor ownership was in effect. For most stocks this ceiling was lifted in May 1998; however, for a number of stocks it is still in place today. Cross-listed stocks using DRs faced an additional restriction: until January 1999, the conversion of underlying shares in DRs was severely restricted (e.g. approval was needed by the issuing company's board). In November 2000, Korea changed its regulations so that underlying shares could be converted to DRs without board approval as long as "the number of underlying shares that can be converted into DRs" is less than "the number of underlying shares that have been converted from DRs."[28] For four of the stocks in our country portfolio (SK Telecom, Kepco, Posco, and KT Corp) this rule has often prevented arbitrage to take place: in effect, these stocks still face controls on capital inflows. The other two stocks in our portfolio (Kookmin Bank and Hanaro Telecom), however, were unaffected by the rule during the period covered by our sample, so that controls were not effectively in place. To accommodate for this difference in the incidence of controls, we divide Korean stocks into two groups: restricted and unrestricted. Furthermore, we divide the control period of Korea into three distinct subperiods. The first one, referred to as very restrictive, lasts until January 1999. The second period, called restrictive, lasts from January 1999 until November 2000, when free conversion was allowed but conditioned by the rule. The third period, less restrictive, goes from November 2000 to the end of the sample period.

In South Africa the dual exchange rate system adopted in 1979, and temporarily abandoned in 1983, effectively worked as a control on capital outflows. This system was abolished in March 1995. Venezuela experienced two episodes of controls on capital outflows. The first one started in June 1994 and lasted until May 1996. A new set of controls on outflows was introduced in January 2003, which were still in place at the end of our sample period.

Crises times are much more difficult to pin down. Perhaps what makes this task particularly challenging is the lack of an uncontroversial operational definition of crisis. The literature has applied different methodologies using various ad-hoc criteria to identify crises. For our purpose, it is essential to determine accurately the beginning and

[28] See the Financial Supervisory Service's Regulation on Supervision of Securities Business, Article 7-9.

the end of the crisis. To do so, we follow the approach adopted by Broner, Lorenzoni, and Schmukler (2004) and use the exchange market pressure (EMP), computed as the weighted average of the daily changes in the interest rate and the log difference of the exchange rate, as a measure of financial distress. This approach allows us to distinguish country-specific crisis periods without resorting to the use of ex-post data.[29]

The crisis periods in the respective countries are determined as follows. First, we construct a series of EMP volatility, measured as the 15-day rolling standard deviations of the EMP. A crisis initiates when the EMP volatility exceeds a threshold level and remains above that level for at least four weeks, where the threshold is defined as the mean of the EMP volatility plus one standard deviation, computed for each country over the period covered by the sample. A crisis ends if the EMP volatility declines below the threshold and remains there for three months (in which case, the end date coincides with the date of the initial decline). The exchange and interest rate series come from Bloomberg and Datastream. The interest rates used vary according to data availability (in all cases, we verify that all available market-determined interest rates behave similarly over the sample period).[30] Table 2.3 reports the crisis periods identified by our methodology. All non-crisis periods are called tranquil periods, which we used in the previous section.

2.6.2 Summary Statistics

Figure 2.3 displays the evolution of the simple average of the cross-market premium of all stocks selected for each country. For the particular case of Korea we include two graphs: one including stocks that have been subject to restrictions over the whole sample period, and one including only the unrestricted stocks. Light shaded areas indicate crisis periods, while darker shaded areas indicate control periods. Periods in which crises coexisted with controls (as was the case for Argentina, Chile, Korea, and Venezuela) are

[29] The weights are equal to the reciprocal of the standard deviation of the respective variables. Ideally, one would also like to include the change in reserves; unfortunately, these data are not available on a daily frequency for the countries in our sample. To define the crisis period, Broner, Lorenzoni and Schmukler (2003) additionally use the 9-year bond spread, which is not readily available for all countries in our sample.

[30] The following rates were used: 7-day interbank rate (Argentina), the bank deposit certificate rate (Brazil), the 30-day CD rate (Chile, Venezuela), the interbank call money rate (Indonesia, Korea, Russia), the 90-day bank deposit rate (Mexico), the 3-month discount rate (South Africa).

Table 2.3: *Crisis Periods*

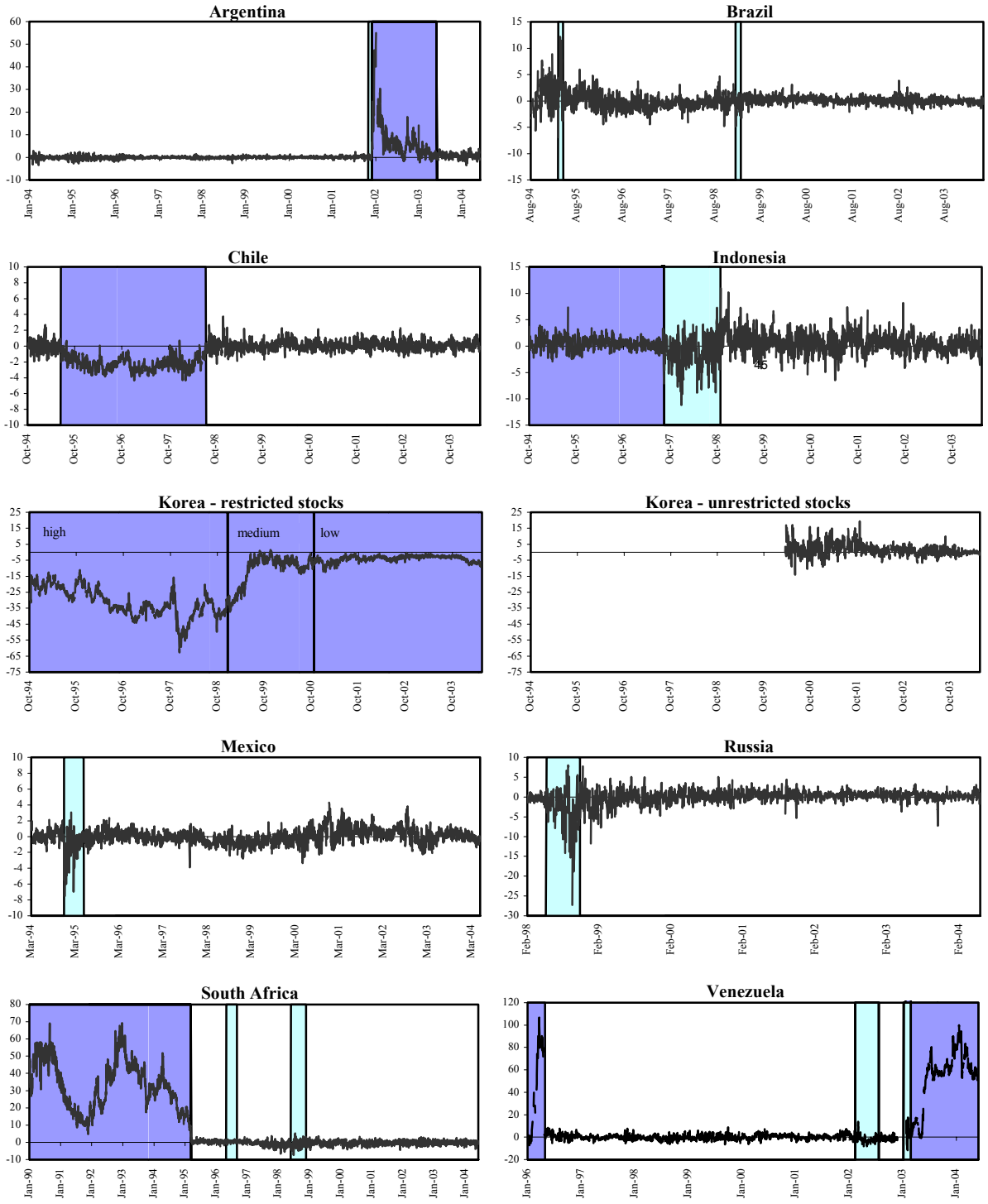
	Start date	End date
Argentina		
Crisis 1	11/1/2001	6/11/2002
Brazil		
Crisis 1	3/7/1995	4/17/1995
Crisis 2	1/13/1999	2/24/1999
Chile		
Crisis 1	1/8/1998	2/24/1998
Indonesia		
Crisis 1	8/15/1997	11/12/1998
Korea		
Crisis 1	12/20/1994	3/21/1995
Crisis 2	11/20/1997	3/16/1998
Mexico		
Crisis 1	12/20/1994	6/2/1995
Russia		
Crisis 1	5/25/1998	11/11/1998
South Africa		
Crisis 1	4/29/1996	8/30/1996
Crisis 2	5/25/1998	11/20/1998
Venezuela		
Crisis 1	2/13/2002	7/24/2002
Crisis 2	1/8/2003	2/27/2003

considered as control periods. Thus, in what follows crisis specifically refers to periods of financial turmoil when capital controls are not in effect.[31] Finally, the control period in Korea is divided into three sub-periods, to reflect the fact that the severity of restrictions lessened during the sample period as explained in the previous section.

Figure 2.3 shows that during tranquil periods the cross-market premium oscillates around zero. This appears to be the case also at times of financial distress, characterized by a larger volatility of the premium. In turn, the average premium turns positive in

[31] Although the crisis in Argentina starts before the controls are introduced, the period without controls (light-shaded in Figure 2.3) is so short that we do not consider it as a crisis period for the purpose of the empirical tests below.

Figure 2.3: *Cross-Market Premium per Country*



periods when capital outflows are restricted (Argentina, South Africa, and Venezuela) and negative in periods of controls on inflows –except in Indonesia, where the (relatively loose) limits on foreign participation may have been not binding at the time.[32] By contrast, in Korea a similar ceiling combined with the lack of convertibility of the DRs, a restriction that impedes arbitrage regardless of whether the ceiling is binding. The evidence that the discount is much lower in Chile than in Korea, on the other hand, directly reflects the different nature of the restrictions: quantitative limits that prevent arbitrage in Korea; an implicit tax that weakens arbitrage in Chile. Note that the Chilean "tax" on inflows effectively increases the price of the underlying stock, which should therefore fluctuate around the average value of the tax from the investor's standpoint, which according to the Figure was roughly two percent.

Table 2.4 displays summary statistics of the average cross-market premium during tranquil, crisis and control times.[33] The Table shows that the presence of controls is associated with sizeable premia of the expected sign, ranging from 49 percent under controls of outflows in Venezuela, to –31 during the period of most restrictive controls on inflows in Korea. The only exception is, again, Indonesia, where the small positive premium is associated with the presence of controls on inflows suggests that the latter were not binding at the time.

In addition, a comparison with tranquil times shows that the volatility of the premium increases significantly both during crisis and under controls, as expected. In particular, the volatility and the mean of the average premium are positively correlated. Thus, the volatility is highest for control periods and, to a large extent, proportional to the premium generated by the controls, in line with the view that the latter induce a zone of inaction that allows for wider (and persistent) deviations from LOOP. In the following sections, we explore this preliminary evidence more closely.

[32] A ceiling on foreign investment does not have to impact the possibility of arbitrage; as long as foreign participation is well below the limit, the underlying stock and the DR can be freely converted. Additional evidence indicating that controls in Indonesia were not binding is provided below.

[33] For Korea, the statistics are derived from the average premium of the unrestricted stocks (tranquil period) and the average premium of the restricted stocks (control periods).

Table 2.4: *Summary Statistics – Tranquil, Crisis and Control Periods*

Pooled data

Period	Mean	Median	Std. Dev	Pc. 5	Pc. 95	Obs.
Tranquil	0.15	0.04	1.65	-2.10	2.73	15,533
Crisis	-1.06***	-0.92	3.48	-6.31	3.92	918
Control inflows	-10.10***	-3.40	13.93	-38.11	1.10	3,733
Control outflows	31.51***	30.40	21.59	1.32	65.93	1,996

By Country

Country	Period	Mean	Median	Std. Dev	Pc. 5	Pc. 95	Obs.
Argentina	Tranquil	0.06	0.00	0.72	-0.97	1.35	2,138
	Control outflows	6.35***	4.70	7.54	-0.85	19.90	344
Brazil	Tranquil	0.04	0.01	1.21	-1.90	1.94	2,301
	Crisis	1.07***	0.01	3.73	-3.80	8.79	53
Chile	Tranquil	0.09	0.07	0.62	-0.85	1.13	1,587
	Control inflows	-2.20***	-2.24	0.88	-3.45	-0.69	750
Indonesia	Tranquil	0.58	0.53	1.89	-2.32	3.88	1,315
	Crisis	-1.27***	-1.27	2.84	-6.32	3.28	300
	Control inflows	0.48	0.50	1.19	-1.48	2.30	689
Korea	Tranquil	1.59	1.17	3.80	-3.76	7.87	972
	Control inflows - high	-31.18***	-31.75	8.89	-46.10	-16.96	1,011
	Control inflows - medium	-8.84***	-6.25	8.11	-31.69	-1.46	670
	Control inflows - low	-3.60***	-3.13	1.58	-7.75	-1.71	612
Mexico	Tranquil	0.01	-0.02	0.89	-1.36	1.47	2,379
	Crisis	-1.12***	-0.94	1.80	-4.88	1.26	109
Russia	Tranquil	0.11	0.23	1.52	-2.50	2.30	1,371
	Crisis	-3.22***	-2.69	5.44	-13.85	5.14	108
South Africa	Tranquil	-0.31	-0.25	1.22	-2.46	1.51	2,031
	Crisis	-0.46	-0.15	1.85	-3.77	1.95	206
	Control outflows	33.13***	32.97	14.23	11.59	55.73	1,277
Venezuela	Tranquil	0.09	-0.05	2.26	-3.40	4.21	1,439
	Crisis	-0.68***	-1.75	4.83	-6.24	9.51	122
	Control outflows	49.06***	57.24	29.05	-0.41	89.12	375

***, ** and * indicate whether the mean is statistically different from the mean in the tranquil period at one, five or ten percent significance level respectively.

2.6.3 Integration in Control Periods

When (binding) controls on capital outflows are introduced the premium can become substantially positive as the upper band of no-arbitrage becomes larger, while the lower

band is unaffected by the controls. In the case of controls on inflows, we expect to observe exactly the opposite.

For each stock in the portfolio that was traded during a period of controls, we estimate the TAR model in the following way. First, the model is estimated for the tranquil period. Next, a TAR model is estimated for the control period, setting the threshold of the no-arbitrage band that should not be affected by the introduction of the controls (the floor in case of controls on outflows, and the ceiling in the case of controls on inflows) equal to the value estimated for the tranquil period, and estimating the remaining threshold. Thus, the impact of controls should be reflected in an asymmetric widening of the band.

In turn, for the AR model we expect the persistence to be much higher when controls are in place. Furthermore, we examine whether the control period affects the volatility of the premium. To identify the impact of controls on the premium the AR model is specified as follows:

$$\begin{aligned} x_t &= \alpha_0 + \alpha_1 D_{cont} + \beta x_{t-1} + \beta_{cont} x_{t-1} D_{cont} + \sum_{j=1}^{k} (\phi_j \Delta x_{t-k} + \phi_{contj} \Delta x_{t-k} D_{cont}) + \varepsilon_t \\ \sigma_t^2 &= \alpha_0 + \exp(\lambda D_{cont}) + \sum_{j=1}^{p} \alpha_j \varepsilon_{t-p}^2 + \sum_{j=1}^{q} \gamma_j \sigma_{t-q}^2 \end{aligned} \tag{2.3}$$

where D_{cont} is a dummy which is one during the control period and zero otherwise. For each stock a different model is estimated in which *k*, *p* and *q* are set in such way that the residuals do not contain any serial correlation or heteroskedasticity up to lag 10.

Table 2.5 shows the simple averages of the estimated thresholds and half-lives from the TAR model and the half-lives and volatility changes from the AR model for the stocks in each country's portfolio that are traded during the time capital controls were in effect.[34] As can be seen, the upper threshold goes up when controls on outflows are introduced (Argentina and South Africa), whereas the introduction of controls on inflows in Chile lowers the average floor of the band.[35] Indonesia, by contrast, yields mixed

[34] For Korea, we cannot make a comparison between tranquil and control periods on a stock by stock basis as the restricted stocks have been restricted over the whole sample period, while the group of unrestricted stocks did not experience a period of controls. Furthermore, the TAR model cannot be estimated for the stocks in the portfolio of Venezuela due to the limited number of trading days in the control period.

[35] The results for individual stocks in each country are comparable. The estimations are available from the authors upon request.

Table 2.5: *Financial Market Integration in Periods of Capital Controls*

country	period	TAR Average Thres-up	TAR Average Thres-low	TAR Average Half-life	AR Average Half-life	AR Avg. Increase Volatility
Argentina	Tranquil	0.29	0.29	0.69	0.96	
	Control Outflows	7.80	0.29	3.65	4.41	2.74
Chile	Tranquil	0.23	0.23	0.56	0.84	
	Control Inflows	0.23	3.11	1.08	3.42	-0.26
Indonesia	Tranquil	0.17	0.17	1.42	1.31	
	Control Inflows	0.17	1.19	1.04	1.31	-1.25
South Africa	Tranquil	0.09	0.09	0.71	0.92	
	Control Outflows	53.36	0.09	4.28	44.46	1.55
Venezuela	Tranquil				1.17	
	Control Outflows				53.92	1.53

Thres-up refers to the upper threshold estimated by the TAR model and Thres-low refers to the lower threshold. Half-life of TAR model implies the half-life of a shock when outside the band of no-arbitrage. Half-lives are equal to ln(0.5)/ln(1-beta). Volatility in the AR model reflects the impact of the control period on the conditional variance. Both TAR and AR models are corrected for heteroskedasticity and serial correlation.

results: the average shows only a slight widening of the band under the control period, which is driven by one of the two stocks in the portfolio.

In turn, AR estimates indicate that deviations from LOOP are, as expected, much more persistent in the periods where capital controls are in effect. The notable exception is, again, Indonesia, where half-lives are virtually identical, suggesting that controls may have not been binding in this case. In addition, our results show that periods of controls on outflows were associated with an increase in the volatility of the premium, in line with the widening of the band. In Indonesia, by contrast, we see a slight *decline* in volatility in the control period compared to the tranquil period. This, again, is consistent with the finding that controls were not binding at the time.

2.6.4 Integration in Crises Periods

A priori, we expect the bands of no arbitrage to widen during a crisis period, to the extent that the risk associated with converting a DR into its underlying stock (or vice versa) increases due to transfer and convertibility risk, or simply as a reflection of greater price volatility.

To test in a rigorous way whether this is indeed the case, we should estimate the TAR model for both tranquil and crisis periods on a stock-by-stock basis. However, the

TAR model cannot be identified for the (typically short) crisis periods, and we have to rely primarily on the less informationally demanding AR model for the following discussion. As in the case of controls, the AR model is specified, so as to allow for an increase in the volatility of the premium, as follows:

$$\begin{aligned} x_t &= c_0 + c_1 D_{cris} + \beta x_{t-1} + \beta_{cris} x_{t-1} D_{cris} + \sum_{j=1}^{k} (\phi_j \Delta x_{t-k} + \phi_{crisj} \Delta x_{t-k} D_{cris}) + \varepsilon_t \\ \sigma_t^2 &= \alpha_0 + \exp(\lambda D_{cris}) + \sum_{j=1}^{p} \alpha_j \varepsilon_{t-p}^2 + \sum_{j=1}^{q} \gamma_j \sigma_{t-q}^2 \end{aligned} \tag{2.4}$$

where D_{cris} is a dummy which is one during the crisis period and zero otherwise, k, p, and q are set in such way that the residuals do not contain any serial correlation or heteroskedasticity up to lag 10.

The upper panel in Table 2.6 compares, for the stocks that are traded during a crisis period, the average linear half-lives estimated by the AR specification in tranquil and crisis periods. The results indicate that the estimated half-lives remain mostly unchanged during a crisis period. In fact, the individual stock estimates show that in 28 out of 30 cases there is no significant difference between the persistence of a shock in the tranquil and in the crisis period.[36] By contrast, the volatility of the premium does increase, as expected. Only in eight cases we find that the volatility remains unchanged during the crisis.

The results on the linear model suggest that crisis episodes are associated with a higher volatility, but not with a higher persistence of deviations from LOOP –which would indicate weaker integration. After all, the fact that the AR half-lives remain unchanged suggests that the band of inaction does not widen. However, it is possible that two counteracting forces are at work: a widening of the band of inaction in combination with a decline of the persistence outside the band.

This possibility can only be examined using a TAR model. As noted, the short length of crises prevents a stock-by-stock estimation. To overcome this constraint, we pooled the observations for the five most liquid stocks that traded during a crisis period (where liquidity is measured as before), and estimate the TAR model in both the crisis

[36] The results for the individual stocks are available upon request.

Table 2.6: *Financial Market Integration during Crisis Periods*

Results AR Estimations - Average

Country	Period	Average Half-life	Avg. Increase Volatility
Brazil	Tranquil	0.71	
	Crisis	0.71	5.19
Indonesia	Tranquil	1.59	
	Crisis	1.59	2.13
Mexico	Tranquil	0.80	
	Crisis	0.75	2.06
Russia	Tranquil	0.71	
	Crisis	1.92	3.62
South Africa	Tranquil	1.08	
	Crisis	1.08	0.84
Venezuela	Tranquil	1.23	
	Crisis	1.23	1.75

Results TAR Estimations - Pooled Data

	Period	TAR Thres	TAR LLR	TAR Half-life
Top 5	Tranquil	0.02	0.28	0.88***
	Crisis	0.36	5.70	0.36***
Top 15	Tranquil	0.02	0.42	1.25***
	Crisis	0.22	3.41	0.71***

In the upper panel volatility reflects the impact of the crisis period on the conditional variance. In the lower panel the TAR estimations are provided for the group of the five most liquid stocks (tne, tv, au, gfi and hmy) and the group of the fifteen most liquid stocks (tne, tv, au, gfi, hmy, emt, ssl, tlk, vnt, sid, ara, dro, kof, elp and saj). Thres refers to the threshold estimated by the TAR model and LLR is the accompanying log likelihood ratio of the TAR significance test. Half-life of TAR model implies the half-life of a shock when outside the band of no-arbitrage. Half-lives are equal to ln(0.5)/ln(1-beta). Both TAR and AR models are corrected for heteroskedasticity and serial correlation. Thresholds are expressed in percentage terms. ***, **, * refer to significance at the one, five and ten percent level respectively.

and the tranquil period –bearing in mind that by pooling we may be biasing the results.[37] For robustness, we replicate the test using the fifteen most liquid stocks. The results, reported in the lower panel of Table 2.6, are consistent with the hypothesis that two countervailing forces (wider band-width, faster convergence) are at play, causing the AR half-life to remain unchanged. However, a definitive test would have to wait for longer time series. In the meantime, whether crises, in addition to increasing volatility, reduced financial integration remains an open question.

[37] Note that pooling across countries all stocks that traded during a crisis (30 stocks) would be even more problematic due to the large differences in volatility (which, for this sample, would range from 0.79 to 5.76) that may affect the TAR estimation.

2.7 Conclusion

This paper showed that the cross-market premium is a good gauge of the degree of financial integration as seen through the lens of LOOP, free from the comparability and aggregation problems that characterized previous attempts. It should be stressed, however, that this measure is not intended as a test of capital mobility: on the contrary, transaction costs may inhibit financial integration even if capital is perfectly mobile.

Using the same methodology as in the PPP literature, our estimates revealed the presence of non-linearities in the behavior of the cross-market premium, in the form of no-arbitrage bands driven by transaction costs. More generally, our results showed that LOOP holds well in international equity markets: integration is stronger in financial markets than in goods markets, possibly due to a much lower incidence of transaction costs. As expected, integration is stronger for more liquid stocks, where these costs (including the associated liquidity risk) are likely to be smaller. Moreover, the cross-market premium reflects accurately the effective impact of capital controls on the international arbitrage, in the form of sizeable and persistent deviations from LOOP. Ultimately, the findings reported in this paper complement the literature on capital controls by providing a direct measure of de facto integration through which the effectiveness of controls can be assessed more precisely.

2.A Appendix: Arbitrage and the Cross-Market Premium

The relationship between transaction costs and price deviations can be illustrated by a simple example. An investor that purchases a stock in the local market at a price P_t^{und}, converts it to the DR and sells it in the New York market at time $t+n$ at a price P_{t+n}^{dr}, (where n reflects the time it takes to convert the underlying stock and sell the DR) obtains an expected return:

$$E_t R_1 = \frac{E_t[P_{t+n}^{dr}(1-\tau_{us}^s-\tau_{conv})]-S_t r P_t^{und}(1+\tau_l^b)}{S_t r P_t^{und}(1+\tau_l^b)}, \qquad \text{(A2.1)}$$

where $S_t r P_t^{und}(1+\tau_l^b)$ reflects the dollar amount needed to purchase the stock in the local market, (with S_l denoting the nominal exchange rate, r the number of underlying stocks per unit of DR and τ_l^b the associated transaction cost), and τ_{conv} and τ_{us}^s the transactions costs associated with the conversion to DR and the sale in the U.S., respectively.

Similarly, (denoting by τ_l^s the transaction cost of selling the stock in the local market), an investor that purchases a DR at P_t^{dr} to sell the stock at $t+n$ at a price P_{t+n}^{und} expects to make:

$$E_t R_2 = \frac{E_t[S_{t+n} r P_{t+n}^{und}(1-\tau_l^s-\tau_{conv})]-P_t^{dr}(1+\tau_{us}^b)}{P_t^{dr}(1+\tau_{us}^b)}, \qquad \text{(A2.2)}$$

In turn, assume that (proportional) transaction costs are fixed, and that stock prices follow a random walk, so that $E_t\,[P_{t+n}{}^{und}]= P_t^{und}$ and $E_t\,[P_{t+n}{}^{dr}]= P_t^{dr}$.

The two equations characterize the arbitrage bounds faced by investors: no profit can be made by arbitrage if the premium is such that

$$b_l \equiv -\frac{\tau_{us}^s+\tau_{conv}+\tau_l^b}{1+\tau_l^b} < \frac{S_t r P_t^{und}-P_t^{dr}}{P_t^{dr}} < \frac{\tau_{us}^b+\tau_{conv}+\tau_l^s}{1-\tau_l^s-\tau_{conv}} \equiv b_h, \qquad \text{(A2.3)}$$

The interval $[b_l, b_h]$ constitutes a "no-arbitrage band", within which transaction costs exceed the gains to be had through price arbitrage. From equation (A2.3), it is easy to see that the higher transaction costs induce the widening of the band and, in turn, a weaker integration.

A number of factors can potentially influence these transaction costs. These are risk premia associated with trading in illiquid stocks or with uncertainty during crisis periods, and costs associated with the introduction of controls on the inflow or outflow of capital –where a binding quantitative control would be equivalent to infinite transaction costs.

One can assume that the costs (i.e., brokers and transaction fees) involved in buying and selling the underlying stock and the DR are independent of the stock involved and, in particular, would be the same for liquid and illiquid stocks. However, a risk premium ρ needs to be added to account for liquidity risk, namely, the uncertainty about the actual price at which the sale takes place, which will typically differ across stocks.[38] As a result, equation (4) needs be rewritten as

$$b_l \equiv -\frac{\tau_{us}^s + \tau_{conv} + \tau_l^b + \rho}{1+\tau_l^b} < \frac{S_t r P_t^{und} - P_t^{dr}}{P_t^{dr}} < \frac{\tau_{us}^b + \tau_{conv} + \tau_l^s + \rho}{1-\tau_l^s - \tau_{conv}} \equiv b_h \qquad \text{(A2.4)}$$

where the more illiquid (the riskier) the stock, the wider the band will be.

The introduction of controls on stock market transactions may have an impact on financial integration provided that they are effective. Assume that in the domestic country controls on outflows and inflows of funds entail an effective (unit) transaction cost equal to κ and λ, respectively. We are assuming, implicitly, that there is a way to circumvent quantitative controls, and that the cost of doing it is a function of both the intensity and the effectiveness of the latter.[39]

In the presence of capital controls, an international investor seeking to buy the DR to sell the underlying stock would need to repatriate the proceeds from this sale and incur cost κ. Conversely, purchasing the underlying stock to sell the DR would require paying an inflow cost of λ. This implies that the no-arbitrage band becomes:

$$b_l \equiv -\frac{\tau_{us}^s + \tau_{conv} + \tau_l^b + \rho + \lambda}{1+\tau_l^b} < \frac{S_t r P_t^{und} - P_t^{dr}}{P_t^{dr}} < \frac{\tau_{us}^b + \tau_{conv} + \tau_l^s + \rho + \kappa}{1-\tau_l^s - \tau_{conv}} \equiv b_h \quad \text{(A2.5)}$$

[38] Note that transaction costs are likely to be non-linear (e.g., large transactions command proportionally smaller fees). However, there is a priori no reason to expect that the average trade size of illiquid stocks should be smaller than that of more liquid stocks –if they were, this would add to the liquidity premium described above.

[39] In the case of tax-based controls on inflows as in the Chilean reserve requirement, the proportional cost can be readily estimated, as it was indeed done by the authorities, which allowed investors to pay an equivalent fee up-front as an option to depositing the required reserves with the central bank.

Thus, as quantitative controls on outflows increase in effective intensity ($\kappa \to \infty$), the potential deviation of local stock prices relative to DRs increases proportionally: binding controls on outflows would elicit a large cross-market premium. Similarly, controls on inflows would introduce a negative cross-market premium, as they inhibit international investors to profit from relatively low domestic prices. In sum, controls on outflows (inflows) increase the upper (lower) band, keeping the other band unchanged, and causing the premium to be, on average, positive (negative).

The impact of a financial crisis is more ambiguous. It can temporarily influence the level of financial integration, as the risk associated with swapping the underlying stock for the DR and vice versa increases, due to higher exchange rate volatility, as well as transfer and convertibility risk. On the other hand, an increase in the variability of the premium could simply reflect the greater price volatility that characterizes episodes of financial turmoil, even if the degree of arbitrage remains unaltered. The results in the paper appear to favor the latest hypothesis.

Appendix Table A2.1: *Firms in Sample*

Firm name	Abbreviation	Sample Period	Firm name	Abbreviation	Sample Period	Firm name	Abbreviation	Sample Period
Argentina			**Brazil**			**Mexico**		
YPF	ypf	1/12/1994-12/31/2000	TIM	tsu	11/16/1998-5/31/2004	America Movil - series A	amo	2/7/2002-5/31/2004
Petrobas Energia (Perez Companc)	pze	1/26/2000-5/31/2004	Tele Nordeste Celular	tnd	11/16/1998-5/31/2004	America Movil - series L	amx	2/7/2002-5/31/2004
Telecom Argentina	teo	12/9/1994-5/31/2004	Tele Leste Celular	tbe	11/16/1998-5/31/2004	Cemex	cx	5/8/2002-5/31/2004
Telefonica de Argentina	tar	3/8/1994-12/31/2000	Tele Norte Celular	tcn	11/16/1998-5/31/2004	Grupo Televisa	tv	3/23/1994-5/31/2004
Transportadora de Gas del Sur	tgs	1/4/1995-5/31/2004				Fomento Economico Mexicano	fmx	5/11/1998-5/31/2004
BBVA Banco Frances	bfr	1/12/1994-5/31/2004	**Chile**			Coca-cola Femsa	kof	4/6/1994-12/31/1998
MetroGAS	mgs	1/25/1995-12/31/1998	Banco Santander Chile	san	5/22/1997-5/31/2004	Grupo Elektra	ekt	12/5/1994-5/31/2004
IRSA Inversiones y Representaciones	irs	1/20/1994-5/31/2004	Enersis	eni	10/17/1994-5/31/2004	Grupo Imsa	imy	12/11/1996-12/31/1999
			Endesa - Chile	eoc	10/17/1994-5/31/2004	Grupo Industrial Maseca (Gimsa)	msk	5/17/1994-12/31/1999
Brazil			Telefonica CTC Chile	ctc	10/17/1994-5/31/2004	Controladora Comercial Mexicana	mcm	10/11/1996-12/31/2001
Petroleo Brasileiro	pbr	8/10/2000-5/31/2004	Embotelladora Andina	akoa	4/7/1997-5/31/2004	Grupo Simec	sim	12/8/1994-12/31/1997
Petroleo Brasileiro - preferred	pbra	2/22/2001-5/31/2004	Distribucion y Servicio D&S	dys	10/8/1997-5/31/2004	Grupo Casa Saba	sab	4/6/1994-12/31/1997
Companhia Vale do Rio Doce	rio	3/21/2002-5/31/2004	Compania Cervecerias Unidas	cu	10/17/1994-5/31/2004	Savia	saj	4/6/1994-12/31/2000
Banco Itau Holding Financeira	itu	2/19/2002-5/31/2004	Lan Airlines	lfl	1/1/1999-12/31/2001			
Telesp	tsp	6/1/2001-5/31/2004	Sociedad Quimica y Minera	sqm	10/17/1994-5/31/2004	**Russia**		
Embraer	erj	7/20/2000-5/31/2004	Quinenco	lq	6/25/1997-5/31/2004	Tatneft	tnt	3/30/1998-12/31/2002
Tele Norte Leste (Telemar)	tne	11/16/1998-5/31/2004	Masisa	mys	10/17/1994-5/31/2004	Rostelecom	ros	2/17/1998-5/31/2004
Companhia Siderurgica Nacional	sid	1/1/1999-5/31/2004	Gener	gnr	10/17/1994-12/31/2000			
Aracruz Celulose	ara	8/2/1994-5/31/2004				**South Africa**		
Gerdau	ggb	3/10/1999-5/31/2004	**Indonesia**			Sasol	ssl	1/1/1996-5/31/2004
Votorantim Celulose e Papel	vcp	4/13/2000-5/31/2004	Telekomunikasi Indonesia	tlk	11/14/1995-5/31/2004	Anglogold Ashanti	au	1/1/1990-5/31/2004
CEMIG	cig	9/18/2001-5/31/2004	Indosat	iit	10/19/1994-5/31/2004	Gold Fields	gfi	8/1/1990-5/31/2004
Unibanco - Uniao de Bancos	ubb	1/1/2000-5/31/2004				Harmony Gold Mining	hmy	1/1/1997-5/31/2004
Acucar	cbd	5/29/1997-5/31/2004	**Korea**			Sappi	spp	1/1/2000-5/31/2004
Braskem	bak	1/1/2000-5/31/2004	SK Telecom	skt	6/27/1996-5/31/2004	Drdgold	dro	1/1/1998-5/31/2004
Tele Centro Oeste Celular	tro	11/16/1998-5/31/2004	Kepco	kep	10/27/1994-5/31/2004	Randgold and Exploration Company	ran	3/12/1997-12/31/2000
Embratel	emt	11/16/1998-5/31/2004	Posco	pos	10/14/1994-5/31/2004			
Copel	elp	7/30/1997-5/31/2004	KT Corporation	ktc	5/25/1999-5/31/2004	**Venezuela**		
Telemig Celular	tmb	11/16/1998-5/31/2004	Kookmin Bank	kb	11/9/2001-5/31/2004	Cantv	vnt	1/3/1997-5/31/2004
Ultrapar	ugp	10/13/1999-5/31/2004	Hanaro Telecom	han	3/29/2000-12/31/2003	Mavesa	mav	1/1/1996-3/28/2001

Appendix Table A2.2: *TAR and AR Estimations for All Stocks*

Country	Stock	Obs.	TAR Thres	TAR Half-life	TAR LLR	TAR Prctin	TAR P-value	AR Half-life
Argentina	ypf	1,545	0.09	0.01***	13.24	9.81	0.00	0.39***
	pze	496	1.25	0.95***	7.29	23.05	0.08	1.72***
	teo	1,522	0.02	0.56***	0.99	4.08	0.64	0.59***
	tar	1,515	0.10	0.10***	9.29	9.98	0.02	0.30***
	tgs	1,482	0.11	0.80***	4.93	7.25	0.21	0.89***
	bfr	1,971	0.01	0.49***	-0.46	1.87	0.95	0.63***
	mgs	558	0.40	0.48***	4.25	5.73	0.23	0.67***
	irs	1,429	0.05	0.63***	8.64	6.38	0.03	0.67***
Brazil	pbr	726	0.11	0.62***	1.19	3.27	0.76	0.77***
	pbra	674	0.06	0.66***	2.66	1.60	0.41	0.73***
	rio	406	0.48	0.51***	11.06	10.77	0.00	1.26***
	itu	489	0.18	0.38***	3.08	4.35	0.45	0.42***
	tsp	529	1.85	0.46***	4.27	22.63	0.27	1.35***
	erj	755	0.30	0.28***	8.47	9.82	0.04	0.60***
	tne	1,139	0.17	0.48***	5.64	7.18	0.08	0.62***
	sid	1,128	0.03	0.36***	0.16	1.32	0.84	0.52***
	ara	1,633	0.16	1.17***	2.27	9.10	0.50	1.37***
	ggb	1,118	0.07	0.41***	0.97	2.15	0.59	0.45***
	vcp	795	0.03	0.63***	-0.03	1.04	0.95	0.65***
	cig	459	0.06	1.42***	0.64	1.08	0.96	1.51***
	ubb	960	0.06	0.54***	0.51	1.92	0.87	0.57***
	cbd	1,273	0.83	0.25***	15.49	33.08	0.00	0.75***
	bak	780	0.1	0.43***	2.67	1.28	0.30	0.48***
	tro	1,212	0.04	0.47***	1.12	1.12	0.52	0.49***
	emt	1,115	0.03	0.43***	-1.13	1.24	1.00	0.45***
	elp	1,143	0.18	1.03***	5.79	5.51	0.14	1.20***
	tmb	1,120	0.05	0.51***	2.60	1.60	0.38	0.53***
	ugp	735	0.09	0.95***	5.16	1.52	0.19	1.35***
	tsu	1,136	0.08	0.52***	4.39	2.75	0.26	0.56***
	tnd	1,029	0.22	0.58***	3.54	5.66	0.26	0.69***
	tbe	1,044	0.34	0.51***	8.96	6.42	0.03	0.64***
	tcn	1,039	0.3	0.55***	4.55	5.79	0.17	0.67***
Chile	san	1,647	0.07	0.82***	2.93	3.34	0.43	0.89***
	eni	1,237	0.25	0.74***	15.08	14.60	0.00	1.03***
	eoc	1,355	0.15	0.64***	6.10	7.80	0.09	0.80***
	ctc	1,361	0.13	0.57***	7.90	10.57	0.03	0.75***
	akoa	753	0.16	0.77***	3.06	3.98	0.43	0.87***
	dys	1,166	0.31	0.40***	15.58	12.77	0.00	0.66***
	cu	1,109	0.02	0.76***	1.17	0.99	0.77	0.77***
	lfl	447	1.91	0.30***	2.28	22.34	0.61	1.11***
	sqm	1,136	0.20	0.50***	7.96	12.87	0.05	0.66***
	lq	610	0.13	1.42***	1.58	3.35	0.82	1.52***
	mys	1,068	0.70	0.35***	20.83	20.88	0.00	0.79***
	gnr	618	0.15	0.39***	2.19	3.30	0.59	0.52***
Indonesia	tlk	1,118	0.09	0.88***	3.69	2.69	0.28	1.06***
	iit	805	0.25	1.95***	6.62	8.63	0.08	2.21***
Korea	kb	496	0.10	0.35***	5.10	6.72	0.11	0.45***
	han	344	0.33	2.95***	5.23	2.12	0.10	1.98***
Mexico	amo	467	0.33	1.20***	4.57	4.16	0.21	1.53***
	amx	556	0.18	0.95***	12.29	7.70	0.01	1.66***
	cx	405	0.06	0.85***	3.38	2.54	0.38	1.07***
	tv	1,932	0.05	0.52***	4.05	6.24	0.14	0.67***
	fmx	1,301	0.02	0.45***	0.30	1.73	0.71	0.48***
	kof	727	0.12	0.36***	5.43	3.31	0.13	0.59***
	ekt	1,566	0.07	0.61***	1.07	3.81	0.75	0.75***
	imy	643	0.42	0.38***	13.88	8.08	0.00	0.67***
	msk	896	0.39	0.58***	9.55	10.93	0.00	1.42***
	sim	490	0.56	0.55***	6.53	2.89	0.07	0.40***
	mcm	968	0.25	0.20***	2.32	6.27	0.52	0.95***
	sab	510	0.06	0.70***	3.50	1.12	0.33	0.73***
	saj	1,210	0.07	0.87***	2.10	3.89	0.53	0.96***
Russia	tnt	764	0.06	0.58***	2.18	1.73	0.39	0.89***
	ros	1,210	0.15	0.61***	2.71	3.89	0.43	0.90***
South Africa	ssl	1,260	0.20	0.77***	3.72	8.82	0.28	0.93***
	au	1,631	0.05	0.68***	3.20	2.65	0.38	0.72***
	gfi	1,525	0.12	0.74***	2.27	3.62	0.51	0.81***
	hmy	1,267	0.16	0.68***	4.52	4.48	0.28	0.75***
	spp	790	0.06	0.77***	0.68	1.37	0.84	0.82***
	dro	987	0.12	1.57***	3.94	2.29	0.29	1.64***
	ran	343	0.82	1.27***	2.11	3.62	0.59	1.52***
Venezuela	vnt	966	0.12	0.90***	3.43	5.52	0.43	0.99***
	mav	723	1.23	0.92***	10.63	18.96	0.00	1.69***

TAR and AR estimations for all stocks in each country's portfolio for the tranquil period. Thres refers to the threshold estimated by the TAR model and LLR is the accompanying log likelihood ratio of the TAR significance test. Half-life (HL) of the TAR model reflects the half-life of a shock when outside the band of no-arbitrage. Half-lives are equal to ln(0.5)/ln(1-beta). Prctin indicates the percentage of the observations that falls in the no-arbitrage regime. P-value reflects the empirical p-value of the LLR statistic based on Monte Carlo simulations. Observations are based on the TAR model. Both TAR and AR models are corrected for heteroskedasticity and serial correlation. ***, **, * refer to significance at the one, five and ten percent level respectively.

Appendix Table A2.2: *Controls on Stock Market Transactions*

Argentina
In December 2nd 2001 controls on capital outflows were introduced as one of the measures of the corralito. All investors, both foreign and domestic were prohibited from transferring funds abroad, wire transfers required central bank approval and foreign currency futures transactions were prohibited. Exactly one year later the corralito was lifted and capital was allowed to leave the country, albeit some restrictions on capital outflows remained. From June 2003 onwards virtually all controls were eliminated.

Chile
In July 1995 secondary DRs became subject to the Unremunerated Reserve Requirement (URR) that had covered several types of capital inflows since its introduction in June 1991. A 30 percent reserve deposit that earned no interest needed to be paid, with the holding equal to the loan maturity with a minimum of three months and a maximum of one year. Primary DRs were considered capital additions and were therefore never subject to the URR. With markets in turmoil and the Chilean peso under attack the reserve requirement was lowered to ten percent in June 1998. In August of that year the URR was eliminated for secondary DRs (and in September reserve requirements on all inflows were eliminated).

Indonesia
When the first Indonesian company introduced a publicly traded DR, the Indonesian capital market was largely liberalized. However, foreigners were only allowed to purchase up to 49 percent of all companies' listed shares. In September 1997 this restriction was lifted and foreign investors could purchase unlimited domestic shares (except banking shares).

Korea
When the first publicly traded DR was introduced there existed restrictions on foreign investment in the stock markets. These ceilings were gradually increased over time and in May 1998 the government lifted the foreign investment restrictions on Korean securities, except on Kepco, Posco, mining and air transportation companies and information and telecommunication companies (for some companies foreign investment ceilings are still in place). For firms cross-listed using Depositary Receipts an additional restriction was in place. Although there was no restriction on the conversion of DRs into underlying shares, until January 1999 the conversion of underlying shares into DRs was restricted (e.g. approval was needed by the issuing company's board). Starting from January 1999, Korean companies that issued DRs, starting with Kookmin Bank, started allowing free conversion. As of November 2000, Korea changed its regulations so that underlying shares can be converted into DRs without board approval as long as "the number of underlying shares that can be converted into DRs" is less than "the number of underlying shares that have been converted from DRs".

South Africa
In the early 1990's there existed a dual exchange rate system in South Africa (introduced in 1979 and temporarily abandoned in 1983) with a commercial rate subject to intervention by the monetary authorities, and a free floating financial rate (usually at a discount from the commercial rate). The financial rate operated with respect to the local sale and redemption proceeds of South African securities and other investments in South Africa owned by nonresidents, capital remittances by emigrants and immigrants, and approved outward capital transfers by residents. Exchange control restrictions applied to financial rand accounts of non-residents of the Common Monetary Area (CMA). Local sales and redemption proceeds of South African securities and other investments owned by nonresidents had to be credited to these accounts. Funds in these financial rand accounts could be used freely for reinvestment in locally quoted securities (which could be exported and sold abroad) or for acquiring quoted central government, municipal, or public utility stocks. On application and approval, financial rand could be used by nonresidents for the purchase of other assets. Outward transfers of capital by residents to destinations outside the CMA required approval of the central bank. Transfers of residents for the purchase of South African or other shares on foreign stock exchanges were generally not permitted except in amounts not exceeding R 5,000. In March 1995 the financial rand and the currency exchange system were abolished. The 15% tax on remittances by non-resident shareholders was also eliminated.

Venezuela
In June 1994 the foreign exchange market was closed and controls on capital outflows were introduced to stop the severe speculative attacks against the Bolivar. The controls implied an outright prohibition of capital outflows, including the repatriation of nonresident investment but excluding flows related to the repayment of external debt. Furthermore, the measures restricted the availability of foreign exchange for import payments. By May 1996 these controls were abolished. In January 2003 exchange rate trading was suspended, limits to dollar purchases were introduced. Originally the measure was introduced as a temporary measure but it is still in place accompanied by stringent capital controls introduced in February.

Sources: Bloomberg, IFC Emerging Markets Factbook, IMF Annual Report on Exchange Arrangements and Exchange Restrictions, Korea's Financial Supervisory Service's Regulation on Supervison of Securities Business.

Chapter 3

Trade Credit as a Competitiveness Tool; Evidence from Developing Countries

3.1 Introduction

Trade credit is created whenever a supplier offers terms that allow the buyer to delay payment.[1] Evidence shows that trade credit is an integral part of doing business for a large number of firms. Petersen and Rajan (1997) and Atanasova and Wilson (2002) show respectively that 70 percent of small U.S. firms and 80 percent of firms in the U.K provide credit to their customers. Furthermore, a yearly survey of the Central Bank of Mexico shows that in the first half of 2004 on average about 76 percent of the Mexican firms provided trade credit to their suppliers. A striking feature of the data from the Mexican Central Bank is that small Mexican firms are more likely to provide trade credit than their larger counterparts. As small and medium enterprises, especially in developing countries, are typically more financially constrained than large firms (Beck, Demirguc-Kunt and Maksimovic (2004)), these survey results raise the question why do firms, even when they are financially constrained, provide trade credit to their customers?

Several possible motives for the provision of trade credit by firms have been introduced in the literature. First, trade credit might be used as a way to reduce transaction costs between seller and buyer (Ferris (1981)). Alternatively, suppliers may provide trade credit because they have a long term interest in the survival of the customers (Cunat (2000); Wilner (2000)). Finally, suppliers may have an information,

[1] The customer can also provide trade credit to its supplier through the advance payment of money, so called customers credit. However, we do not study this type of trade credit.

controlling and enforcement advantage over banks that gives them a cost advantage when offering credit to a buyer that is financially constrained. As a result trade credit can be used to redistribute funds from financially stronger firms to firms that are constrained by lack of finance (see for example Smith (1987); Mian and Smith (1992); Biais and Gollier (1997); and Cunat (2000)).[2]

However, these theories do not provide a satisfactory explanation why so many *small* firms, for whom providing trade credit in general is expensive, sell their goods on credit. In this paper we suggest an alternative motive that can potentially explain why firms, especially small, young and financially constrained ones, sell their goods on credit: the use of trade credit as a tool to be competitive.

Trade credit can be looked upon as a competitiveness tool in two ways. One, it allows the supplier to give easier terms of payment to a potential customer. This effectively lowers the price for the product especially for potential customers that are financially constrained. In other words, the provision of trade credit enables suppliers to price-discriminate (Smith (1987); Brennan, Maksimovic, and Zechner (1988)). Two, as trade credit gives the customer time to test the good and possibly return it, it indirectly works as quality insurance (Smith (1987)). By offering trade credit the supplier can give the customer an opportunity to test the product without pay, potentially making the product more interesting than similar products of competing suppliers.

If firms use trade credit as a competitiveness tool, a phenomenon that we will dub *trade credit competition*, the market structure in which the firm operates should have a large explanatory value in the percentage of goods the firm sells on credit. If the supplier is faced with a customer with large bargaining power he is more likely to provide trade credit as the customer can credibly threat to move to another supplier. If the supplier functions as a monopolist he will less likely provide trade credit, as customers have no option to move to another supplier.

To examine the use of trade credit competition in developing countries we use a new dataset based on survey studies recently conducted by the World Bank. This dataset contains information on almost 18,000 firms, mostly small and medium enterprises, in 42

[2] For an extensive review of theoretical and empirical literature on trade credit see Mian and Smith (1992), Smith (1995) and Petersen and Rajan (1997).

developing countries dispersed over all regions. A major advantage of the survey is that information about customer bargaining power can be derived directly from the survey. Furthermore, the survey-based nature of the dataset allows us to test whether firm characteristics affect the use of trade credit competition by suppliers. In addition, as the surveys are conducted in a large number of developing countries, we can examine the impact of country characteristics like the development of the financial and legal system, on the use of trade credit as a competitiveness tool.

We find evidence that the market power of the customer has a positive impact on the provision of trade credit while the market power of the supplier has a negative impact. This is consistent with the idea that firms use trade credit as a competitiveness tool. We also find that small and young firms and firms that lack access to finance are more inclined to use trade credit as a tool to sell products. This suggests that reputation of the supplier is an important determining factor in its need to use trade credit competition. Thus the use of trade credit to lock in customers seems to provide an explanation for the provision of trade credit by firms for whom selling goods on credit is relatively expensive. Exploiting the cross-country variation in our data we find that customers exert less market power in countries where the banking sector is relatively well developed. This indicates that the use of trade credit to lock in customers is more prevalent in countries were information is limited. The development of the legal system, on the other hand, proves to have no effect on the use of trade credit competition.

The paper builds on and extends earlier work done on the use of trade credit. It adds to the literature that tries to explain why trade credit is so prevalent amongst firms (see, for example, Petersen and Rajan (1997) for an overview). A number of papers in this area already have considered the impact of supplier market power (Petersen and Rajan (1995); McMillan and Woodruff (1999); and most notably Fisman and Raturi (2004)); however the impact of customer market power on the provision of trade credit has not received attention. Furthermore, most of the research in this area has concentrated on industrialized countries due to unavailability of data from developing countries. Only a few studies have examined the determinants of supply of trade credit in developing countries (Fafcamps (1997) (Zimbabwe); McMillan and Woodruff (1999) (Vietnam); and Fisman and Raturi (2004) (five African countries)). The new dataset we use in this paper

allows us to get a better understanding of the reasons behind the use of trade credit by firms in developing countries. In addition, due to the large cross-country variation the impact of specific country characteristics on the provision of trade credit can be studied. This relates our research to the literature that looks at the relationship between the use of trade credit and the development of a country's financial and legal system as examined by Demirgüç-Kunt and Maksimovic (2002). Our paper complements their study as it focuses mainly on small and medium enterprises in contrast to publicly listed firms in their sample.

The rest of the paper proceeds as follows. The next section discusses the theory and states the hypotheses. In section three the data are described. Section 3.4 lays out the empirical strategy, while the results are presented in Section 3.5. Section 3.6 concludes.

3.2 Theory and Hypotheses

In the literature a number of theories have been developed that attempt to provide an explanation why suppliers are willing to sell their goods on credit. Ferris (1981), for example, argues that firms provide trade credit to lower transaction costs. By separating the exchange of goods from the exchange of money, trade credit substantially reduces the costs involved in paying and administering invoices between suppliers and buyers who undertake regular exchanges of goods and services. Evidence supporting the transaction motive has been found by Ferris (1981), Long, Malitz, and Ravid (1993) and Nilsen (2002).

In addition, suppliers may provide trade credit because they have a long-term interest in the survival of a customer. Especially when the bulk of a supplier's sales are to one firm, the supplier will have an incentive to provide finance to secure the survival of the customer when it faces a temporary liquidity problem. (Cunat (2000); Wilner (2000)). Love, Preve, and Sarria-Allende (2003) find that during the Asian crisis trade credit indeed functioned as a transmission mechanism through which bank credit was redistributed from firms with a strong financial position to financially weaker ones.

Alternatively, suppliers can have a number of advantages over banks that can give them a cost advantage in offering credit to a buyer. First, suppliers can assess the

creditworthiness of a buyer during the normal course of business, making it easier for them to evaluate credit risk. Second, the supplier is also more likely to be able to enforce repayment since he can credibly threat to cut off future supplies. Third, in case of buyer default, the supplier can seize the goods that are sold. Consequently, firms with a strong financial position can use trade credit to intermediate funds to firms that lack this access (Smith (1987); Mian and Smith (1992); Biais and Gollier (1997); and Cunat (2000)).

Here we provide an alternative motive for the provision of trade credit by firms, one that can account for the fact that trade credit is also offered by firms that are financially constrained and for whom trade credit is thus relatively expensive: the use of trade credit as a competitiveness tool.

Trade credit can function as a competitiveness tool in two ways. One, it allows the supplier to give easier terms of payment to a potential customer. This effectively lowers the price for the product especially for potential customers that are financially constrained. In other words, the provision of trade credit enables suppliers to price-discriminate (Smith (1987); Brennan, Maksimovic, and Zechner (1988)). Two, as trade credit gives the customer time to test the good and possibly return it, it indirectly works as quality insurance (Smith (1987)). So by offering trade credit the supplier can give the customer an opportunity to test the product without pay, potentially making the product more interesting than similar products of competing suppliers. We dub the use of trade credit as a competitiveness tool trade credit competition.

If trade credit competition is indeed a reason for firms to provide trade credit the market structure in which the firm operates should have a significant impact on the percentage of goods sold on credit. If the supplier sells its products to a customer with strong market power, he is more likely to sell goods on credit as the customer can credibly threat to move to another supplier. In addition, a supplier who faces hardly any competition from other firms in the market will be less likely to provide trade credit as customers have no option to move to another supplier.[3] Our *"trade credit competition" hypothesis* summarizes this:

[3] Fisman and Raturi (2003) look at the relationship between the monopoly power of the supplier and the provision of trade credit and also find a negative relationship. However, their argument differs from the one posed in this study. They argue that since trade credit is only provided when there is trust that the loan will be repaid, relationship-specific investments need to be made by the customer. The customer will only do

Hypothesis 1a: Suppliers who sell to customers with large market power sell a larger percentage of their goods on credit.

Hypothesis 1b: A monopolist provides less trade credit than a supplier in a competitive market.

Most theories explaining the provision of trade credit implicitly assume that the decision to provide trade credit is made at the discretion of the supplier. The decision is based on whether the firm has the sources to provide it and the creditworthiness of the receiving customer, with the customer making the decision to use the credit or not. Hypothesis 1a, however, introduces the possibility of role-reversion: it is not the supplier that chooses to provide credit to a 'well-behaving' customer, it is the customer that forces the supplier to provide trade credit threatening to move to another supplier in case of refusal.

In the literature a number of firm-specific characteristics have been identified that impact the use of trade credit. Besides the direct impact these firm characteristics have on trade credit, they can also potentially impact the use of trade credit indirectly through their effect on the use of trade credit competition by suppliers. A number of hypotheses can be distinguished that capture possible interaction effects between firm-specific characteristics and the use of trade credit as a competitiveness tool.

The first firm-specific characteristic that can potentially affect the use of trade credit competition is reputation of the firm. A number of theories have been developed arguing that trade credit provision requires an established relationship between buyers and sellers (Smith (1987); Cunat (2000); and Wilner (2000)). This explains the positive link between age of a firm and the levels of account payables found in many empirical studies (Petersen and Rajan (1997) and Cunat (2000), among others). Furthermore, as relationship-building takes time, the need for an established relationship is one possible factor that explains why older firms in general provide more trade credit than younger

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that in a competitive market because only then it can extract part of the surplus as it can potentially shift to another supplier. So monopolists will provide less trade credit as borrowers are deterred from investing in establishing creditworthiness.

firms. With respect to the *"trade credit competitiveness" hypothesis* this argument would imply that when a relationship is young, firms in a competitive industry do not provide more trade credit than monopolistic suppliers.

However, when trade credit is used as a competitiveness tool by firms selling to customers with strong market power, the link between the provision of trade credit and the length of the relationship with the customer might be reversed. One could argue that when customers have large bargaining power firms that lack a solid reputation are more likely obliged to sell the goods on credit in order to make the sale. Suggesting a negative correlation between reputation of the firm and the supply of trade credit to large customers. The relation between reputation and the use of trade credit competition is summarized in the "*reputation" hypothesis:*

Hypothesis 2a: Firms that lack a solid reputation will provide trade credit to customers with large bargaining power compared to firms with a good reputation.

Hypothesis 2b: Lack of reputation decreases the difference between the percentage of goods sold on credit by a competitive supplier and a monopolist.

Petersen and Rajan (1997) have pointed out that buyer reputation and credit rating can reduce concerns about non-payment. Their argument provides an additional explanation why firms dealing with customers with strong market power sell more goods on credit relative to firms with small customers. In other words a positive relation between customer market power and the provision of trade credit does not necessarily have to reflect the occurrence of trade credit competition.

The *"reputation" hypothesis,* however, should provide additional information as to whether competitiveness issues do play a role. If the reputation hypothesis holds, small and young firms, i.e. firms that lack a solid reputation should provide more trade credit to customers with large market power. As trade credit is relative expensive for these firms it is more likely that their credit provision, as opposed to the credit provision of large firms, is driven by competitiveness issues than by the fact that large customers or multinationals pose less credit-risk. In other words, an acceptance of the *"reputation" hypothesis* can be

interpreted as evidence that a positive correlation between the provision of trade credit and customer market power is (at least partly) driven by competitiveness considerations.

If trade credit competition is perceived by all firms, regardless their standing with (potential) customers, as an effective tool to sell products, one would expect that firms with more access to external sources of finance use trade credit more extensively as a competitiveness tool. If this *"capital-availability" hypothesis* holds, firms with access to external sources of finance sell more goods on credit to customers with large bargaining power as compared to firms that lack this access.[4] Similarly, the difference in trade credit provided by a monopolist and a competitive supplier should, under these assumptions, be positively related with the financial strength of the firm. Note that the *"capital availability" hypothesis* is an alternative to *the "reputation" hypothesis* as firms that have build a solid reputation in general are also firms that have access to external sources of finance, i.e. the two hypotheses are opposite. The *"capital availability" hypothesis* can be summarized as follows:

Hypothesis 3a: Firms with access to external sources of finance are more likely to provide trade credit to customers with large bargaining power.

Hypothesis 3b: Access to finance increases the difference between the percentage of goods sold on credit of a competitive supplier and a monopolist.

Another possible firm-specific characteristic that can impact the use of trade credit competition is the type of good sold. The need for quality insurance is higher when the goods sold are heterogeneous as opposed to homogeneous. For example Long, Malitz, and Ravid (1993) find that firms producing products whose quality requires longer to assess are more likely to extend trade credit relative to sales. This suggests that customers that buy highly technical products are more likely to demand quality insurance than customers that buy commodities, and as a result more strongly exercise their market

[4] Note that the argument put forward here differs from, but does not contradict, the so-called redistribution view of trade credit. This view suggests that firms with access to external sources of finance function as intermediaries for firms that lack this access as suppliers have an information, controlling and enforcement advantage over banks (see for example Smith (1987); Mian and Smith (1992); Biais and Gollier (1997); and Cunat (2000)).

power. Similarly, the difference between a monopolist and a competitive supplier in their provision of trade credit should decrease when the supplier produces more sophisticated products. We refer to this hypothesis as the *"need for quality insurance" hypothesis*:[5]

Hypothesis 4a: Firms producing technical products are more likely to provide trade credit to customers with large bargaining power.

Hypothesis 4b: The difference between the percentage of goods sold on credit of a competitive supplier and a monopolist decreases when the goods sold are technical.

Besides firm characteristics also certain country characteristics, like the development of the financial and legal system can potentially influence the use of trade credit as a competitiveness tool. As argued by Demirgüç-Kunt and Maksimovic (2002) the development of a country's banking system and the use of trade credit by firms can theoretically either be substitutes or complements. They find evidence that the two are complements, which implies that it is efficient for firms to supply credit, even if they have to borrow to do so, as firms have advantages in evaluating loans and enforcing payment over pure financial intermediaries.[6]

Besides having a direct effect on the provision of trade credit, the development of the financial sector can also possibly have an indirect effect through its impact on the use of trade credit competition. When a financial system is relatively well developed more information is available on firm's credit histories. This information can serve as a guarantee for product quality, making customers less likely to exert market power when the financial system is well developed. Similarly, the increase of available information can explain a reduction in the difference between trade credit provided by monopolists and competitive suppliers. Since more information is available on firms' credit histories

[5] An additional potential interesting hypothesis is whether trade credit competition is more prevalent when goods are internationally traded. Unfortunately, we cannot test whether this is indeed the case as all our competitiveness variables (discussed in the next section) are based on the market power of both supplier and customer in the firm's domestic market.

[6] Similarly Frank and Maksimovic (1998) and Biais and Gollier (1997) argue that the use of trade credit complements the existence of a well-functioning banking sector.

the need for a supplier to use trade credit as a tool to lock in customers diminishes. The impact of the development of the country's banking system via the information channel is summarized in the *"information" hypothesis*:

Hypothesis 5a: In a country with a well-developed banking system customers with large bargaining power will receive less trade credit.

Hypothesis 5b: A well-developed banking sector decreases the difference between the percentage of goods sold on credit of a competitive supplier and a monopolist.

In addition to more available information, the development of the banking sector implies that on average more credit is available for domestic firms. Under the assumption that the reasons for use of trade credit competition remain unchanged, the increase in capital available would imply a higher use of trade credit competition in these countries. Furthermore, in a country with a well-developed financial system the risk of holding account receivables is relatively small as there often exists the potential of selling them to a factoring company. This positive relation between the development of a country's banking sector and the use of trade credit competition is posited in the *"credit-availability" hypothesis*. This hypothesis is the opposite of the *"information" hypothesis*, and states that:

Hypothesis 6a: Customers with large bargaining power will receive more trade credit in a country with a well-developed banking sector.

Hypothesis 6b: A well-developed banking sector increases the difference between the percentage of goods sold on credit of a competitive supplier and a monopolist.

Demirgüç-Kunt and Maksimovic (2002) show that the development of the legal system and the usage of trade credit are negatively correlated. This can be explained by the fact

that efficiency in legal systems is more important for financial intermediaries than for suppliers in their risk exposure, as banks are more in need to resort to legal recourse in order to solve non-repayment of credit. Trade creditors are in a better position to punish debtors without resorting to the legal system for example because they can withhold further deliveries. When law and order is strong bank credit will be easier to come by lessening the relative importance of trade credit, especially when bank and trade credit are substitutes.

There does not seem to exist a direct reason why there would be a relationship between the development of the legal system and using trade credit as a competitiveness tool. Even though when rule of law is weak and firms have no legal recourse in the case of credit non-payment, the impact of this will not be very substantial. Suppliers, in contrast to financial intermediaries, have ways to mitigate the problems of credit protection for example because they can credibly enforce payment by threatening to cut off future supplies. This leads to the final hypothesis referred to as *"constant impact legal system" hypothesis*:

Hypothesis 7a: The development of the legal system will leave the impact of customer bargaining power on trade credit provision unaffected.

Hypothesis 7b: The difference between trade credit provision of a competitive supplier and a monopolist is unaffected by the development of the country's legal system.

3.3 Data

The data used in this paper come from the World Bank Investment Climate Unit (ICU)-Firm Level Survey study. This project is an initiative of the World Bank to get a better understanding of the impact of a country's investment climate on enterprise performance and international competitiveness. The main focus of the survey is on microeconomic and structural dimensions of a nation's business environment, viewed in an international process.

Starting in 2000 surveys have been carried out in a number of developing countries, and more will be conducted in the future. In general a survey is conducted once in each country, but occasionally the survey was conducted twice. A major focus of the project is to provide information that is comparable across countries, regions and/or income-levels (and in some cases even comparable on a sub-national regional level). With this objective in mind recently a core set of questions has been developed and all country surveys need to include at least 85 percent of these questions. However, some of the surveys conducted previously contain questions that are not comparable to this Core. As cross-country comparison is important for our purpose we use the dataset based on the Core, accepting that some of the countries in the sample only provide information on a subsample of the questions.

The survey comprises of quantitative indicators such as sales, supplies, ownership, sources of finance and employment levels, along with qualitative questions dealing with the opinion of the firm's manager on the business environment and with his motivation to do business. Questions relating to age, legal status and ownership of the firm apply to the entire firm, including all establishments (factories, stores and/or service outlets), while the remaining questions are answered with respect to the establishment at which the survey was conducted.[7]

This database is unique for a number of reasons. First, it provides information for a large group of developing countries dispersed over all regions, making cross-country comparison possible. Currently data are available for 43 countries from which 42 provided information on the use of trade credit in sales. Table 3.1 shows the number of firms in each country with information on the provision of trade credit.[8] Second, the vast majority of the firms surveyed are small and medium enterprises and especially for these firms cross-country data have not been readily available. Third, and especially important for our purpose, this database explicitly provides information about the type of customers the surveyed firm is doing business with. This has the major advantage that information

[7] However, 74 percent of the firms in our sample has only one establishment and of the remaining 26 percent about half consists of two establishments.

[8] In seven countries in our sample two surveys were conducted (India, Kyrgyz Republic, Moldova, Poland, Serbia and Montenegro, Tajikistan and Uzbekistan). For each country we only use one survey as to avoid that firms enter the dataset twice. For India the last survey is used as this survey includes most of our variables of interest. For the other countries the first survey is used as the latter survey mainly focuses on balance-sheet data.

Table 3.1: *Number of Firms in Sample Countries*

Country	No. Obs	Country	No. Obs	Country	No. Obs
Albania	129	Georgia	174	Peru	564
Armenia	169	Honduras	449	Philippines	681
Azerbaijan	167	Hungary	250	Poland	500
Bangladesh	998	India	1,788	Romania	255
Belarus	250	Kazakhstan	249	Russia	500
Bosnia & Herzegovina	175	Kenya	239	Serbia & Montenegro	393
Brazil	1,636	Kyrgyz Republic	171	Slovakia	163
Bulgaria	250	Latvia	175	Slovenia	188
Cambodia	502	Lithuania	200	Tajikistan	175
China	1,500	Macedonia, FYR	148	Tanzania	264
Croatia	187	Moldova	174	Turkey	514
Czech Republic	267	Mozambique	91	Uganda	299
Estonia	169	Nicaragua	452	Ukraine	258
Ethiopia	427	Pakistan	965	Uzbekistan	358

about customer bargaining power can be derived directly from the survey and thus does not have to be proxied for example by looking at industry concentration levels.

3.4 Empirical Strategy

The survey provides a measure of provision of trade credit, as the respondents were asked what percent of the establishment's sales were sold on credit. This gives us a dependent variable (*soldoncred*), which shows variability beyond the yes or no distinction of a dummy variable often used in this type of studies.

Our dependent variable shows a concentration around zero and 100 percent so OLS regression is not appropriate as it fails to account for the qualitative difference between limit (zero and 100) observations and nonlimit (continuous) observations. Therefore we treat *soldoncred* as a censored variable, with the percentage of sales sold on credit only observed when it falls between zero and 100 percent and use as our regression model a standard tobit model with two-sided censoring.[9]

The survey contains information about the market power of both the supplier and its customers that allows us to test whether trade credit is used as a competitiveness tool. Our variable measuring consumer market power, *conspower*, equals the percentage of domestic sales sold by the firm to multinationals located in the firm's home country and

[9] A two-side censored tobit model is also used by McMillan and Woodruff (1999) who have a comparable dependent variable.

to large domestic firms (those with approximately 300 plus workers). These are firms that are more likely to have large bargaining power when it comes to the suppliers they choose, especially when they buy inputs from small enterprises.

The market power of the supplier is determined by using the answers to the survey question whether raising prices of the main product would alter the quantity demanded from customers. We created a dummy variable called *monop,* which is one if the firm answered that customers would continue to buy the same quantities if prices would increase and zero otherwise.

To study the heterogeneous firm responses to the use of trade credit competition we interact a number of firm characteristics with our two competitiveness variables. In order to test the validity of the *"reputation" hypothesis* we use two well-established proxy variables of reputation: the size of the firm and its age. Our variable *size* equals the log of the number of permanent plus temporary employees and our variable *age* matches the log of the age of the firm.

Another variable that can give information about the reputation of the firm is whether it has access to external sources of finance. Using access to finance as a proxy for reputation is based on the premise that firms that have no access to external sources of finance are firms that are not perceived as creditworthy by financial institutions and as a result are more likely to lack sufficient reputation with their customers.

We construct a variable that measures the access of a firm to domestic as well as to foreign sources of finance, *access*. It is a dummy which is one if the firm has a relationship with a domestic bank or has access to the foreign capital markets. Firms are said to have access to foreign capital markets if they have a relationship with a foreign owned commercial bank, if any of their borrowing is in foreign currency, if a foreign company is the largest shareholder or owner, or if the firm has holdings or operations in other countries.

The *"capital availability" hypothesis* is the direct opposite of the *"reputation" hypothesis* and we can test both hypotheses simultaneously. Like access to finance can proxy for reputation of the firm so can *size* and, to a lesser extent, *age* proxy for access to finance as larger (and older) firms are in a better position to find external sources of finance as they are perceived to be more creditworthy.

In order to determine whether the *"need for quality insurance" hypothesis* holds we need to construct a variable that can capture the technological content of the firm's products to interact with our two competitiveness variables. We created a variable *tech* which is one if the firm indicated in the survey to have developed a new product line and/or a new technique that substantially changed the way the main product is produced in the last three years and/or received ISO certification and zero otherwise.

To analyze the impact of country differences on the use of trade credit as a competitiveness tool, we interact variables capturing the development of the banking sector and of the legal system with our competitiveness variables *conspower* and *monop*. To examine the validity of the *"information"* and *"credit availability" hypotheses,* we use the ratio of the claims on the private sector by deposit money banks to GDP, *private*. This variable has been used in previous studies examining the impact of differences in financial system development across countries (see, for example, Rajan and Zingales (1998), and Demirgüç-Kunt and Maksimovic (2002)).[10]

To test whether the development of the legal system indeed has no effect on the use of trade credit competition we use an index produced by International Country Risk Rating agency that captures for each country the efficiency of the state in enforcing property rights. This measure, *legal*, reflects the degree to which the citizens of a country are willing to accept the established institutions to make and implement laws and adjudicate disputes. The measure ranges from one to six, with a low value indicating that claims in general are settled by physical force or illegal means, while a high value implies that sound political instruments and a strong court system exist in the country. This indicator has been used in previous studies comparing institutions in different countries (see, for example, Knack and Keefer (1995) and Demirgüç-Kunt and Maksimovic (2002)).[11]

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[10] In the case of China *private* is extremely high (1.2 on average) making China an outlier. As a result we have excluded China from the regressions where the impact of country characteristics on the use of trade credit as a competitiveness tool are studied. In addition, data on claims on the private sector by deposit money banks were not available for Albania, Serbia and Montenegro, and Uzbekistan. As a result, also these countries are not included in abovementioned regressions.

[11] For a number of countries in our sample no indicator for the development of the legal system is available. These are Bosnia and Herzegovina, Cambodia, Macedonia FYR, Georgia, Kyrgyzstan, Tajikistan, and Uzbekistan. As a result, in the regressions in which the impact of country characteristics are examined .these countries are excluded from the sample.

Table 3.2: *Summary Statistics*

	No. Obs.	Mean	Median	Std. Dev.
Dependent Variable				
Soldoncred	17,419	39.55	30.00	38.84
Competitiveness Variables				
Monop	9,771	0.17	0.00	0.37
Conspower	12,339	22.77	0.00	32.81
Firm variables				
Age	16,363	2.44	2.30	0.80
Size	16,429	3.66	3.42	1.68
Access	16,794	0.38	0.00	0.49
Tech	14,263	0.51	1.00	0.50
Export	15,518	0.16	0.00	0.37
Country variables				
Private	15,287	0.24	0.26	0.11
Legal	15,816	3.38	4.00	1.10
Gdpcap	17,231	1697.75	880.06	1624.64
Growth	17,231	3.64	3.22	2.93
Inflation	17,169	9.08	4.86	12.61

The summary statistics are for the sample restricted to the firms with information on the percentage of goods sold on credit. For definition of variables and their sources see Appendix Table A3.1

Table 3.2 contains the sample statistics of the variables we consider. In addition to the competitiveness variables, *conspower* and *monop*, and the various interaction terms discussed above, we control for some potential firm-specific determinants of the provision of trade credit. These include both age of the firm and the number of employees. We allow the relationship between both *age* as well as *size* and the provision of trade credit to be non-linear. Additional years of the firm add significantly to a firm's reputation early in life, but will have little effect later. A similar argument can be made for the size of the firm. Furthermore, we include *access* as control variable to account for the fact that firms with access to finance potentially pass on funds to financially more constrained firms.

Also the export content of the firm's sales can potentially impact the percentage of goods sold on credit (see for example Ng, Smith, and Smith (1999)). International compared to domestic customers are more likely to experience delivery delays and be unfamiliar with the seller. Because of these increased risks an international buyer will more likely demand trade credit. A positive relationship can also be the result of international customers potentially being more creditworthy, which will make it less risky

for the seller to provide trade credit. However, from the supplier's perspective dealing with an international customer can also intensify information problems concerning credit quality and therefore the seller is more likely to demand cash payments. In other words, the effect of export on trade credit provision can work two ways. As to control for the impact of this, we created a dummy variable *export,* which is one if the firm exports at least 25 percent of its products directly (exports through a distributor are not taken into account).[12]

To correct for the possibility that the provision of trade credit is sector driven, sector dummies are included: manufacturing, services, construction, agroindustry and other firms. To control for country-specific differences in the provision of trade credit, country dummies are included. When the impact of the development of the financial and the legal system on the use of trade credit competition is assessed, additional country variables are included to control for country differences not captured by the variables *private* and *legal*. Following Demirgüç-Kunt and Maksimovic (2002) we include three macroeconomic variables that can potentially affect the provision of trade credit. First, real GDP per capita (*gdpcap*) which controls for the economic development of the country. Second, the growth rate of per capita real GDP (*growth*) to control for potential business-cycle effects, and third, the rate of inflation (*inflation*) which may proxy for the willingness to enter into long-term financial contracts rather than short-term trade credit.

Table 3.3 shows the correlation matrix for the variables in our study. Our competition variables show the expected correlations. Customer market power is associated with more trade credit while monopoly power of the supplier with less trade credit, a preliminary indication that trade credit competition does play a role in a firm's decision to provide trade credit.

3.5 Results

The main focus of this paper is establishing whether competitiveness plays a role in the decisions of firms in developing countries to provide trade credit and, if so, whether firm

[12] An increase in the minimal percentage of direct exports in total sales to 50 percent would make the concentration of non-exporters too large (i.e. more than 90 percent). However, we tested whether the estimation results were robust to other cutoffs. This was indeed the case.

Table 3.3: *Correlation Matrix*

	Soldoncred	*Conspower*	*Monop*	*Age*	*Size*	*Access*	*Tech*	*Exporter*	*Private*	*Legal*	*Gdpcap*	*Growth*
Conspower	0.2062***											
Monop	-0.1058***	-0.0150										
Age	0.1174***	0.0790***	-0.0113									
Size	0.0823***	0.2287***	-0.0124	0.2902***								
Access	0.1258***	0.1699***	-0.0540***	0.0457***	0.2508***							
Tech	0.1402***	0.1035***	-0.0275***	0.0476***	0.2169***	0.1724***						
Exporter	0.0384***	0.1510***	0.0209**	0.0330***	0.2970***	0.1871***	0.0857***					
Private	0.1751***	0.1408***	-0.0354***	0.1513***	0.0673***	0.0444***	0.0309***	0.0979***				
Legal	-0.1840***	-0.0226**	0.0279**	-0.0887***	-0.1374***	-0.2294***	-0.1759***	-0.0465***	-0.1443***			
Gdpcap	0.1419***	0.0967*** -	0.0615***	0.0183**	-0.0221***	0.1508***	0.1598***	-0.0852***	0.3405***	-0.0131*		
Growth	-0.2419***	-0.0310***	0.0699***	-0.1559***	0.0453***	-0.1441***	-0.1356***	-0.0379***	-0.4259***	0.5128***	-0.0975***	
Inflation	-0.0484***	-0.0438***	0.1355***	-0.0726***	-0.0542***	-0.0109	0.0266***	-0.0637***	-0.2265***	-0.1056***	0.2018***	0.1890***

The correlation coefficients are for the sample restricted to the firms with information on the percentage of goods sold on credit. ***, ** and * correspond to one, five and ten percent significance levels respectively.

and country characteristics influence the use of trade credit competition. Table 3.4 presents our results. To aid the economic interpretation we show, instead of parameter estimates, the marginal effects for the unconditional expected value of the dependent variable, E(y), where y=max(*a*, min(y*,*b*)) where *a* is the lower limit for left censoring (0) and *b* is the upper limit for right censoring (100). The marginal effects are calculated at the mean of the independent variable, except when the independent variable is a dummy in which case the marginal effect is calculated as the dummy variable changes from 0 to 1. To accommodate for possible heteroskedasticity all standard errors are robust.

The first column in Table 3.4 tests the *"trade credit competition" hypothesis*. The results indicate that competitiveness is indeed a reason for firms to provide trade credit. The positive correlation between *conspower* and the percentage of goods sold on credit, significant at the one percent level, suggests that the willingness to provide trade credit is dependent on the customer's market power. When customers have large market power, the supplier is more likely to provide trade credit, than when the customer is a small firm. The impact of customer market power on the provision of trade credit is economically relevant. If a firm sells 50 percent of its products to a multinational or to large companies instead of zero percent, the provision of trade credit will be 5.9 percent higher. This is a substantial increase considering that the median firm in our sample sells 30 percent of its goods on credit.

Like Fisman and Raturi (2004) we find that an increase in monopoly power lessens the provision of trade credit. The result is significant at the one percent level and economically sizeable. A monopolist provides 5.1 percent less trade credit compared to competitive suppliers. Following the trade credit competition argument this negative relationship is driven by the fact that customers of competitive suppliers, in contrast to the ones of monopolists, have an option to move to another supplier and therefore the competitive seller has a stronger incentive to provide trade credit to lock in customers.

In the next three columns we interact the two competitiveness variables *monop* and *conspower* with the variables that proxy for reputation: *age*, *size*, and *access*. This allows us to test our *"reputation" hypothesis* versus the *"capital availability" hypothesis*. The results show that both size and age of the firm negatively affect the need to provide trade credit to customers with large market power. This is consistent with the

Table 3.4: *Using Trade Credit as a Competitiveness Tool*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Conspower	0.117***	0.266***	0.222***	0.146***	0.118***	0.213***	0.134***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.002]
Monop	-5.057***	-4.495*	-6.146*	-4.443***	-6.118***	-6.385**	-2.377
	[0.000]	[0.065]	[0.059]	[0.001]	[0.000]	[0.024]	[0.613]
*Conspower*Size*		-0.040***					
		[0.000]					
*Monop*Size*		-0.219					
		[0.747]					
*Conspower*Age*			-0.044***				
			[0.004]				
*Monop*Age*			0.478				
			[0.727]				
*Conspower*Access*				-0.054**			
				[0.035]			
*Monop*Access*				-1.664			
				[0.451]			
*Conspower*Tech*					-0.002		
					[0.944]		
*Monop*Tech*					1.825		
					[0.409]		
*Conspower*Private*						-0.347***	
						[0.010]	
*Monop*Private*						-8.112	
						[0.505]	
*Conspower*Legal*							-0.001
							[0.920]
*Monop*Legal*							-1.677
							[0.208]
Age	7.545***	7.259***	7.778***	7.397***	7.553***	10.894***	11.021***
	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.000]	[0.000]
Agesq	-1.951***	-1.886***	-1.822***	-1.924***	-1.941***	-2.579***	-2.612***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Size	6.847***	6.704***	6.586***	6.772***	6.661***	8.838***	8.817***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sizesq	-0.670***	-0.547***	-0.637***	-0.662***	-0.656***	-0.939***	-0.938***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Access	5.816***	5.824***	5.802***	7.261***	5.629***	6.469***	6.514***
	[0.000]	[0.000]	0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Export	4.737***	4.910***	4.800***	4.804***	4.777***	0.102*	2.933*
	[0.001]	[0.000]	[0.000]	[0.000]	[0.001]	[0.087]	[0.077]
Tech					1.493		
					[0.131]		
Private						-97.604***	-108.481***
						[0.000]	[0.000]
Legal						-5.562***	-5.349***
						[0.000]	[0.000]
Gdpcap						0.009***	0.009***
						[0.000]	[0.000]
Growth						-1.817***	-1.848***
						[0.000]	[0.000]
Inflation						-0.069**	-0.066*
						[0.046]	[0.053]
LR chi2	4709.92	4769.78	4727.03	4727.59	4715.45	2855.07	2880.32
No. Obs.	8,983	8,983	8,983	8,983	8,964	6,733	6,733

All regressions include sector dummies and regressions (1)-(5) also include country dummies, however these are omitted from the table due to space considerations. All regressions include a constant. Coefficients are marginal effects. The robust p-values appear in brackets and ***, ** and * correspond to one, five and ten percent level of significance respectively.

"reputation" hypothesis. Suppliers that mainly sell to multinationals or large corporations need to provide more trade credit, however, when they are large themselves or are already in business for several years it becomes easier to decline a potential demand for trade credit made by these customers without loosing their business. The magnitude of the interaction may be thought of in the following terms. A move from the 75th percentile of

size to the 25th percentile will widen the gap between a supplier who sells zero percent and one that sells 50 percent of its goods to large customers by 4.7 percent.[13]

The negative interaction between access to domestic and foreign sources of finance and *conspower* also provides evidence in favor of the *"reputation" hypothesis.*[14] The gap between a firm selling zero percent to large customers and a firm selling 50 percent to large customers will be narrowed by almost three percent if the firm has access to external sources of finance. These results suggest that firms that lack a solid reputation in the market use more trade credit competition.

The fact that especially small, young and financially constrained firms provide trade credit to customers with high market power is an indication that the positive correlation between customer market power and the provision of trade credit by firms is to a large extent driven by the urge to be competitive. Even though the high credit-quality of multinationals and large firms might partly explain why they receive more trade credit as suggested by Petersen and Rajan (1997), the fact that small and young firms and firms that lack access to external sources of finance provide more trade credit, even though the provision of trade credit is relative expensive for them, indicates that lower credit risk is unlikely to be the sole explanation, as these firms need a clear motivation as to why they provide trade credit.

We find no significant evidence that lack of reputation reduces the negative correlation between monopoly power and the percentage of goods sold on credit. This result contrasts with the result found by Fisman and Raturi (2004), that the length of the relationship between supplier and his customer indeed increases the negative impact of monopoly power on the provision of trade credit. This difference might be caused by the fact that their measure of reputation is customer-supplier relationship specific, while our measure only provides a broad proxy for reputation.

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[13] The difference in size between the 25th and 75th percentile is 2.35, this multiplied by an increase of the percentage of goods sold to large firms with 50 percent and the marginal effect of the interaction term implies a change in the percentage of goods sold on credit of 4.7 percent.

[14] As a robustness check we created two variables capturing access to finance, one capturing access to domestic finance and the other access to foreign finance, as to accommodate for the possibility that firms with access to foreign sources of finance have a better reputation. Both domestic as well as foreign access to finance had a significant negative effect on the impact of customer power on trade credit. The interaction with *monop* was in both cases insignificant. We have omitted the result for brevity. They are available from the author upon request.

We find substantial evidence that a company's reputation has a significant impact on the market power exerted by its customers. However, also the type of goods produced, like the level of technically advancement, potentially affects the use of trade credit competition. The results of interacting our competitiveness variables with *tech* can be found in column five of Table 3.4. Examining the interaction effects we find that the impact of customer market power is unaffected by whether the product made is technically advanced or not. Similarly, the interaction between *tech* and *monop* is also insignificant. It is possible that the market power exerted by the customer when the firm sells technically advanced goods does not lead to an increase in the percentage of the goods sold on credit, but is reflected in modified credit conditions, such as longer terms of credit as to allow the customers a longer time to test the quality of the product (Long, Malitz, and Ravid (1993)). Unfortunately we have no information on the terms of trade credit, thus testing for this is not possible.

The impact of country characteristics on the use of trade credit competition is shown in the last two columns of Table 3.4.[15] In both specifications we find a negative relation between the provision of trade credit and the development of the legal system, consistent with the results found by Demirgüç-Kunt and Maksimovic (2002). Contrary to their results, we also find a negative correlation between the development of the financial system and the provision of trade credit. This suggests that the development of the country's banking system and the use of trade credit are substitutes instead of complements. A possible explanation for this negative relationship is that information about firms' credit histories is more readily available which makes the need for trade credit to lock in customers less important.[16] This is especially likely to affect small and medium enterprises. The fact that Demirgüç-Kunt and Maksimovic (2002) look at

[15] In all these regressions the country variables are based on the year that coincides with the year of the survey questions. However, as a robustness check we estimated the same regression taking the country variables as the average of the year that coincides with the survey questions and the two preceding years. This did not affect our main results

[16] As suggested by Fisman and Raturi (2004), customers have to invest in relationship building before receiving trade credit. Because of the relationship-specific cost involved the customer will not easily shift to another supplier once the relationship is established. This provides security for the supplier that customers will not intentionally default on the trade credit received and thus makes it less risky for the supplier to provide trade credit to lock in a customer. When information about the creditworthiness of the customer is more readily available it is easier for the customer to switch from one supplier to another. This increases the risk of intentional default and as such has a negative effect on the provision of trade credit.

publicly listed firms in both developed and developing countries and our dataset contains mainly small and medium enterprises might explain the contrasting results.

The negative and significant interaction between *conspower* and the development of the financial sector suggests that customers are less likely to exert their market power when information about firms is more widely available, as this information can serve as a guarantee for product quality. Consider a move from the country at the 25th percentile of financial development (Russia) to a country at the 75th percentile (Hungary). This will narrow the gap of goods sold on credit between a firm selling zero percent to large customers and a firm selling 50 percent to large customers with 3.3 percent.[17] The evidence confirms part a of the *"information" hypothesis.* However, we find no evidence that the development of the banking sector influences the difference in trade credit provision between monopolists and suppliers in a competitive market.

The results in the last column of Table 3.4 are consistent with our *"constant impact legal system" hypothesis*. The insignificance of the interaction term suggests that when rule of law is weak firms have ways to mitigate problems of credit protection in contrast to banks. As a result, the development of the legal system leaves the use of trade credit competition unaffected.

The coefficients of the control variables in all equations are as expected. Both firm size and age, proxies for the reliability and reputation of a company, are large and highly significant, with the significance of the squared term indicating that the size of the effect is decreasing over size and age. Similarly, the coefficient on *access* is also positive and highly significant. This finding indicates that a firm with access to finance, whether domestically or through the international capital markets, sells more goods on credit than a firm without this access.[18] This result is consistent with the results found by, for example, Petersen and Rajan (1997).

[17] The difference in private between the 25th and 75th percentile is 0.19, which multiplied by the marginal effect of –0.35 and the change in percentage of goods sold to large customers amounts to a drop in trade credit provided of 3.3 percent.

[18] We have also estimated all regressions using to separate variables capturing access to domestic and to foreign sources of finance as control variables. Both variables were highly significant in all specifications with the expected positive sign. The results are available upon request.

The positive sign of *export*, significant at the five percent level in most specifications, indicates that exporters provide more trade credit to their customers. This positive relation can be explained by the fact that international customers are more creditworthy, or alternatively by the fact that the quality risk faced by international customers overrides the increased credit risk faced by the exporters. This result is in line with Ng, Smith, and Smith (1999) who find that selling to international customers marginally increases the likelihood of the seller adopting two-part trade credit (i.e. trade credit where the buyer is offered a discount for prompt payment).

Similarly the country-level control variables are consistent over all specifications. There exists a positive relationship between the use of trade credit and the economic development of the country, a negative correlation between growth and trade credit and a negative relationship, albeit not always significant, between inflation and the use of trade credit.

The inclusion of both competitiveness variables *conspower* and *monop* in order to test our hypotheses, is preferred as it avoids the possibility that the results are driven by an omitted variable bias. However, this approach has a significant downside. A number of countries in our sample have no information about the monopoly power of the supplier. These countries are Bangladesh, China, Ethiopia, India, Kenya, Mozambique, Pakistan, Peru, The Philippines, and Uganda. As a result cross-country and regional variation is limited in the specifications used in Table 3.4.

To determine whether adding additional countries has an impact on the results and thus to check the robustness of our conclusions, we exclude the variable *monop* from the regressions and estimate each specification again with the extended sample. The results can be found in Table 3.5.

Our earlier findings are robust to the exclusion of *monop* and the consequential increase in the number of countries in our sample. Again we find a positive and highly significant relation between the market power of the customer and the percentage of goods a firm sells on credit. A good reputation, as measured by the firm's age, size and its access to domestic and foreign sources of finance, lessens the need to use trade credit competition. In addition, the impact of customer bargaining power is higher in countries

Table 3.5: *Using Trade Credit as a Competitiveness Tool, Robustness Test*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Conspower	0.129***	0.232***	0.213***	0.147***	0.115***	0.231***	0.166***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
*Conspower*Size*		-0.026***					
		[0.000]					
*Conspower*Age*			-0.034***				
			[0.009]				
*Conspower*Access*				-0.037*			
				[0.091]			
*Conspower*Tech*					0.017		
					[0.445]		
*Conspower*Private*						-0.357***	
						[0.004]	
*Conspower*Legal*							-0.006
							[0.595]
Age	5.539**	5.568**	5.931**	5.457**	5.894**	10.036***	10.104***
	[0.013]	[0.012]	[0.007]	[0.014]	[0.009]	[0.000]	[0.000]
Agesq	-1.528***	-1.528***	-1.442***	-1.514***	-1.602***	-2.309***	-2.325***
	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]
Size	6.499***	6.328***	6.302***	6.449***	6.415***	9.963***	9.986***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sizesq	-0.593***	-0.506***	-0.569***	-0.587***	-0.592***	-0.977***	-0.985***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Access	6.206***	6.180***	6.175***	7.107***	5.953***	6.357***	6.432***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Export	3.283***	3.401***	3.286***	3.367***	3.351***	2.065	2.175
	[0.006]	[0.004]	[0.006]	[0.005]	[0.006]	[0.171]	[0.151]
Tech					1.626*		
					[0.060]		
Private						-55.961***	-64.300***
						[0.000]	[0.000]
Legal						-7.101***	-6.980***
						[0.000]	[0.000]
Gdpcap						0.006***	0.006***
						[0.000]	[0.000]
Growth						-1.513***	-1.521***
						[0.000]	[0.000]
Inflation						-0.079**	-0.075**
						[0.016]	[0.021]
LR chi2	5196,39	5228,79	5206,67	5206,63	4931,55	2851,37	2827,13
No. Obs.	11,587	11,587	11,587	11,587	11,353	7,947	7,947

All regressions include sector dummies and regressions (1)-(5) also include country dummies, however these are omitted from the table due to space considerations. All regressions include a constant. Coefficients are marginal effects. The robust p-values appear in brackets and ***, ** and * correspond to one, five and ten percent level of significance respectively.

with a less developed banking system, while the country's legal system has no impact on the use of trade credit competition.

3.6 Conclusion

Statistics show that the use of trade credit by firms in both developed and developing countries is widespread, even when these firms are financially constrained and thus face relative high costs when providing trade credit. In this paper we argue that a possible explanation for this extensive use of trade credit is that it can function as a competitiveness tool. If the supplier's customers have strong market power the firm is more likely to sell its goods on credit as the customer can credibly threat to move to

another supplier. Furthermore, a competitive supplier can use trade credit as a way to lock in customers. A monopolist, on the other hand, will be less inclined to provide trade credit as customers have no option to move to another supplier.

Using data from almost 18,000 firms, mostly small and medium enterprises, in 42 developing countries, we find strong evidence of the importance of competitiveness in the provision of trade credit. Our results suggest that a monopolist sells significantly less of its goods on credit, while customer market power proves to have a positive effect on the amount of trade credit a supplier provides. Furthermore, we find that on average small and young firms and firms that lack access to finance are more inclined to use trade credit as a tool to sell products. This suggests that reputation of the supplier is an important determining factor in a firm's need to use trade credit competition.

Examining the impact of institutional development we find that the development of the legal system, while negatively correlated with the provision of trade credit, hardly affects the use of trade credit as a competitiveness tool. Contrary, a better developed financial system lessens the market power exercised by customers, likely because more firm-specific information is available which can function as a guarantee for product quality.

All in all, the results put forward in this paper suggest that trade credit competition is an integral part of doing business for firms in developing countries, especially for those firms that still have to establish a solid reputation in the market and firms located in countries with an underdeveloped banking sector.

Appendix Table A3.1: *Variable Definitions and Sources*

Variable	Definition	Source
Soldoncred	Percentage of goods sold on credit	ICU Investment Climate Survey
Conspower	Percentage of domestic sales sold to multinationals in the firm's home country and to large domestic firms (those with approximately 300 plus workers).	ICU Investment Climate Survey
Monop	Dummy variable that takes on the value one if the firm does not expect to see demand drop after a price increase, zero otherwise.	ICU Investment Climate Survey
Age	Log of the age of the firm.	ICU Investment Climate Survey
Size	Log of the number of permanent plus temporary employees.	ICU Investment Climate Survey
Access	Dummy variable that takes on the value one if the firm has a relationship with a domestic and/or a foreign owned commercial bank, if a share of the firm's borrowing is in foreign currency, if a foreign company is the largest shareholder or owner, or if the firm has holdings or operations in other countries, zero otherwise.	ICU Investment Climate Survey
Tech	Dummy variable that takes on the value one if the firm developed a new product line and/or developed a new technique that substantially changed the way the main product is produced in the last three years and/or received ISO certification, zero otherwise.	ICU Investment Climate Survey
Export	Dummy variable that takes on the value one if the firm exports at least 25 percent of its products directly (exports through a distributor are not taken into account), zero otherwise.	ICU Investment Climate Survey
Private	Credit extended by deposit money banks to the private sector divided by GDP, based on the year that coincides with the year of the survey questions.	International Financial Statistics
Legal	Measure of law and order tradition in the country, scored 1 to 6. Low scores indicate a tradition of depending on physical force and illegal means to settle claims. High scores indicate sound political institutions and a strong court system, based on the year that coincides with the year of the survey questions.	International Country Risk Guide
Gdpcap	Real per capita GDP, based on the year that coincides with the year of the survey questions.	World Development Indicators
Growth	Growth rate of real per capita GDP, based on the year that coincides with the year of the survey questions.	World Development Indicators
Inflation	Inflation rate of the GDP deflator, based on the year that coincides with the year of the survey questions.	World Development Indicators

Chapter 4

The Price of Inconvertible Deposits: The Stock Market Boom during the Argentine Crisis*

4.1 Introduction

During 2001, Argentina faced a currency run that triggered a generalized bank run.[1] As a result, Argentina suspended convertibility of their bank deposits on December 3 (the so-called 'corralito'),[2] and imposed extensive capital controls, measures that were followed on January 7 by the devaluation of the peso and a compulsory 'pesification' and reprogramming of most bank deposits on February 3. Following the establishment of the corralito, the stock market witnessed a 'boom' in prices, in contrast with other recent crises, resulting in a cumulative increase of the local stock exchange index of 64 percent between the start of the corralito and the devaluation, and a further increase of 50 percent by end-2002. Two recent papers by Auguste, Dominguez, Kamil, and Tesar (2003) and Melvin (2002) attribute this seemingly unexpected development to a boom in stocks of companies with American Depositary Receipts (ADRs) that may have been used as a channel for capital outflows.

In this note, we complement this new literature by showing that the price increase was generalized to all stocks, including stocks with and without ADRs, and more

* Published in *Economics Letters*, 2004, vol. 83, pp. 7-13. See http://www.elsevier.com.wps/find/journaldescription.cws_home/505574/description#description.

[1] See, for example, De la Torre, Levy Yeyati and Schmukler (2003) and references therein for an analysis of the crisis.

[2] The name corralito ('little fence') was initially adopted because deposits could be transferred freely within the financial system but could not be redeemed in cash and leave the system, beyond a certain limit.

pronounced in liquid stocks. We also argue that this mechanism did not generate capital outflows. Indeed, while ADR stocks did provide a way to migrate equity and obtain in exchange dollars outside Argentina, at most only a small fraction of these stocks were transferred abroad. Instead, the boom reflected the price investors were willing to pay to cash out their inconvertible bank deposits, in light of the impending devaluation, reprogramming, and confiscation risks. As a result, the boom could be interpreted as a consequence of the effectiveness of both the suspension of deposit convertibility and the capital controls.

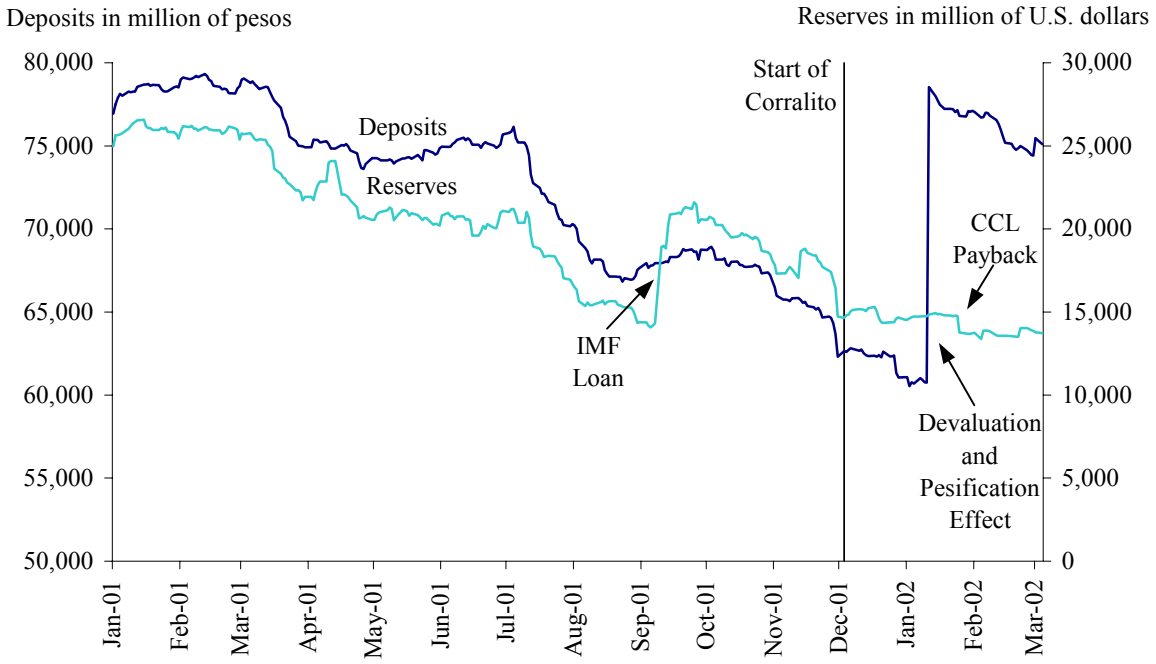
4.2 The Corralito and the Stock Market Boom

As shown in Figure 4.1, the corralito was preceded by a steady decline in reserves and deposits during 2001. The cumulative slide in reserves from January 2001 until November 2001 amounted to a loss of 10.9 billion dollars, paralleled by a loss of 11.5 billion dollars in deposits. The run peaked (possibly in anticipation of the coming controls) on November 30, when deposits and reserves fell by 1.4 and 1.7 billion dollars respectively. The imposition of the corralito, coupled with a ban on capital outflows, significantly halted the decline in both deposits and reserves. [3]

If by November, the abandonment of the fixed parity was judged highly likely, the corralito signaled the practical demise of convertibility and the question was no longer whether a devaluation was inevitable, but rather what the post-devaluation exchange rate would be. Moreover, the perception that the corralito had all but reduced the incentives to run fueled beliefs that deposits would need to be (at least partially) reprogrammed to avoid a banking collapse or hyperinflation, in the event the corralito was lifted. Finally, the option to pesify deposits and loans, already under discussion in policy circles, appeared ever more likely, as a way to avoid generalized defaults.

[3] While there were no restrictions on the purchase of dollar bills, right after the imposition of the corralito the supply of dollars was increasingly rationed until December 21, when the foreign exchange market was officially closed.

Figure 4.1: *Evolution of Deposits and Reserves*



Deposits include dollar and peso deposits held by the private sector. Dollar deposits are converted into pesos using the market exchange rate. The large jump in deposits on January 11, 2002 reflects the combined effect of the devaluation of the exchange rate, increasing the peso value of dollar deposits, and the pesification of dollar deposits at the 1.40 conversion rate. Reserves include gold and currency in possession of the central bank. The increase in reserves on September 10, 2001 is due to the disbursement of an IMF loan, which was deposited in the central bank. The one billion U.S. dollar drop on January 24, 2002 corresponds to the payback of the contigent credit line (CCL). Sources: Bloomberg and Central Bank of Argentina.

Consequently, the dollarization of deposits was no longer a realistic hedge against exchange rate risk.[4]

There were at least three powerful reasons to leave the corralito: i) the reduced liquidity of bank deposits due to limited convertibility (only within the banking sector) that generated a 'cash premium';[5] ii) the possible reprogramming of deposits; and iii) the impending devaluation in combination with a threat of pesification.

These reasons generated an increase in stock prices relative to inconvertible corralito deposits. Stocks prices (with and without ADRs) were affected by all three

[4] All of these beliefs eventually materialized. Most time and savings deposits (including those matured in December and shifted to sight accounts) were reprogrammed at a longer duration and dollar deposits were converted at the official (below market) 1.40 peso-dollar exchange rate.

[5] This premium was regularly measured as the discount rate on checks, which declined gradually as the funds waiting to get out of the corralito fell over the year. By the time the corralito was lifted on December 2, 2002, the discount was about 2 percent. Unfortunately, data on this premium is only available starting in February 2002.

factors: stock prices were quoted in illiquid 'corralito pesos',[6] stocks were reprogramming-free, and stocks protected investors from a devaluation (as part of their returns were tied to dollar revenues).

This is confirmed by the evolution of market capitalization-weighted portfolios of ADRs and non-ADR stocks (Figure 4.2).[7] A closer look reveals that the post-corralito boom was more pronounced in liquid stocks: the top five most liquid stocks in the portfolio (as determined by their average value traded in the period August 2001 – September 2001) experienced a substantially larger price hike.[8] As a result, once we restrict attention to the most liquid stocks, the evolution of both portfolios after the imposition of the corralito exhibits a similar pattern.[9]

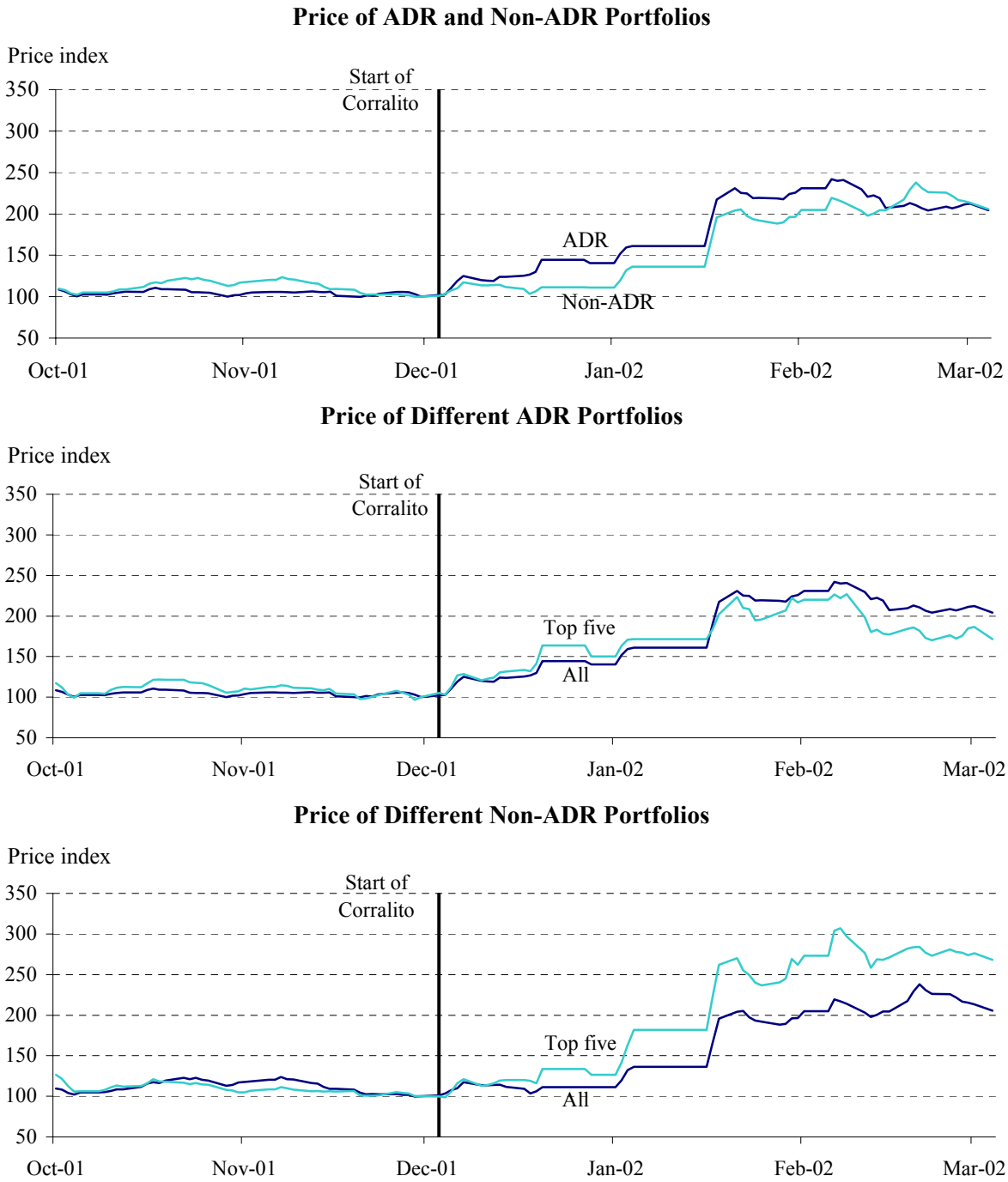
4.3 ADRs, Capital Controls, and Capital Outflows

As argued in previous papers, ADR stocks gave investors the option to exchange inconvertible deposits for U.S. dollars in the international financial centers. However, did this fund-shifting mechanism provide a way to circumvent the controls on deposits or on capital outflows? And did investors actually use this fund-shifting alternative to get fresh dollars abroad? We turn to these two questions next.

Even though ADR stocks allowed investors to migrate their stocks to New York, this migration did not mean that controls were circumvented. On the contrary, in normal times this migration is the counterpart of capital inflows to emerging markets, as domestic stocks are exchanged for new funds invested in the country.[10] While it is unlikely that the capital obtained through migration was repatriated during the crisis, it is still true that these transactions did not entail a decline in the overall level of deposits

[6] An investor holding cash and willing to invest in stocks could have, for example, purchased a deposit at a discount and use it to buy the stock. Alternatively, he could have bought the stocks cash, but at a discount.
[7] The results are not affected by the use of alternative weighting schemes.
[8] We use value traded in August and September as the December and January values are affected by the boom in prices. The results are robust to the use of different months to compute the weights.
[9] As the top five ADR stocks are more liquid than the top five non-ADR stocks, one would naturally expect that the price boost would be larger in the former, which was not the case. This seemingly contradicting result can be explained by the fact that the price of ADR stocks in Buenos Aires is also a function of the price of the ADR in New York, which remained relatively stable.
[10] Investors willing to invest in those countries demand their stocks in international equity markets, among other things. See Claessens, Klingebiel, and Schmukler (2002), Levine and Schmukler (2003), and the long literature cited therein.

Figure 4.2: *The Boom in the Stock Market*



The complete ADR portfolio includes all publicly listed ADR stocks (12 stocks), except Nortel which is highly illiquid. The non-ADR portfolio includes 43 stocks, excluding stocks that were traded less than three days in the first month of the corralito. The portfolio is market capitalization weighted, with the weight of each stock determined by its average relative market capitalization in the period August 2001-September 2001. Top five refers to the five stocks with the highest average value traded in the period August 2001-September 2001. The top five ADR stocks includes BBVA Banco Frances, Grupo Financiero Galicia, Petrobas Energia (Perez Companc), Siderca, and Telecom Argentina. The top five non-ADR stocks includes Acindar, Ledesma, Minetti Juan, Molinos, and Siderar. All stock prices are taken in pesos. Each index is equal to 100 on November 30, 2001. The flat parts in the graph indicate periods of no trading, as the stock market was closed. Source: Bloomberg.

(which would have been otherwise reflected in a loss of deposits and reserves). Depositors that purchased stocks with inconvertible deposits simply transferred them to previous stocks holders.

The absence of capital outflows can be observed in the data, both in quantities and prices. As Figure 4.1 shows, after dropping significantly in the pre-crisis period, reserves remained stable once the corralito and other controls were imposed. The drop in deposits, reflecting the cash withdrawal within the limits of the corralito, translated into an increase in currency in circulation.

The effectiveness of capital controls is also apparent in the cross-market premium (defined as the difference between prices of ADR stocks in Buenos Aires and ADRs in New York). As shown in Alaganar and Bhar (2001), under perfect integration the law of one price holds as any price difference is instantaneously arbitraged away. By contrast, market segmentation induced by capital controls, providing they are binding (hence, effective), leads to the occurrence of a premium, as full arbitrage cannot take place.[11] The case of Argentina is a good example; the premium was close to zero before the controls were implemented and turned positive thereafter, gradually declining from around 50 percent to a value of around 7 percent by the end of May (Figure 4.3).[12]

As ADR stocks were priced in corralito pesos while ADRs were priced in dollars out of the corralito (and out of the country), the cross-market premium reflected the three factors previously described plus the premium induced by controls on capital outflows.[13] Accordingly, the evolution of the premium over time can be traced not only to the realization of the reprogramming and exchange rate risks, but also to the weakening of the cash premium (as the reprogramming of deposits and the steady leakage of un-reprogrammed deposits slowly reduced the volume of corralito funds pushing for the exit) and to the relaxation of other controls be end-2002.

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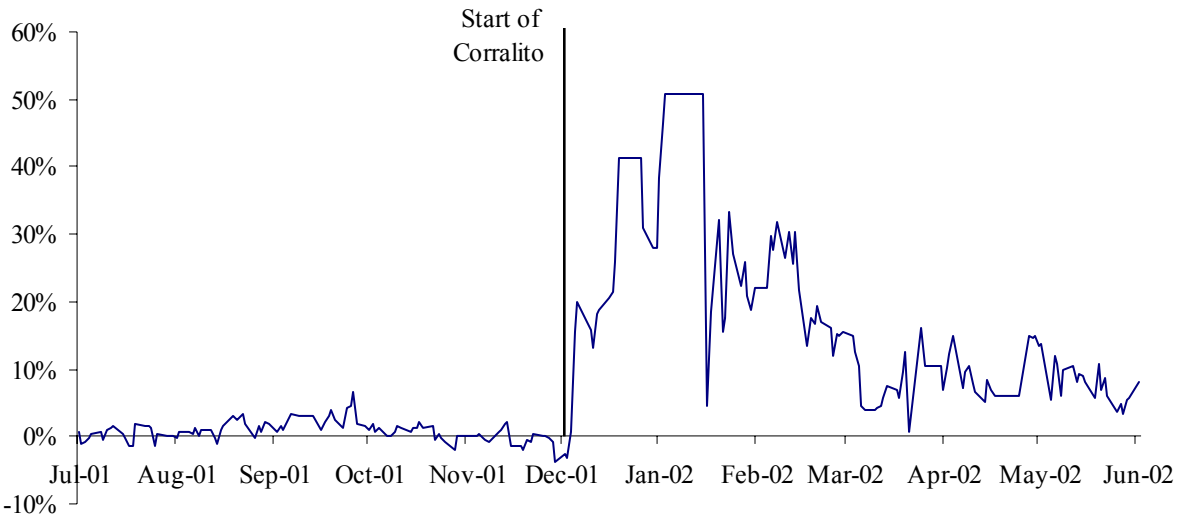
[11] The existence of controls does not prevent arbitrage across markets; it just means that the non-arbitrage bands become wider so a non-zero discount can emerge. Depending on the type of control, a positive or negative premium emerges. See Chapter 2 and Levy Yeyati and Schmukler (1999).

[12] The premium is the percentage difference between the closing dollar price of the stock in Buenos Aires and the closing price of the corresponding ADR in New York.

[13] A crude estimate of the latter is given by the ADR premium of around 15 percent by end-February (when the reprogramming and exchange rate risks had already realized) minus a cash premium of about 9 percent by the same date (as reported by the Central Bank of Argentina).

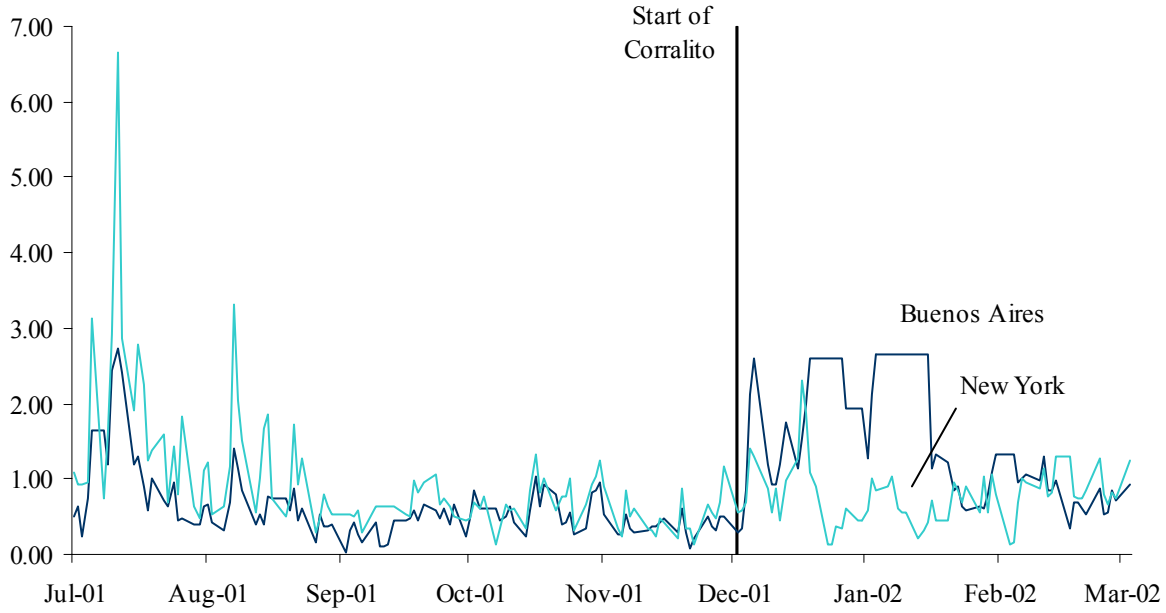
Figure 4.3: *Cross-Market Premium*



The graph plots the cross-market premium for the portfolio of ADRs (12 stocks). Each stock in the portfolio is weighted by its relative market capitalization; with the weight of each stock determined by its average relative market capitalization in the period August 2001-September 2001. Note that during the sample period there were days when one of the stock markets was closed. On those days, the premium from the last trading day is repeated. The peak premium occurred on January 4, 2002, which coincides with the announcement of President Duhalde that the peg with the dollar would be broken. Source: Bloomberg.

Figure 4.4: *Trading in Buenos Aires and New York*

Trading volume in million of U.S. dollars



The figure shows the trading volume of the complete ADR portfolio (12 stocks), using the stocks with ADRs for Buenos Aires trading and the corresponding ADRs for New York trading. The portfolio is market capitalization weighted, with the weight of each stock determined by its average relative market capitalization in the period August 2001-September 2001. On days of no trading the trading volume of the previous trading day is repeated. Source: Bloomberg.

Finally, note that, despite the absence of capital outflows, investors could have still taken advantage of ADR stocks to move their funds out of the country through stock migration. We argue that this occurred only to a limited extent. Figure 4.4 shows that the average trading volume in ADRs in New York was high before the imposition of the corralito, as investors kept selling Argentine stocks abroad while the crisis deepened. With the corralito, by contrast, the trading of ADR stocks in Buenos Aires increased significantly in relative terms, more than doubling the activity in New York (which also represents trades among New York investors). This evidence indicates that only part of the purchases of the underlying stock ended up being transferred abroad during the period. Thus, this fund-shifting ADR-specific motive does not appear to have been a key driver behind the stock market boom.[14]

In sum, the evidence suggests that the boom reflected the desire of depositors to shift their inconvertible deposits out of the banking system, although not necessarily out of the country. In light of this, the boom (as well as the sizeable cross-market premium that accompanied it) was a manifestation that the controls imposed were effective.

[14] Note that that the conversion of local shares into ADRs does not need to be reflected in the trading volume, as investors can transfer their stocks from Buenos Aires to New York, increasing the number of outstanding ADRs with no increase in trading. However, to convert their deposits into cash investors would have needed to sell those ADRs, which would have added to the volume traded.

Chapter 5

Foreign Exchange Market Contagion in the Asian Crisis: A Regression-based Approach

5.1 Introduction

On July 2, 1997 the value of the Thai baht declined sharply, indicating the start of the Asian crisis. The fall of the baht was quickly followed by pressure on the currencies of Indonesia, Malaysia, the Philippines and, somewhat later, Korea. As the fundamentals of these currencies did not seem to warrant the extent of pressure they experienced, it hinted at the existence of transmission mechanisms between Thailand and these countries. Instigated by the events in Asia, a growing body of literature has emerged that tries to answer the question how a crisis can spread so easily from one country to another. This paper adds to this literature.

Most of the earlier research on the transmission of crises in general has taken the form of cross-country studies aiming to assess whether the occurrence of a currency crisis in one country or group of countries increases the probability of a crisis in another country (see Eichengreen, Rose, and Wyplosz (1996); Glick and Rose (1999); Kaminsky and Reinhart (2000), among others). This literature is directed at identifying the linkages through which a crisis spreads without distinguishing between tranquil periods and crisis periods.

More recent transmission studies make a distinct difference between normal interdependence (spillovers), that is the propagation of shocks due to fundamental real and financial linkages that were also prevalent during tranquil times, and contagion, which implies a regime change in the 'factors' driving the transmission of negative shocks

(King and Wadhwani (1990); Baig and Goldfajn (1999); Forbes and Rigobón (2002), among others).

In this paper we follow the approach of the second group. We define contagion as the spread of a shock during a crisis from one country to another beyond any normal interdependencies between the countries. This choice enables us to distinguish theories that argue that investors behave differently during a crisis from theories that assume that shocks are propagated through stable (trade and financial) linkages.[1] This allows us to circumvent the difficult task of measuring directly different channels through which shocks can propagate.[2] Moreover, the contagion definition provides a relatively straightforward test of contagion, as a significant increase of comovement during a crisis period is evidence of contagion (provided that proper controls are taken into account).

The possibility of discontinuities in international transmission mechanisms in the wake of a crisis is relevant for both investors and policy makers. After all, the benefits of diversification for international investors are smaller if cross-country correlations of asset returns are significantly higher in periods of crisis. In this case portfolio diversification may fail to deliver exactly when its benefits are needed most. Furthermore, if negative shocks to one country spread to other countries independent of the countries' fundamentals, this can justify international official lending and availability of an international lender of last resort fund.

The goal of this paper is to determine empirically whether pressure on the exchange market in Thailand, the origin of the crisis, was transmitted to the exchange markets of Indonesia, Korea, Malaysia, and the Philippines as a result of contagion effects, and if so, to what extent this contagion explains the pressure on the currencies of the latter countries during their crises. As the Asian crisis started in Thailand, this is also referred to as 'ground-zero' contagion.

This paper adds to the existent literature in several ways. First, it examines contagion in the foreign exchange market, which has, in contrast to stock market contagion, received limited attention. Second, rather than using actual exchange rate

[1] See Forbes and Rigobón (2001); Pericoli and Sbracia (2003); and Claessens, Dornbusch, and Park (2001) for extensive overviews of different theories on crisis transmission.
[2] For example Kaminsky and Reinhart (2000) argue that it is very difficult to distinguish between trade and financial channels as they are often highly correlated.

changes, we test for contagion using the exchange market pressure indicator (EMP), to account for the fact that most of the crisis countries had a fixed exchange rate before the crisis. This indicator combines exchange rate changes with changes in the interest rate and international reserves. To our knowledge, only Gelos and Sahay (2001) have also studied variation in EMP over time.

Our third contribution to the literature is of a methodological nature. In general, contagion has been measured by the increase in the correlation of asset returns between two countries. This approach has been gradually improved by correcting for domestic fundamentals and exogenous global shocks. Recently, studies have also accounted for (conditional) heteroskedasticity (Forbes and Rigobón (2002)). However, the validity of this correction is questioned (see, for instance, Corsetti, Pericoli, and Sbracia (2002)).

Instead of continuing to seek progress in correcting correlation analysis, we turn into a different route by using regression analysis. This makes a test for contagion simply a test for a break in the parameter for the transmission variable. Regression analysis allows controlling for domestic macroeconomic fundamentals, common external shocks and heteroskedasticity in a straightforward manner. Hence, regression seems a natural approach for studies on contagion.

The fourth contribution to the literature is that we apply an alternative approach to control for macroeconomic fundamentals. It is based on the signalling approach introduced by Kaminsky and Reinhart (1999). We construct a time-varying composite indicator for the fragility of an economy, consisting of 14 macroeconomic and financial variables that according to Kaminsky and Reinhart's analysis have a good explanatory power in predicting a financial crisis. To our knowledge this approach has not yet been used in contagion studies based on time series analysis.

Fifth, application of regression analysis provides us with the opportunity not only to determine the significance of the contribution of contagion to the EMP explanation, but also to measure the size of this contribution. We use the partial R^2 of the contagion variable for that.

The data yield evidence of contagion from Thailand to Indonesia and to Malaysia, but not to Korea and the Philippines. For Indonesia 13 percent of the pressure can be attributed to contagion effects from Thailand, and for Malaysia 21 percent. Our evidence

is robust to a large number of specification tests and does not seem to be driven by endogeneity bias either resulting from omitted variables or from simultaneity of the contagion regressor.

The remainder of the paper is structured as follows. Section 5.2 gives an overview of the empirical literature. Section 5.3 elaborates on our alternative empirical strategy. Our estimation results, including a number of specification tests, and the determination of the extent of contagion are presented in Section 5.4. Section 5.5 concludes.

5.2 Measuring Contagion – A Literature Overview

As pointed out in the Introduction, the existing literature can be broadly divided into two groups. The first group of papers studies the transmission of shocks, without identifying whether this transmission mechanism differs between tranquil and crisis periods. This group typically uses probit/logit and GARCH models. The second group of papers specifically tests for a change in the transmission mechanism during a crisis. These studies use correlation coefficients. In this section we provide an overview of both groups.

Studies using a probit/logit approach examine whether the likelihood of a crisis in a specific country increases when another country or a group of countries is hit by a crisis. For example, Eichengreen, Rose, and Wyplosz (1996) find that a currency crisis elsewhere raises the likelihood of a currency crisis by about 8 percent. Glick and Rose (1999) apply a similar approach to five episodes of currency crises and 161 countries and find that trade linkages are important in propagating a crisis. De Gregorio and Valdes (1999) find that transmission during the 1982 Debt crisis was as severe as in the Asian crisis, while in the Mexican crisis it was considerably less so.

GARCH models are used to test whether volatility is transmitted between countries. Chou, Ng, and Pi (1994) and Hamao, Masulis, and Ng (1990) find evidence of significant spillovers across markets after the U.S. stock market crash in 1987. Edwards (2000) examines the propagation across bond markets after the Mexican crisis and finds strong evidence of transmission from Mexico to Argentina, but not from Mexico to Chile.

This literature builds on the crisis prediction literature. It has the main advantage that it readily allows statistical tests for the occurrence of crisis transmission and allows to identify channels through which it might occur. For example, Eichengreen, Rose and Wyplosz (1996) and Glick and Rose (1999) identify trade links as an important channel of crisis transmission, while Kaminsky and Reinhart (2000), examining the Mexican, Asian and Russian crisis, find evidence of the existence of the common creditor channel.

In contrast to the studies just mentioned, the second set of papers does allow for differences in the transmission mechanism between tranquil and crisis periods. In this sense, these studies are most closely related to our paper. They test whether correlation coefficients, regarding stock prices, exchange rates, sovereign bond spreads or interest rates, change during a financial crisis. In this literature, a significant increase in correlation is considered evidence of contagion. King and Wadhwani (1990) look at the correlation between the U.S, the U.K and Japanese stock markets and find a significant increase after the U.S. stock market crash of 1987. Calvo and Reinhart (1996) use this approach to test for contagion after the Mexican crisis. They find that the correlation in both stock prices and Brady bonds between Asian and Latin American emerging markets increased significantly. Frankel and Schmukler (1998) present evidence that the returns of country funds in Latin America and East Asia displayed higher comovements with those of Mexican country funds during the Mexican crisis. Baig and Goldfajn (1999) find evidence of substantial contagion in the Asian crisis through the foreign exchange and debt markets, but only tentative evidence of contagion through the stock market. Kleimeier, Lehnert and Verschoor (2003) test for contagion during the Asian crisis. They find little evidence of a change in the transmission mechanism from Thailand to any other country in the sample, but they do find evidence of contagion from the Hong Kong stock market. This result is in contrast with Forbes and Rigobón (2002). They find no evidence of contagion, but only of interdependence during the Hong Kong stock market crash and likewise during the Mexican crisis and the U.S. stock market crash. Finally, Gelos and Sahay (2001) study comovements in EMP for Eastern European countries and find that correlations can partly be explained by direct trade linkages, but not by measures of other fundamentals.

When contagion is defined as the increase in cross-market comovement during a crisis, the approach taken in this study, the use of correlation coefficients provides a straightforward method to test for the presence of contagion. This method has been gradually improved to account for macroeconomic fundamentals and exogenous global shocks. Recently, studies have examined the impact of the presence of heteroskedasticity in asset returns. As Forbes and Rigobón (2002) point out, the presence of heteroskedasticity can lead to an increase in correlation in the crisis period, even when transmission remains unchanged. This implies that a marked increase in correlation is insufficient proof of contagion. Forbes and Rigobón show how to correct for this bias. Boyer, Gibson, and Loretan (1999) and Loretan and English (2000) suggest an alternative correction. Corsetti, Pericoli, and Sbarcia (2002), however, show that the results based on both models are due to arbitrary and unrealistic restrictions on the variance of the country-specific shocks. The fact that both models disregard the market-specific noise in the country where the crisis originates, leads to overcorrection of the correlation coefficient, inducing a bias towards the null hypothesis of no contagion.

Another correction of the correlation-based method is needed to account for the two-step nature of the approach. In the first step one often filters out common shocks and/or domestic fundamentals by a regression in order to correct the correlation coefficients for them. In the second step, the correlation between the residuals is used to test for contagion (see Valdes (1997); Baig and Goldfajn (1999); and Forbes and Rigobón (2002)). However, as there is estimation uncertainty involved in the residuals generated in the first step, the normal standard errors of the correlations are biased. As such they should be corrected (Pagan (1984)). This correction is ignored in the literature.

Instead of continuing to attempt to improve the correlation approach, this paper adds to the literature by using a different approach to identify contagion, that is, regression analysis. In the next section we will set out that methodology.

5.3 Measuring Contagion – A Regression-based Approach

In this paper we have defined contagion as the spread of a shock during a crisis from one country to another country beyond any normal interdependencies between the countries. To test for contagion, we thus need a method that can identify a break in the transmission process. Regression models can deal with such breaks. At the same time, they allow us to control for domestic macroeconomic fundamentals, common external shocks and heteroskedasticity in a straightforward manner. Furthermore, the aforementioned correction of standard errors is no longer relevant, because the test for contagion will only involve one step of estimation. Hence, regression seems a natural approach for studies on contagion.

5.3.1 The Dependent Variable: EMP

As we are interested in contagion in the foreign exchange market, our dependent variable should capture the pressure on the foreign exchange market. In the literature one often focuses on the change in the exchange rate (Baig and Goldfajn (1999) and Dungey and Martin (2002)). The exchange rate has the advantage of being available on a high-frequency level. However, to identify contagion, that is, a regime change in the transmission process during a crisis, we have to know the transmission in the pre-crisis period as a benchmark. In the pre-crisis period the Asian crisis countries had a more or less fixed exchange rate against the dollar, leading to very limited variation over time. This makes it problematic to identify the pre-crisis transmission and thereby contagion.

In essence, this problem is caused by the fact that the exchange rate change does not completely represent pressure on the foreign exchange market. As Girton and Roper (1977) stress, this pressure can also be alleviated by a change in the reserves or a change in the interest rate. In fact, the Thai monetary authorities indeed defended the baht in the months before the crisis by incurring foreign exchange losses. Therefore, we construct an exchange market pressure (EMP) indicator that combines changes in the nominal exchange rate with changes in the interest rate and international reserves:

$$EMP_t \equiv a\Delta s_t + b\Delta i_t - c\Delta R_t / M_{t-1} \quad (5.1)$$

where s_t is the natural logarithm of the exchange rate in month t measured as the domestic currency price of the U.S. dollar, i_t the interest rate, R_t the reserves, and M_t the stock of narrow money.[3] Δ is the first difference operator. The weights a, b, and c are positive. Hence, a positive value of the EMP indicator reflects pressure on the domestic currency to depreciate.

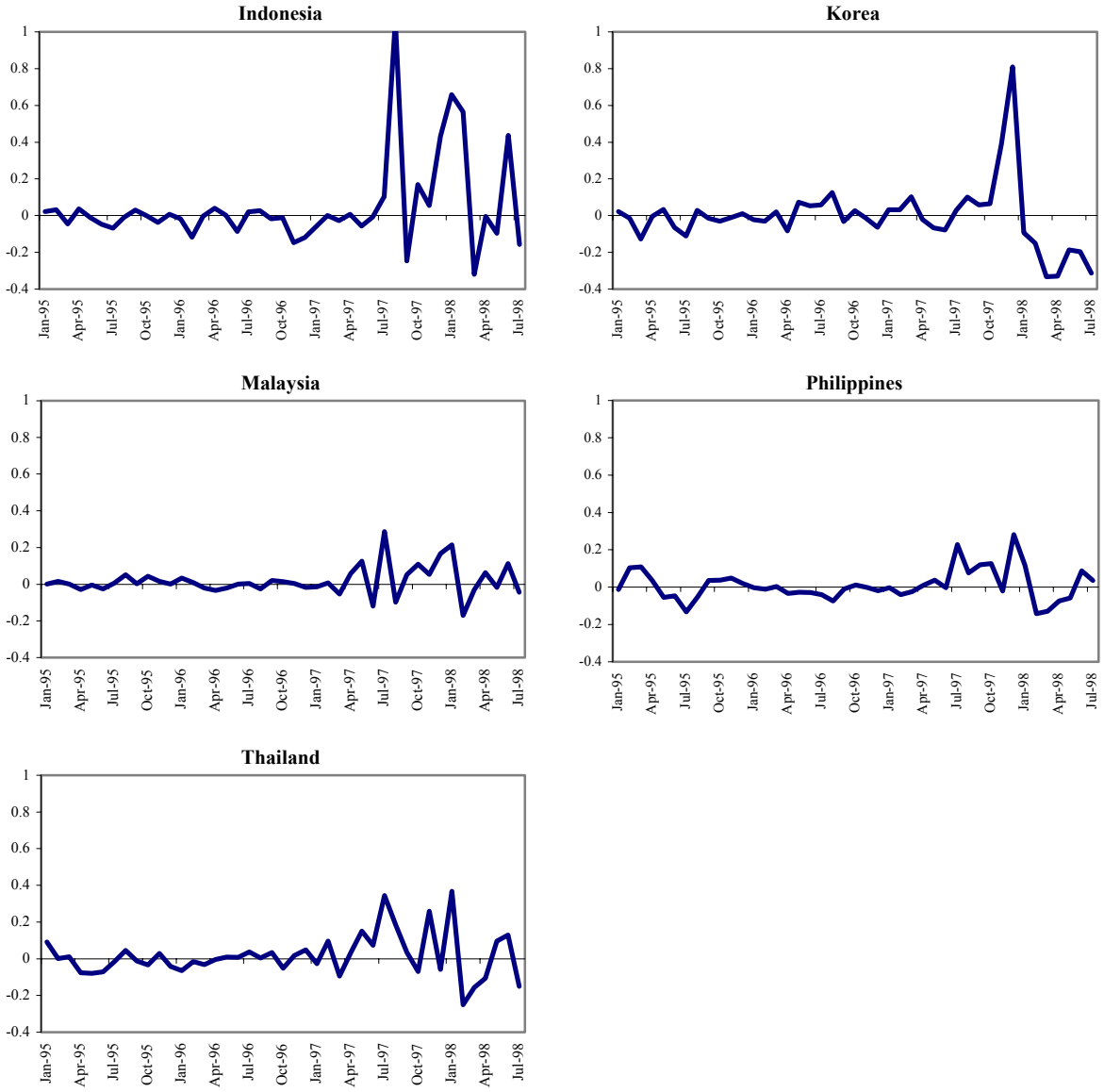
Following Eichengreen, Rose, and Wyplosz (1996) we set the weights in (5.1) equal to the inverses of the standard deviations of the corresponding variables. This standardization ensures that the EMP indicator will not be dominated by any one of the variables. Subsequently, we normalize the weights by setting *a* equal to one, so that the EMP is measured in units of relative exchange rate changes necessary to clear the exchange market. This standardization makes it easy to compare the level of EMP across countries.

The movements of the EMP indicators of Indonesia, Korea, Malaysia, the Philippines, and Thailand over the sample period (January 1995 - July 1998) are shown in Figure 5.1 (see the Appendix Table A5.1 for the specific definitions of the variables and their sources). The graphs show that there indeed existed moments of excess supply and demand on the foreign exchange market in the tranquil period. Because the exchange rate was fixed in most of the countries, these fluctuations were mainly driven by interest and reserve changes.

Moreover, for all countries except the Philippines we see, as expected, a sharp increase in pressure around the beginning of the crisis. In Thailand the pressure first mounted in May 1997 and reached its height in July 1997 when the baht fell. In Indonesia, the pressure was highest compared to the other countries with August 1997 being the first month of extreme pressure. Malaysia, experiencing pressure similar in magnitude as that of Thailand, saw its highest pressure in July. While the currencies of the other countries were under attack, the Korean won only experienced moderate pressure. Extreme pressure only occurred a couple of months later and subsided rapidly.

[3] Reserves are scaled by the narrow money stock to remove the upward trend in interventions due to growth of international transactions in general.

Figure 5.1: *EMP Indicator per Country*



In the Philippines the difference between tranquil and crisis period was less distinct, probably a reflection of the fact that the Philippine economy already experienced more macroeconomic instability in the tranquil period compared to the other crisis countries.

As we are interested in 'ground zero' contagion only - with Thailand being the source country of contagion - we use as dependent variable in our regression model the EMP indicator $EMP_{i,t}$ of, respectively, Indonesia, Korea, Malaysia, and the Philippines (the sub-script i denotes the country).

5.3.2 The Explanatory Variables

Spillovers and contagion

A crisis can be transmitted through two channels: normal links or "spillovers", and contagion. Crisis spillovers result from links between countries that exist during both tranquil and crisis periods. For example, a major trade partner of a country where a financial crisis has caused a large currency depreciation will experience a decline in its exports to the crisis country and hence a deterioration in its trade account. Investors foresee this, which can cause a decline in asset prices and large capital outflows from the exporting country. In addition, a country competing with a country hit by a financial crisis in a third country loses its export competitiveness which can put pressure on its currency especially when it is not freely floating. Hence, trade links can cause a crisis to spread.

In contrast to spillovers, contagion only occurs during a crisis. An example of a mechanism though which contagion materializes is the endogenous liquidity shock. Valdes (1997), for example, shows how a crisis in a country can reduce the liquidity of market participants. To rebalance their portfolios, investors may need to sell their assets in countries not affected by the initial crisis, thereby spreading the crisis.[4]

Because we want to test for contagion, we have to separate the spillovers from contagion. As spillovers also occur during tranquil periods, we identify them by including a tranquil period in our estimation period, assuming that the mechanisms of spillovers are constant over the whole sample period. We then allow for a structural break in the transmission parameter between tranquil and crisis period.

More specifically, to capture spillover effects, we include the Thai EMP, $EMP_{th,t}$, as a regressor. To measure contagion, we introduce $EMPCRIS_{th,t}$, which is equal to $EMP_{th,t}$ if t belongs to the crisis period and zero otherwise. Our definition of a crisis period follows Eichengreen, Rose and Wyplosz (1996) and Gelos and Sahay (2001) in that a crisis means extreme values of the EMP indicator. More specifically, a crisis

[4] For an extensive description of the various channels of crisis transmission, see Claessens, Dornbusch and Park (2001); Forbes and Rigobón (2001); and Pericoli and Sbracia (2003).

episode is defined as a month in which the EMP exceeds its overall mean μ_{EMP} by 1.5 times its standard deviation σ_{EMP}.[5]

The expected sign of the impact of $EMPCRIS_{th,t}$ is positive. The effect of $EMP_{th,t}$, however, is ambiguous. On the one hand, the example above suggests that this regressor has a positive impact. However, also negative spillover effects can occur. For example, a contractionary fiscal policy in the home country lowers its long-term interest rate. With full capital mobility and the existence of financial linkages, this will cause a capital outflow. This puts pressure on the domestic currency, yet at the same time lowers pressure on the foreign currency, thus leading to negative spillovers.

Macroeconomic fundamentals and common shocks

When the transmission parameter shows a significant increase during the crisis period, this does not necessarily have to imply that contagion occurred, as the increase in comovement during a crisis can also be the result of an increase in similarities of macroeconomic fundamentals or the occurrence of a common (external economic) shock. To test for the presence of contagion, it is thus important to control for these economic effects.

Finding good proxies for the impact of macroeconomic fundamentals on the foreign exchange market is difficult. One problem is that the behavior of such variables over time often cannot explain the movements of the EMP variable, as their movements are too slow to pick up rapid changes in the EMP indicator. Furthermore, theory is not clear about the lag length that should be used for the various variables. News dummies to capture changes in fundamentals, as used by Kaminsky and Schmukler (2002), Ganapolsky and Schmukler (2001), and Baig and Goldfajn (1999), while being available on a high frequency, have the disadvantage that it is only possible to focus on the dynamics around the onset of the crisis. As it is problematic to determine what constitutes good or bad news, especially outside the context of devaluation of currencies, creating news dummies for the tranquil period is problematic. As a result we do not apply this method.

[5] Note that we use a longer period (January 1992 - July 1998) than the sample period to determine this mean and standard deviation. Therefore, the assigned crisis period is not forced to be in the sample period.

In an attempt to find a better way to capture the impact of macroeconomic fundamentals, we apply the signals approach introduced by Kaminsky and Reinhart (1999) to analyze currency and banking crises. This approach is based on monitoring the evolution of several variables that tend to exhibit an unusual behavior in the periods preceding a crisis. It applies the idea that not all changes in a variable indicate that the economy becomes more vulnerable, but that a specific variable signals vulnerability in the economy when it comes above a certain threshold. Instead of using this methodology to estimate the probability of a currency crisis in the wake of a crisis elsewhere, as is done by Kaminsky and Reinhart (2000), we use it to construct a time-varying indicator that captures the fragility of the domestic economy at any point in time.

To implement this, we follow Kaminsky (1999). We choose 14 variables based on theoretical priors, their performance in correctly signalling a crisis, and data availability.[6] On an indicator-by-indicator basis, a threshold needs to be determined at which a variable switches from zero to one, where a value of one points at economic weakness. We use the thresholds from Kaminsky (1999). They are defined in relation to percentiles of the distribution of observations of each indicator, using a sample of 20 developed and developing countries from 1970-1995 including 76 currency crises and 26 banking crises. For example: if the threshold for a given indicator, such as the change in reserves, is 10, this means that a signal is considered to be issued whenever the change in reserves in a given country is in the lowest 10 percent of observations for that country. (For variables with opposite expected signs, a threshold of 10 refers to the upper 10 percent of observations). In order to determine the optimal threshold, a grid search is performed on all percentiles with a maximum of 30 percent. For each threshold value in the grid search

[6] These are the following indicators. Indicators associated with financial liberalization are the M2 multiplier, the ratio of domestic credit to GDP and real interest rate on deposits. Other financial indicators include excess real M1 balances and the ratio of M2 to reserves. As current account indicators we include the percentage deviation of the real exchange rate from trend and the value of exports. Capital account indicators include foreign exchange reserves, the domestic and foreign real interest rate differential on deposits, the amount of foreign debt, short-term debt relative to total foreign debt and capital flight. Finally, the real sector indicators included are industrial production and the index of equity prices. All variables, except the interest rate variables, the deviations of the real exchange rate from trend and the excess real M1 balances, are in 12-month percent changes. Filtering the data in this way ensures that the units are comparable across countries and that the transformed variables are stationary with well-defined moments and free from seasonal effects.

a noise-to-signal ratio is computed.[7] Then the threshold percentile is selected that minimizes the noise-to-signal ratio. The mass of the distribution below/above this threshold is referred to as the critical region. The optimal threshold is constrained to be the same across countries. However, the corresponding country-specific value of the variable at the threshold (for instance, the change in reserves associated with the optimal percentile (10 percent)) most likely differs.

Following Kaminsky we construct a composite indicator including the zero/one indicators based on the 14 macroeconomic and financial variables. Using one composite indicator that captures the vulnerability of the economy has two important advantages. On the one hand it limits the loss of degrees of freedom, as we do not have to include a great number of variables in the regression. This is important for our purpose, because we have a limited number of observations. Furthermore, including all variables at the same time can create multicollinearity, as many of these variables are correlated. However, using a composite indicator has the drawback that the variables have to be weighted in some fashion. As pointed out by Kaminsky, there are several weighting procedures. In our benchmark model we choose the simplest way, that is, we sum the number of signals given in a particular month by the individual indicators. Our sensitivity analysis in Section 5.4.3 shows that our main conclusions are robust with respect to another weighting scheme.

To get an idea of the explanatory power of the composite indicator in capturing the fragility of the economy, we compute for each country the correlation of the EMP indicator with the composite indicator. They are 0.298 (Indonesia), 0.070 (Korea), 0.306 (Malaysia), 0.177 (Philippines), and 0.304 (Thailand), where the three largest ones are significant at the five or ten percent level. They are all positive, suggesting that a deterioration of the macroeconomic fundamentals (higher composite indicator) coincides with pressure on the foreign exchange market to depreciate (higher EMP indicator), as expected.

[7] The noise-to-signal ratio is defined as follows: If a variable signals and a crisis occurs in the following 24 months, the signal is considered accurate. If a variable signals and no crisis occurs in that time frame, the signal is said to be false alarm or noise. The noise-to-signal ratio is the ratio of false signals to all possible bad signals divided by the ratio of good signals to all possible good signals.

Our measure of macroeconomic fundamentals already includes some common external shocks, like the world and domestic interest rate differential and the real appreciation of the dollar against the domestic currencies. However, we like to control for some additional external economic factors. Following Baig and Goldfajn (1999) we control for the changes in the U.S. stock market index and for the yen/dollar exchange rate. We use the 12-months growth in the U.S stock market index as a proxy for the U.S. economic health. Growth in the United States positively affects exports from Asian countries to the U.S., thereby increasing the demand for their currencies. On the other hand, growth may stimulate capital flows to the United States, leading to excess supply of Asian currencies. In total, the impact of the U.S. stock market index on EMP is ambiguous.

The percentage change in the yen/dollar exchange rate is included as Indonesia, Korea, Malaysia, and the Philippines all had strong currency linkages with the dollar and substantial trade linkages with Japan. Hence, an appreciation of the dollar with respect to the yen would imply an appreciation of the domestic currency with respect to the yen. This would have hurt these countries' export sectors and consequently led to depreciation pressure on the domestic currencies. We thus expect a positive coefficient for this variable.

Detailed definitions of all macroeconomic fundamentals and common shocks and their sources are provided in Appendix Table A5.1.

5.3.3 The Model and its Estimation

The above-mentioned considerations lead to the following regression model:

$$EMP_{i,t} = \alpha + \beta EMPCRISt_{th,t} + \gamma EMP_{th,t} + \delta_1 I_{i,t} + \delta_2' C_t + \delta_3 EMP_{i,t-1} + \varepsilon_{i,t} \qquad (5.2)$$

The contagion effect β is the parameter we focus on. If contagion takes place from Thailand to country i, β is positive. The spillover effect is measured by γ. As explained above, this parameter can theoretically have a positive as well as a negative sign. The impact of the macroeconomic fundamentals, the composite indicator $I_{i,t}$, is captured by δ_1 and has a positive expected sign. C_t is a vector of common shocks

including the U.S. stock market index (ambiguous sign) and the yen/dollar exchange rate (positive). In addition, we add a lagged dependent variable to correct for significant serial correlation prevalent in the data, for instance caused by market sentiments, bandwagon effects, or overshooting. We have no a priori expectation regarding the sign of its coefficient as the latter cause supports a negative sign and the other two a positive one. Finally, the mean zero disturbance term is represented by $\varepsilon_{i,t}$.

We estimate our model over the period January 1995 until July 1998. This period allows us to capture a significant period before the start of the Asian crisis and stops before events like the Russian ruble and Brazilian real crises took place. As this period is rather arbitrary, we test whether our results are sensitive to the sample period chosen in our specification analyses.

Our model is estimated using OLS. However, the usual standard errors are not valid for two reasons. First, we found evidence of heteroskedasticity resulting from the high volatility in exchange market pressure in the crisis period. Second, standard autocorrelation tests indicated that autocorrelation occurred in the residuals. Further analysis of the data showed that this was mainly the result of some outliers. Tests demonstrated that including a second lag for the dependent variable did not significantly improve our model. Nevertheless, to make the standard errors robust for heteroskedasticity and autocorrelation we use the Newey-West method.[8]

A potential problem with the use of OLS is that this may lead to inconsistent estimates due to the existence of endogenous regressors and/or omitted variables. This is by no means a problem specific to our approach, but affects almost all methodologies applied in the contagion literature. For example, Forbes and Rigobón (2002) show that their correction for the correlation coefficient is not valid in case of endogeneity caused by omitted variables or by simultaneity of the contagion regressor. As crises are typically

[8] We realize that including $EMP_{i,t-1}$ in the model in combination with the occurrence of serial correlation can lead to inconsistent estimates as the regressor and the error term will be correlated. We do, however, want to include the lagged EMP in our model because of its statistical significance, and we cannot model the serial correlation in a general way as it is mainly caused by outliers, which leaves us with this inconsistency. In Section 5.4.3 we show that the inconsistency is negligible as the main results are not affected by exclusion of the lagged regressor.

Table 5.1: *Estimation Results for Benchmark Model (5.2)*

	Indonesia	Korea	Malaysia	Philippines
Contagion	1.620***	-0.440	0.483***	0.008
	(0.301)	(0.347)	(0.066)	(0.232)
Spillover	-0.351	0.224	0.093	0.185**
	(0.266)	(0.143)	(0.064)	(0.107)
Macroeconomic fundamentals	0.054***	0.003	0.012***	0.001
	(0.014)	(0.013)	(0.002)	(0.005)
U.S. stock returns	-0.107	0.065	-0.073*	-0.055
	(0.296)	(0.058)	(0.040)	(0.065)
Yen/dollar exchange rate	0.119	0.125	0.664	0.491*
	(0.371)	(0.588)	(0.305)	(0.264)
Lagged EMP	-0.140**	0.536***	-0.465***	0.338**
	(0.060)	(0.107)	(0.059)	(0.145)
Constant	-0.047	-0.022	-0.007	0.012
	(0.072)	(0.027)	(0.005)	(0.015)
Extent of Contagion	0.13	0.02	0.21	0.00
Adjusted R-sq	0.17	0.12	0.61	0.14

Newey-West standard errors are in parentheses. ***, **, * denotes significance at the one, five and ten percent level respectively. Tests are two-sided for all parameters, except for contagion for which a one-sided test is required. The extent of contagion is equal to the partial R-sq of the contagion variable.

characterized by turmoil in a number of countries, it may well be that events in one country affect the other country while the reverse also occurs. To analytically solve the problem of endogeneity would go beyond the scope of this paper. However, by focusing exclusively on contagion coming from Thailand, where the crisis originated, we limit the endogeneity problem. Furthermore, one of our specification tests (using instrumental variables estimation) suggests that the main conclusions of the paper are not affected by endogeneity bias. Likewise, a test for omitted variables bias supports the robustness of our conclusions.

5.4 Results

5.4.1 Did Contagion Take Place?

Using regression model (5.2) we test for contagion. Since β is either zero if no contagion occurred or positive if it did, a one-sided test is needed. The results are displayed in Table 5.1. We see that the null hypothesis of no contagion can be rejected for Indonesia and

Malaysia, both at the one percent significance level. We do not find evidence of contagion effects from Thailand to Korea, confirming the results found by Park and Song (2001). This result confirms the idea that Korea was more likely to be indirectly affected by the events in Thailand, as the Korean won only started to show signs of severe pressure after the stock market crashes of Taiwan and Hong Kong. This indirect effect cannot be captured by our tests as we only test for contemporaneous contagion.

In the case of the Philippines we do not find evidence of contagion, only of spillover effects. Although the crisis that started in Thailand did spread to the Philippines, we do not find any evidence that this was caused by contagion. A possible explanation for this might be that for this country the tranquil and the crisis episodes were not as different from each other as for the other countries. Contrary to the other economies, the Philippines did not experience high growth rates in the period leading up to the crisis, its fall in GDP growth was moderate through the crisis, and its pressure on the exchange market was much more moderate during the crisis relative to the pressure experienced in the tranquil period. This suggests that the crisis did not really imply a structural break in the performance of the Philippine economy.

For the other countries we do not find any significant spillover effects. This suggests that, among others, the trade channel is not so relevant for these countries. This is consistent with the results found by Kaminsky and Reinhart (2000) who find that the possibility of a crisis spreading through third-country linkages is not significant for the Asian crisis countries. Furthermore, Baig and Goldfajn (1999) argue that trade linkages where not important in spreading the crisis through Asia as trade linkages among those countries were weak.

The variable capturing the impact of macroeconomic fundamentals on the EMP indicators has the expected positive sign for each country. Furthermore, it is significant at the one percent level for both Indonesia and Malaysia. This result indicates that, even though the deterioration of the fundamentals in these two countries had a marked effect on the pressure on the foreign exchange market these countries faced, contagion from Thailand still has additional explanatory power. This strengthens our view that pressure on the currencies of Indonesia and Malaysia was partly the result of a structural break in the transmission mechanisms between Thailand and those two countries.

The common shock variable based on the U.S. stock market index does not seem to explain much of the variation in EMP. The estimates of the impact of the yen/dollar exchange rate, however, are all positive, and significantly so for Malaysia and the Philippines. Hence, a depreciation of the yen with respect to the dollar caused pressure on the Asian currencies, which is in line with our a priori expectations expressed.

Taken all this in consideration we conclude that there is significant evidence of occurrence of ‘ground-zero' contagion through the exchange market during the Asian crisis.

5.4.2 Extent of Contagion

Using regression model (5.2) we test for An advantage of our regression-based approach is that it not only provides a framework to determine the significance of the contribution of contagion to the EMP explanation, but that it also provides a measure of the size of this contribution. After all, the partial R^2 of the contagion regressor estimates how much the addition of this variable explains of the variance in $EMP_{i,t}$ left unexplained by the other regressors (see Greene (2003, p.28) for its computation).

The bottom part of Table 5.1 contains the partial R^2 realizations. We see that the extent of contagion from Thailand experienced by Indonesia is 13 percent and by Malaysia 21 percent.

5.4.3 Sensitivity Analysis

Using regression model (5.2) The results from our benchmark model (5.2) indicate that during the Asian crisis contagion occurred from Thailand to Indonesia and Malaysia, but not to Korea and the Philippines. To test the robustness of these basic results, we perform a number of sensitivity tests. These can be divided into two groups. The first group tests whether different model specifications impact our basic findings. We consider perturbations of our benchmark model related to the sample period, the composite indicator, the common shocks, the lagged dependent variable and the dependent variable. The second group specifically tests for the possibility of endogeneity, either caused by omitted variables or caused by simultaneity of the contagion regressor, affecting our

Table 5.2: *Specification Tests*

	Indonesia	Korea	Malaysia	Philippines
Benchmark	1.620***	-0.440	0.483***	0.008
	(0.301)	(0.347)	(0.066)	(0.232)
Sample Jan 1992- July 1998	1.579***	-0.321	0.481***	-0.005
	(0.280)	(0.327)	(0.104)	(0.208)
Sample Jan 1995 - Jan 1998	1.589***	0.283	0.752***	0.469**
	(0.259)	(0.497)	(0.212)	(0.226)
Lagged composite indicator	1.541***	-0.272	0.498***	0.091
	(0.351)	(0.313)	(0.105)	(0.192)
Different composite indicator	1.696***	-0.426	0.500***	0.010
	(0.332)	(0.324)	(0.065)	(0.233)
Individual indicators	0.580***	-0.112	0.517***	-0.406
	(0.209)	(0.631)	(0.116)	(0.253)
Additional common shocks	1.602***	-0.114	0.453***	-0.020
	(0.479)	(0.289)	(0.053)	(0.217)
Exclusion lagged EMP	1.421**	0.098	0.336**	0.188
	(0.671)	(0.489)	(0.174)	(0.254)
Different threshold in EMP	1.763***	-0.343	0.399***	0.033
	(0.251)	(0.402)	(0.047)	(0.221)
Double weight exchange rate	0.887***	-0.805	0.032	-0.165
	(0.310)	(0.326)	(0.057)	(0.151)
Omitted variables	1.704***	-0.102	0.273***	-0.632
	(0.521)	(0.455)	(0.088)	(0.076)
Simultaneity of contagion	2.105	1.723	0.652***	1.011**
	(1.980)	(1.645)	(0.203)	(0.571)

The results presented in this table refer to the estimates for the contagion variable in the different models. The benchmark model is the model whose results are shown in table 5.1. Newey-West standard errors are in parentheses. ***, **, * denotes significance at the one, five and ten percent level respectively. Tests are two-sided for all parameters, except for contagion for which a one-sided test is required.

results. For each sensitivity test we report the estimates for the contagion parameter in Table 5.2.

In our first set of tests we consider nine perturbations of our basic model. First, we extend the sample period and start in January 1992 so as to increase the number of observations. Second, we reduce the sample period by ending it in January 1998, the last month in which there existed extreme pressure on the Thai foreign exchange market. In both cases the contagion variable remains significant for Indonesia and Malaysia. In the latter case we also find evidence of contagion from Thailand to the Philippines.

Next, we study the composite indicator measuring the impact of macroeconomic fundamentals introduced in Section 5.3.2. First, one may criticize the use of the

composite indicator in a study on EMP because some of the variables that underlie the individual indicators (such as reserves and interest rates) also appear in the dependent variable. We think this is a minor disadvantage for two reasons. First, these variables are only used after a binary transformation and in combination with many other individual indicators, substantially reducing the link with EMP. Moreover, if we use the first lag of the composite indicator instead of the unlagged composite indicator, the results do not change (see Table 5.2).

As a second sensitivity check regarding the (unlagged) composite indicator we replace the simple composite indicator with one that discriminates between signals provided by mild anomalous behavior of a variable and signals provided by extreme aberrant behavior of that variable. A mild signal is issued if the observation of the variable is in the first part of the critical region, and an observation is labeled an extreme signal if it is in the second part of the critical region.[9] In the adjusted composite indicator extreme signals have twice the weight of mild signals. As shown in the fourth row of Table 5.2, the results are unaffected by this perturbation.[10]

The final investigation concerning the composite indicator is that we include each of the 14 macroeconomic indicators that are included in the composite indicator individually in the regression model. Even with many more regressors, the significance remains unchanged, though the point estimate for Indonesia is reduced.

The next sensitivity check concerns the common shocks. Adding three additional common shocks, namely the Japanese interest rate and the change in real GDP of both the United States and Japan, does not change the results.

In the following sensitivity test we raise the outlier threshold in our exchange market pressure indicator from one times the mean plus 1.5 times the standard deviation to one times the mean plus 2 times the standard deviation. The contagion variable

[9] For example, if the size of the critical region is 10 and is located in the lower part of the distribution, then an observation has a mild signal if it is located between the 5th and 10th percentiles, and it has an extreme signal if it is located below the 5th percentile.

[10] We also tested the impact of using the other composite indicators as described in Kaminsky (1999). These include an indicator that captures the ongoing deterioration in the fundamentals and one that weights the signals of the different variables by the forecasting accuracy of each variable (the inverse of their noise-to-signal ratio). As with the composite indicator correcting for mild and extreme signals, replacing the original composite indicator with any of these two does not affect the results on the contagion variable. The results are available upon request from the authors.

remains significant at the one percent level for both Indonesia and Malaysia and insignificant for Korea and the Philippines.

As indicated in Section 5.3.3 including the lagged dependent variable in combination with a Newey-West correction for the standard errors can potentially lead to inconsistent estimates. To test whether this affected our results we excluded lagged EMP in the next specification test. As Table 5.2 shows, excluding the lagged dependent variable does no change our results, indicating that the inconsistency is negligible.

Finally to test whether our results are sensitive to the weighting scheme used to construct our EMP indicator, we double the weight on actual exchange rate changes in our tripartite EMP index. The ninth row in Table 5.2 shows that Indonesia remains significant, but the contagion coefficient for Malaysia loses its significance.

The second set of sensitivity checks focuses on the fact that our results might be biased due to endogeneity either caused by omitted variables or by simultaneity of the contagion regressor. Such bias is not specific to our regression-based approach, as it is also relevant when using correlation coefficients to test for contagion (see Section 5.3.3). Nevertheless, the regression framework gives us some possibilities to get an idea whether our results are biased in favor of finding contagion.

The first endogeneity bias results from the fact that we only test for the impact of extreme pressure of the Thai baht on the currency of country i, and as such do not control for the possibility that EMP of country i could have been affected by the currency movements of the other countries. Because the EMPs of these third countries may be correlated with that of Thailand, omitting these variables implies a correlation between the error term and the contagion variable, which can bias our results. To examine this, we added the EMP and EMPCRIS variables of all three other countries to our baseline model (5.2). As shown in the bottom part of Table 5.2, both contagion from Thailand to Indonesia as well as from Thailand to Malaysia remain significant.

The second endogeneity bias is caused by simultaneity between dependent variable and the contagion regressor. It is possible that during the course of the crisis not only pressure from Thailand affected the EMPs of other countries, but that the causality also ran the other way. Therefore, it is possible that what we measure is not really

contagion from Thailand to the other countries, but also reflects contagion from the other countries back to Thailand, leading to an upward bias in our contagion estimate.

In order to determine whether our results are indeed upward biased, we use the following instrumental variable (IV) approach. As the crisis started in Thailand, it is to be expected that at least in the initial stages of the crisis the causality ran from Thailand to the other countries and not the other way. We assume that this one-way causality holds until the month in which the currency of the other country depreciated. As a result, we can use as instrument for $EMPCRIS_{th,t}$ a new variable $EMPCRISPART_{th,t}$ that equals $EMPCRIS_{th,t}$ up to and including the month of devaluation of the currency of country i (that is, July 1997 for Malaysia and the Philippines, August 1997 for Indonesia, and November 1997 for Korea), and becomes zero after the devaluation. Instrumental variable estimation with Newey-West standard error correction gives the results in the last row of Table 5.2. Interestingly, the contagion estimates are all higher than in case of OLS. As endogeneity of the contagion regressor would lead to an upward bias and hence lower IV estimates, we believe it to unlikely that our finding of contagion is driven by this endogeneity.

In summary, our sensitivity tests confirm the key findings of this paper. That is, the pressure on the Thai baht during the Asian crisis led to contagion to both Indonesia and Malaysia, while no contagion to Korea and the Philippines could be detected.

5.5 Conclusion

The unexpectedness and severity of the Asian crisis gave rise to an ongoing debate about the importance of contagion. Our study attempted to make a contribution to this debate by looking for evidence of contagion through the exchange market during the Asian crisis. More precisely, this paper analyzed whether contagion, defined as the increase in linkages between countries due to a crisis, occurred from Thailand to Indonesia, Korea, Malaysia, and the Philippines, and, if so, to what extent this contagion explained the exchange market pressure (EMP) for the latter countries.

We employed regression analysis, regressing the EMP indicators of the respective crisis countries on the EMP indicator of Thailand. We have shown that this is a natural

and useful alternative for the correlation coefficients based analysis typically performed in the literature. We specifically controlled for spillover effects, macroeconomic fundamentals, common shocks and heteroskedasticity. To control for the fundamentals we used for each of the four countries a time-varying composite indicator based on 14 real and financial variables reflecting the fragility of the economy. This indicator was based on the signals approach introduced by Kaminsky and Reinhart (1999), and has to our knowledge not yet been applied to time series analysis.

From our estimation process we found evidence pointing towards contagion from Thailand to Indonesia and Malaysia. We did not find evidence of contagion from Thailand to Korea and the Philippines. A number of sensitivity checks confirmed that these results were robust to many model perturbations and unlikely to have been affected by endogeneity bias, either caused by omitted variables or by simultaneity of the contagion regressor.

We have also introduced a way to measure the extent of contagion using the partial R^2. We found that contagion explained 13 percent of the pressure on the Indonesian rupiah and 21 percent of the pressure on the Malaysian ringgit.

From our results we cannot conclude that a new currency crisis in Thailand will definitely spread to the other countries. This will mainly depend on the, unpredictable, behavior of investors, as there do not seem to exist strong spillovers between the countries. Should Thailand again be hit by a currency crisis, the governments of the countries will probably best be served by implementing credible policy actions to soothe the markets. This seems to be especially important for Indonesia and Malaysia. Still, the risk of contagion remains and is thus important to guard against.

Appendix Table A 5.1: *Variable Definitions and Sources*

Sources: International Financial Statistics (IFS), International Monetary Fund (IMF); Emerging Market Indicators, Standard and Poors and International Finance Cooperation (IFC); The Maturity, Sectoral and Nationality Distribution of International Bank Lending, Bank for International Settlements (BIS); International Banking and Financial Market Developments, Bank for International Settlements (BIS).

EMP Indicator

Exchange rate	End of period nominal exchange rate of domestic currency per dollar (IFS line ae), log difference
Interest rate	Short term nominal market interest rate (money market rate) (IFS line 60b)
Reserves/ M1	Total non-gold international reserves (IFS line 1 l.d) first difference, divided by narrow money (M1) (IFS line 34) converted into dollars (using IFS line ae) one period lagged.

Macroeconomic fundamentals in composite indicator

M2 Multiplier	The ratio of M2 (IFS lines 34 plus 35) to base money (IFS line 14), 12-month percentage change. Transformed into dummy which is one if the observation lies above or equals the 87th percentile of the distribution. The distribution of the variable is determined over the period January 1971 - July 1998.
Domestic credit/ GDP	IFS line 32 divided by IFS line 64 to obtain domestic credit in real terms, which was then divided by real GDP (IFS line 99b deflated by IFS line 64) (interpolated for quarterly data) to obtain domestic credit / GDP ratio. 12-month percentage change. Transformed into dummy which is one if the observation lies above or equals the 90th percentile of the distribution. The distribution of the variable is determined over the period December 1971 - July 1998.
Domestic real interest rate	Deposit rate (IFS line 60l) deflated using consumer prices (IFS line 64). Monthly rates expressed in percentage points. In levels. Transformed into dummy which is one if the observation lies above or equals the 88th percentile of the distribution. The distribution of the variable is determined over the period April 1974 - July 1998 for Indonesia, January 1970 - July 1998 for Korea and Malaysia, January 1976 - July 1998 for the Philippines and January 1977 - July 1998 for Thailand.
Excess M1 balances	Residual of the regression of real M1 (IFS line 34 deflated by IFS line 64) on real GDP (IFS line 99b deflated by IFS line 64) (interpolated from quarterly data)), inflation and a time trend. In levels. Transformed into dummy which is one if the observation lies above or equals the 94th percentile of the distribution. The distribution of the variable is determined over the period December 1970 - July 1998
M2/ Reserves	IFS lines 34 plus 35 converted into dollars (using IFS line ae) divided by IFS line 11d, 12-month percentage change.Transformed into dummy which is one if the observation lies above or equals the 87th percentile of the distribution. The distribution of the variable is determined over the period January 1972 - July 1998 for Indonesia and January 1971 - July 1998 for the other countries.
Real exchange rate	Nominal exchange rate of domestic currency with the dollar (IFS line ae) adjusted for relative consumer prices (IFS line 64). Deviations of the real exchange rate from a time trend. Transformed into dummy which is one if the observation lies above or equals the 81th percentile of the distribution. The distribution of the variable is determined over the period January 1970 - July 1998.
Export	IFS line 70, 12-month percentage change. Transformed into dummy which is one if the observation lies below or equals the 10th percentile of the distribution. The distribution of the variable is determined over the period January 1971 - July 1998.
Reserves	Total non-gold international reserves (IFS line 11d), 12-month percentage change. Transformed into dummy which is one if the observation lies below or equals the 15th percentile of the distribution. The distribution of the variable is determined over the period January 1972 - July 1998 for Indonesia and January 1971 - July 1998 for the other countries.
Real interest rate differential	The difference between the real rates for the domestic countries and the U.S. Real rates are deposit rate (IFS line 60l) for the domestic country and money market rate (IFS line 60b) for the U.S. deflated using consumer prices (IFS line 64). In levels. Transformed into dummy which is one if the observation lies above or equals the 89th percentile of the distribution. The distribution of the variable is determined over the period April 1974 - July 1998 for Indonesia, January 1970 - July 1998 for Korea and Malaysia, January 1976 - July 1998 for the Philippines and January 1977 - July 1998 for Thailand.
Foreign debt	Liabilities of domestic residents to BIS reporting banks, interpolated from semi-annual data. International Banking and Financial Developments (BIS). 12-month percentage change. Transformed into dummy which is one if the observation lies above or equals the 90th percentile of the distribution. The distribution of the variable is determined over the period December 1974 - July 1998.
Short term foreign debt	Liabilities of domestic residents to BIS reporting banks with maturities up to one year divided by total liabilities of domestic residents to BIS reporting banks. The Maturity, Sectoral and Nationality Distribution of International Bank Lending (BIS). 12-month percentage change. Transformed into dummy which is one if the observation lies above or equals the 74th percentile of the distribution. The distribution of the variable is determined over the period December 1974 - July 1998.
Capital flight	Deposits of domestic residents in BIS reporting banks interpolated from quarterly data. International Banking and Financial Market Developments (BIS). 12-month percentage change. Transformed into dummy which is one if the observation lies above or equals the 81th percentile of the distribution. The distribution of the variable is determined over the period December 1978 - July 1998.
Output	Output of primary commodities (IFS line 66aa) for Indonesia, industrial output (IFS line 66) for Korea and Malaysia and output of manufactured products (IFS line 66ey) for the Philippines. No data available for Thailand. 12-month percentage change. Transformed into dummy which is one if the observation lies below or equals the 11th percentile of the distribution. The distribution of the variable is determined over the period July 1972 - July 1998 for Indonesia, January 1971 - July 1998 for Korea, January 1972 - July 1998 for Malaysia and January 1982 - July 1998 for the Philippines.
Stock returns	Standard and Poors/IFC global indices, 12-month percentage change.Transformed into dummy which is one if the observation lies below or equals the 11th percentile of the distribution. The distribution of the variable is determined over the period January 1991 - July 1998 for Indonesia, January 1977 - July 1998 for Korea and Thailand and January 1986 - July 1998 for Malaysia and the Philippines.

Common shocks

U.S. stock returns	S&P 500 index, 12-month percentage change.
Dollar/ yen exchange rate	End of period nominal exchange rate of yen with respect to the dollar (IFS line ae), log difference
Real interest rate Japan	Deposit rate (IFS line 60l) deflated using consumer prices (IFS line 64). Monthly rates expressed in percentage points. In levels.
Real GDP U.S.	Nominal GDP (IFS line 99b) deflated by GDP deflator (IFS line 99b) (interpolated for quarterly data). 12-month percentage change.
Real GDP Japan	Nominal GDP (IFS line 99b) deflated by GDP deflator (IFS line 99b) (interpolated for quarterly data). 12-month percentage change.

Chapter 6

Conclusion

The importance of the development of domestic financial markets to generate growth is nowadays acknowledged by policy makers and academics alike. Openness to international financial markets has furthermore been understood to facilitate financial sector deepening. Financial liberalization creates, however, both opportunities for developing countries as well as challenges. In particular, capital account liberalization has been associated with systemic financial crises with large disruptive consequences to developing countries' economies. So while access to international financial markets can for developing countries potentially have large benefits, the risks to the economy can also be substantial. This makes research in this area of vital importance, especially in light of the fact that more and more developing countries are embarking on the path of financial integration with the rest of the world. To further our understanding of how financial markets (both domestic as well as international) affect developing countries, this thesis analyzed several aspects of the impact and functioning of financial markets.

In Chapter 2 a novel methodology to measure financial market integration was introduced. In this chapter it was argued that the cross-market premium (the ratio between the domestic and the international market price of cross-listed stocks) provides a valuable measure of international financial integration, reflecting accurately the factors that segment markets and thereby inhibit price arbitrage. Applying to equity markets recent methodological developments in the purchasing power parity (PPP) literature, the chapter showed that Threshold Autoregressive (TAR) models can properly capture the behavior of the cross-market premium. The estimates revealed the presence of narrow no-arbitrage bands and indicated that price differences outside these bands are rapidly

arbitraged away, much faster than what has been documented for good markets. Moreover, we found that financial integration increases with market liquidity. Capital controls, when binding, contribute to segment financial markets by widening the no-arbitrage bands and making price disparities more persistent. By contrast, crisis episodes seem to be associated with higher volatility, rather than by more persistent deviations from the Law of One Price.

International financial integration has been shown to positively affect the development of the domestic financial sector, which in turn affects the behavior of agents in the economy. Chapter 3 showed that the development of the financial system influences the choice firms make whether to sell their goods on credit. The chapter started by providing a possible explanation for the fact that even firms that are financially constrained, and thus face relatively high costs in providing trade credit, sell (part of) their goods on credit, that is, the use of trade credit as a competitiveness tool. By analyzing both the impact of customer as well as producer market power on a firm's decision to provide trade credit, it can be examined whether trade credit is indeed used as a way to 'lock-in' customers by firms. Using a new dataset containing a large number of firms in 42 developing countries, we found strong evidence that an important driving force behind the decision to provide trade credit is the urge to be competitive. Subsequently, the chapter analyzed, among other things, whether the development of the domestic banking sector affects the use of trade credit competition by firms in developing countries. We found evidence that a better developed financial system lessens the market power exercised by customers, likely because more firm-specific information is available that can function as a guarantee for product quality.

The last two chapters specifically investigated the potential downside of financial market integration: financial crises. In Chapter 4 an explanation was provided for the 'boom' in the stock market that characterized the Argentine crisis. When an economy is financially integrated with the rest of the world, capital can easily flow in but it can also quickly flow out. This chapter showed that the capital controls introduced by the Argentine government in the wake of the crisis were effective in curbing the massive outflow of capital that was taking place. It was argued that these capital controls in combination with the inconvertibility of bank deposits resulted in a boom in the stocks

market. This boom, which was generalized to all stocks, but more pronounced in liquid stocks, reflected the costs that depositors were willing to incur to get their money out of the banking system, in light of the impending risks.

Chapter 5 focused on the possibility of crisis transmission when markets are integrated. More specifically, this chapter investigated whether there was contagion through the foreign exchange market in the Asian crisis, and, if so, determined the contribution of the contagion to the crisis. We examined whether the effect of an index of exchange market pressure (EMP) of Thailand, the origin of the crisis, on the EMP of four Asian crisis countries increased during the crisis. Instead of measuring contagion by the commonly used correlation coefficients, we applied regression analysis. To control for the impact of macroeconomic fundamentals, we constructed an indicator measuring the fragility of each economy. Additionally, we controlled for spillovers and common external shocks. We found evidence of contagion from Thailand to Indonesia and Malaysia, with 13 and 21 percent of the pressure on the respective currencies assigned to contagion effects. For Korea and the Philippines we found no evidence of contagion.

The analyses reported in this thesis provide ample suggestions for further research. Using the cross-market premium as a measure of international financial integration, an interesting angle for further research is to focus on the cross-country dimensions. How does international financial integration compare between countries? What factors drive possible differences? Furthermore, the question whether crises, in addition to increased volatility, induce weaker financial integration remains an interesting topic for further research. In addition, how to distinguish crisis times from tranquil ones is a question that warrants more attention in the literature. The lack of an uncontroversial operational definition of a crisis makes it difficult to pin down crisis times. As throughout the literature several methodologies using ad-hoc criteria to identify crises have been applied, the development of a methodology that is broadly accepted will be an important addition to the literature.

Both in Chapter 2 as well as in Chapter 5 an exchange market pressure (EMP) indicator was used. The indicator used was a weighted average of (percentage) changes in exchange rates and interest rates in Chapter 2 and of (percentage) changes in exchange

rates, interest rates and reserves in Chapter 5. The weights were determined using the reciprocal of the standard deviation of each variable. This weighting-scheme is widely used in the literature and assures that none of the variables can dominate the indicator. However, this weighting-scheme is arbitrary. The variables that make up the indicator should rather reflect the pressures on the exchange market that need to be alleviated at a certain time. As such, the weights should reflect the relative contribution of a change in each variable to the overall pressure. An interesting topic for further research is thus to find a methodology that can determine those weights.

The results in Chapter 3 indicated that the development of the banking sector is negatively related to the use of trade credit as a competitiveness tool. In addition it found that in countries where the banking sector is well-developed, the use of trade credit in general (i.e., not necessarily as a competitiveness tool) is lower. This finding contradicts earlier findings in the literature that have found a positive relationship between the development of the banking sector and the use of trade credit. This warrants more research on the question whether bank and trade credit are complements or substitutes. Possible interesting angles are whether there exist differences depending on country circumstances or whether the link between bank and trade credit differs for different types of firms (as suggested in Chapter 3).

Furthermore, the large country variation in the dataset used in Chapter 3 provides opportunities to test more extensively for country characteristics that can impact the use of trade credit competition. One potentially interesting characteristic is the existence of factoring companies in the country, starting from the premise that factoring can make it easier for small firms to extend trade credit. Another potentially interesting country characteristic that could influence the use of trade credit competition is the presence of credit information bureaus. In addition, the dataset provides the possibility to investigate more thoroughly to what extent trade credit is used to redistribute funds from financially stronger firms to financially weaker ones. Evidence suggests that large firms provide more trade credit, but the question is do they use it mostly to support smaller firms? And, do smaller firms in countries with well-developed banking systems (i.e. countries where finance is more easily available) get more trade credit from larger firms?

Developing countries face many challenges on the perilous path to sustainable economic growth and increased welfare for their residents, especially those living in extreme poverty. A commitment by researchers and policy makers in finding ways for developing countries to gain from the opportunities that are associated with a more integrated world, while minimizing the risks that this integration entails, will increase the chance of successful economic development. As lack of development is one of the main causes of the many problems the world faces today, it is important that this area continues to receive ample attention both now as well as in the future.

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Samenvatting (Summary in Dutch)

De laatste decennia zijn gekenmerkt door een snelle integratie van de financiële markten. Er heeft bijvoorbeeld een sterke toename plaatsgevonden in de mondiale uitgifte van obligaties en ook kapitaal verkregen met aandelen uitgegeven op een buitenlandse aandelenmarkt is snel gestegen. Daarnaast is de internationale handel in financiële activa substantieel toegenomen. Ontwikkelingslanden zagen vanaf begin jaren zeventig een sterke toename in netto kapitaainlstroom van $10,5 mld (gelijk aan minder dan 2 procent van het BNP van ontwikkelingslanden) in 1970 naar $324 mld (gelijk aan 4,4 procent van het BNP van ontwikkelingslanden) in 2004. In de periode voor de schuldencrisis van begin jaren tachtig werd de kapitaalstroom naar ontwikkelingslanden voornamelijk gedreven door de noodzaak van niet-olie-exporterende landen om hun lopenderekeningtekorten te financieren. Na een periode van stagnerende kapitaalinstroom als gevolg van de schuldencrisis, nam vanaf begin jaren negentig de instroom van kapitaal in ontwikkelingslanden weer snel toe, als gevolg van een sterke toename van private kapitaalstromen. Een sleutelrol in dit proces speelde de toenemende globalisering van investeringen op zoek naar hogere winsten en internationale risicospreiding. Tegelijkertijd werd de kapitaalinstroom gestimuleerd door het opheffen van restricties op kapitaalinvoer en andere investeringsbarrières in veel landen, in combinatie met verbeteringen in het economische klimaat, waaronder de introductie van markt-georiënteerde hervormingen.

Hoewel de data duidelijk laten zien dat kapitaalstromen naar ontwikkelingslanden in de afgelopen jaren sterk zijn toegenomen, geeft dit op zichzelf nog geen voldoende uitsluitsel over de vraag in hoeverre deze landen ook werkelijk geïntegreerd zijn met de internationale kapitaalmarkt. In de literatuur zijn verschillende maatstaven gesuggereerd om de omvang van internationale financiële integratie te bepalen. In hoofdstuk 2 van dit proefschrift wordt een nieuwe maatstaf geïntroduceerd. Deze maatstaf weerspiegelt het idee dat de ‘Law of one price’ moet gelden als markten volledig geïntegreerd zijn.

Uitgaande van het idee dat twee markten geïntegreerd zijn wanneer identieke goederen of activa precies dezelfde prijs hebben in verschillende landen, construeren wij de 'cross-market'-premie. Deze is gelijk aan het procentuele prijsverschil tussen 'depositary receipts' in internationale markten en hun onderliggende aandelen in binnenlandse markten.

Depositary receipts (ook wel 'American depositary receipts' genoemd) zijn aandelen van niet-Amerikaanse bedrijven die worden verhandeld in de V.S. (en zijn geprijsd in dollars), terwijl de onderliggende aandelen verhandeld worden op de binnenlandse markt van de uitgever van de aandelen (en zijn geprijsd in binnenlandse valuta). Een depositary receipt vertegenwoordigt een specific aantal onderliggende aandelen die worden aangehouden door een zogenoemde beheerders-bank. Het onderliggende aandeel kan gemakkelijk worden omgezet in een depositary receipt en vice versa, wat impliceert dat beide activa identiek zijn. In een goed geïntegreerde markt zou de waarde van de cross-market-premie dus dicht bij nul moeten liggen.

We passen in hoofdstuk 2 onze maatstaf van financiële integratie toe op negen opkomende economieën en we vinden bewijs voor een sterke financiële integratie van deze landen met de V.S. Daarnaast vinden we dat in vergelijking met de goederenmarkt de financiële markten meer geïntegreerd zijn. Rekening houdend met verschillen in liquiditeit van de verhandelde aandelen zien we dat integratie en liquiditeit positief gecorreleerd zijn: d.w.z.. we vinden minder grote afwijkingen ten opzichte van de Law of one price voor liquide aandelen. Het bestaan van kapitaalcontroles, als ze bindend zijn, wordt direct zichtbaar in de cross-market-premie. De positieve premie die ontstaat als gevolg van de introductie van controles op kapitaaluitstroom en de negatieve premie als gevolg van controles op kapitaalinstroom geven aan dat deze maatregelen de markten segmenteren. Een financiële crisis daarentegen, ook al leidt ze tot een toename in de volatiliteit van de premie, lijkt geen invloed te hebben op de mate van financiële integratie.

De positieve trend in financiële integratie van ontwikkelingslanden met de internationale financiële markten die zo kenmerkend was voor de afgelopen jaren, kan onder andere worden verklaard door een aantal voordelen die integratie kan hebben voor deze landen. Financiële integratie kan bijvoorbeeld leiden tot een toename van

binnenlandse besparingen en een daling van de kosten van kapitaal wat een positief effect heeft op investeringen en daarmee op economische groei. Buitenlandse directe investeringen kunnen, naast een instroom van kapitaal en werkgelegenheid, leiden tot een overdracht van technologie en van kennis met betrekking tot managementtechnieken, en een toename in de concurrentie. Daarnaast kan financiële integratie leiden tot een verbetering in beleid en instituties.

Waarschijnlijk het belangrijkste voordeel van financiële integratie voor ontwikkelingslanden is echter de positieve invloed die ze kan hebben op de ontwikkeling van het binnenlands financieel systeem. In een land met een beter ontwikkeld financieel systeem kan de financiële sector op een efficiëntere wijze besparingen alloceren naar de meest productieve investeringsprojecten. Dit draagt bij tot economische groei. Daarnaast zal door deze toename in efficiëntie ook het effect van een toename in besparingen en investeringen als gevolg van financiële integratie groter zijn.

De mate van ontwikkeling van het financiële systeem kan het gedrag van bedrijven in die landen beïnvloeden. Bijvoorbeeld de ontwikkeling van de bankensector in een land lijkt een positieve invloed te hebben op het aanbod en het gebruik van handelskredieten. In hoofdstuk 3 wordt verder ingegaan op deze gedachte. In dit hoofdstuk wordt een motief aangedragen voor de feit dat bedrijven handelskrediet verstrekken: het gebruik van handelskrediet als een concurrentiemiddel. Daarnaast wordt in de hoofdstuk onderzocht of dit motief meer of minder gebruikt wordt in landen waar de financiële sector goed ontwikkeld is.

De cijfers laten zien dat zowel grote als kleine bedrijven een substantieel deel van hun producten op krediet verkopen. In de literatuur zijn een aantal motieven naar voren gebracht die kunnen verklaren waarom grote bedrijven krediet verlenen. Deze motieven kunnen echter maar in heel beperkte mate verklaren waarom ook kleine bedrijven, voor wie het verstrekken van handelskrediet meestal relatief duur is, veelvuldig hun producten op krediet verkopen. Het gebruik van handelskrediet als concurrentiemiddel lijkt dit fenomeen te kunnen verklaren. De analyses in hoofdstuk 3 geven aan dat vooral bedrijven die geen solide reputatie in de markt hebben (bijvoorbeeld kleine bedrijven, jonge bedrijven en bedrijven zonder toegang tot externe vormen van financiering) handelskrediet gebruiken om hun afzet te vergroten, m.a.w met name deze bedrijven

gebruiken handelskrediet als een concurrentiemiddel. Hoe kleiner de marktmacht van de aanbieder en hoe groter de marktmacht van zijn consumenten, hoe meer de aanbieder zijn producten op krediet zal verkopen, vooral als het bedrijf nog geen sterke reputatie heeft opgebouwd.

In het hoofdstuk wordt verder gekeken naar de invloed van de ontwikkeling van het financiële en het rechtssysteem van een land op het gebruik van handelskrediet als een concurrentiemiddel. We vinden dat de ontwikkeling van het rechtssysteem nauwelijks effect heeft op het gebruik van handelskrediet als een concurrentiemiddel. De ontwikkeling van het financiële systeem heeft wél invloed. Wanneer het financiële systeem beter ontwikkeld is, is de kans dat consumenten hun marktmacht uitoefenen kleiner. We beargumenteren dat dit resultaat wordt veroorzaakt doordat in landen met een goed ontwikkeld financieel systeem informatie over bedrijven wijder verbreid beschikbaar is; deze informatie kan vervolgens gebruikt worden als een garantie voor productkwaliteit. Vandaar dat onder deze omstandigheden de noodzaak van een consument om marktmacht uit te oefenen door middel van het eisen van handelskrediet beperkt is.

Via de financiële markten kan kapitaal stromen naar plaatsen waar het het productiefst gebruikt kan worden. Dit vermindert de restricties die landen met een beperkte kapitaalvoorraad hebben en bevordert een efficiëntere allocatie van investeringen tussen landen. Echter, gebeurtenissen in het laatste decennium, zoals de Tequila-crisis, de Azië-crisis, en de ondergang van het Argentijnse vaste-wisselkoerssysteem, hebben de aandacht gericht op de risico's van financiële integratie, voornamelijk voor ontwikkelingslanden.

Er kunnen verschillende kanalen geïdentificeerd worden waardoor financiële integratie invloed kan uitoefenen op wisselkoersinstabiliteit, mogelijk uitgroeiend tot een financiële crisis. Bijvoorbeeld, de stringente marktdiscipline opgelegd door buitenlandse investeerders kan landen op de korte termijn fragiel en kwetsbaar voor een financiële crisis maken. Aangezien deze landen sterk afhankelijk zijn van externe geldstromen ter stimulering van economische groei is de veerkracht van hun economie zeer beperkt wanneer de kapitaalinstroom opeens stopt. Daarnaast zijn deze landen kwetsbaar doordat

kapitaalstromen naar ontwikkelingslanden vrijwel geheel in buitenlandse valuta luiden en vrijwel uitsluitend kortetermijnleningen zijn.

Hoewel crises vaak geassocieerd worden met financiële liberalisatie, spelen ook binnenlandse factoren een sleutelrol. In hoofstuk 4 van dit proefschrift wordt gekeken naar een crisis die voor een belangrijk deel werd veroorzaakt door binnenlandse factoren: de Argentijnse crisis van eind 2001. Deze crisis was het resultaat van een aantal factoren zoals een vast-wisselkoerssysteem, onhoudbaar begrotingsbeleid resulterend in een excessieve hoeveelheid schulden in dollars, een inflexibele arbeidsmarkt en een aantal buitenlandse schokken. Dit leidde eind 2001 tot grote economische wanorde en sociale onrust, maar, verrassend, ook tot een sterke stijging van de aandelenkoersen. Een stijging volledig in tegenstelling met de ervaringen van andere landen die recentelijk te maken hebben gehad met een crisis en hun aandelenmarkten juist sterk zagen dalen. In hoofstuk 4 wordt een mogelijke verklaring geven voor dit opmerkelijke kenmerk van de Argentijnse crisis.

Het feit dat de Argentijnse economie geïntegreerd was met de rest van de wereld leidde ertoe dat de dreiging van het uitbreken van een crisis een grote kapitaaluitstroom tot gevolg had, resulterend in een snelle daling van de buitenlandse reserves in de tweede helft van 2001. Om dit tegen te gaan stelde de Argentijnse overheid op 3 december 2001 stringente controles in op kapitaaluitstroom. Hoofstuk 4 beargumenteert dat de kapitaalcontroles die aan het begin van de crisis waren geïntroduceerd effectief waren in het tegengaan van de kapitaaluitstroom. De effectiviteit van de controles in combinatie met de opschorting van de convertibiliteit van banktegoeden (de zogenoemde ‘corralito’), maakte investeringen in liquide Argentijnse aandelen een betere optie dan het aanhouden van geld op een spaarrekening. Dit resulteerde in een sterke stijging van de aandelenmarkt.

Men kan terugblikken op de jaren negentig als een periode van systematische financiële crises: de crisis van het Europese wisselkoersmechanisme (ERM) in 1992 en 1993, de Tequila-crisis van 1994, de Azië-crisis van 1997, de financiële ineenstorting van Rusland in 1998 en de devaluatie van de Braziliaanse real in 1999. Een opvallend kenmerk van veel van deze crises was dat een schok in een land niet beperkt bleef tot dat land zelf, maar zich snel verspreidde naar andere landen. Dit kenmerk wakkerde een

actief debat aan tussen zowel wetenschappers als beleidsmakers over de transmissie van een crisis van het ene land naar het andere land.

Het gelijktijdig voorkomen van financiële crises in verschillende landen kan door verschillend factoren veroorzaakt worden. Op de eerste plaats kan het het resultaat zijn een een externe schok die beide landen gelijktijdig treft. Daarnaast kunnen er reële en financiële verbindingen tussen de landen bestaan die ervoor zorgen dat een schok in het ene land overslaat naar het andere land. Deze vorm van 'comovement' wordt vaak een 'spillover'-effect genoemd. Spillover-effecten worden veroorzaakt door normale onderlinge afhankelijkheid van economieën en komen voor in zowel rustige als in crisisperioden. Worden de verbindingen tussen landen echter sterker gedurende een crisisperiode, in vergelijking met een rustige periode, dan wordt vaak gesproken van besmetting. Besmetting kan bijvoorbeeld plaatsvinden door kuddegedrag van investeerders.

In het laatste hoofdstuk van dit proefschrift analyseren we of dergelijke besmetting ook is opgetreden tijdens financiële crises in ontwikkelingslanden. Met de Azië-crisis als een case study bestuderen we in dit hoofdstuk of besmetting plaats vindt via de valutamarkt. Hierbij kijken we uitsluitend naar besmetting vanuit Thailand, het land waar de Azië-crisis begon, richting andere landen in de regio. De resultaten van dit hoofdstuk suggereren dat besmetting een rol heeft gespeeld in de verspreiding van de Azië-crisis. We vinden bewijs van besmetting via de valutamarkt van Thailand naar Indonesië en Maleisië, doch niet van Thailand naar Korea en de Filippijnen.

Financiële markten creëren zowel kansen als ook uitdagingen voor ontwikkelingslanden. Het belang van de ontwikkeling van de binnenlandse financiële markt om groei te genereren wordt tegenwoordig erkend, maar de financiële openheid die een verdieping van de financiële sector bevordert wordt geassocieerd met financiële crises met grote potentiële verstoringen voor de economieën van ontwikkelingslanden. Het is de uitdaging voor wetenschappers en beleidsmakers om mogelijkheden te vinden waardoor ontwikkelingslanden zoveel mogelijk voordeel kunnen halen uit de mogelijkheden die worden gecreëerd door een geïntegreerde wereld, terwijl de risico's geminimaliseerd worden. Daarom is het van belang een goed beeld te krijgen van hoe

financiële markten (zowel binnenlands als internationaal) ontwikkelingslanden beïnvloeden. Dit proefschrift probeert hieraan een bijdrage te leveren.

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