International Financial Integration through the Law of One Price: The Role of Liquidity and Capital Controls

Eduardo Levy Yeyati Sergio L. Schmukler Neeltje Van Horen*

September 2008

Abstract

This paper takes advantage of the fact that some stocks trade both in domestic and international markets to characterize the degree of international financial integration. The paper argues 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 and the effectiveness of capital controls. Using Autoregressive (AR) models to estimate convergence speeds and non-linear Threshold Autoregressive (TAR) models to identify non-arbitrage bands, the paper shows that price deviations across markets are rapidly arbitraged away and bands are narrow, particularly so for liquid stocks. The paper also shows that regulations on cross-border capital flows effectively segment domestic markets. As expected, the effects of both types of capital controls are asymmetric but in the opposite direction: controls on outflows induce positive premia, while controls on inflows generate negative premia. Both vary with the intensity of capital controls.

JEL Classification Codes: F30; F36; G15

Keywords: capital market integration; market segmentation; AR; TAR; law of one price

* Levy Yeyati is with Barclays Capital and the Barcelona Graduate School of Economics, Schmukler is with the World Bank, and Van Horen is with the Dutch Central Bank and the University of Amsterdam. We are grateful to Ross Levine (the Editor) and two anonymous referees for excellent suggestions. We also thank Stijn Claessens, Constantino Hevia, Woochan Kim, Franc Klaassen, Luis Serven, Dick van Dijk, Naoyuki Yoshino, and participants at presentations held at the Asian Development Bank Institute (Tokyo), the European Economic Association Annual Meetings (Amsterdam), the Latin American and Caribbean Economic Association Annual Meetings (Paris), and the World Bank Macro Research BBL (Washington) for helpful comments. We thank the Asian Development Bank Institute for offering financial support for this project. Francisco Ceballos, Maria Bernarda Dall'Aglio, David Khon, Mira Olson, and Maria Mercedes Politi provided excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily represent those of the institutions with which they are affiliated. E-mail addresses: ely@utdt.edu, sschmukler@worldbank.org, and N.van.Horen@dnb.nl.

1. Introduction

As part of the process of increasing international financial integration, countries have experienced in recent years a migration of stock market activity from domestic markets to international markets. By now, many countries have several firms simultaneously trading equity in domestic stock markets and international financial centers. The growth of international markets as a source for financing and trading is generating a wedge within countries between large, liquid firms and the rest, and is influencing domestic stock market development around the world. Emerging economies have been particularly affected by this process.[1]

In this paper, we take advantage of this migration of stocks to international financial centers and the fact that two identical assets trade in domestic and international stock markets to study the degree of international financial integration, and how it is affected by liquidity and the imposition of capital controls. To do so, we measure international financial integration through the lens of the law of one price (LOOP). This law stipulates that two markets are integrated when identical goods or assets are priced equally across borders. We analyze the percentage price difference displayed by the (underlying) shares in domestic markets and the corresponding depositary receipts (DRs) in international markets (henceforth, the *cross-market premium*), controlling and testing for the presence of non-linearities.

The behavior of the cross-market premium provides a useful price-based measure of integration. If there are no restrictions to trading, the possibility of arbitrage implies that the prices of the depositary receipt and the underlying share would be equal, after adjusting for exchange rate and transaction costs. It follows that, in a fully integrated market, the cross-market premium should be approximately zero.[2] However, full integration of capital markets can be disrupted by several factors. Two of them are studied in this paper: liquidity and capital controls.

Liquidity affects the ability to perform arbitrage. Two mechanisms stand out. First, stocks may not be traded in all markets on a daily basis (i.e., stocks might be infrequently traded). Thus, it takes longer to effectively arbitrage a price difference, since

[1] See Gozzi et al. (2008a,b), Levine and Schmukler (2006 and 2007), and references therein.
[2] In the absence of legal or technological barriers to cross-country capital flows, effective integration (price convergence) would still be affected by the intensity of transaction costs.

the arbitrageur has to wait for trades to happen in both markets. Second, stock prices might be sensitive to the trading activity of particular investors because the market is not deep enough. Therefore, arbitrage activity might be hampered in the case of these non-liquid companies. In other words, there might be a liquidity premium that drives transaction costs upwards and reduces the scope for arbitrage.

Government controls on cross-country capital movement are also expected to affect the cross-market premium. The effects will vary by type of control and will be asymmetric. To the extent that these controls are effective in limiting the ability to transfer funds across borders, the cross-market premium would reflect the desire of investors to purchase the securities inside or outside the country.[3]

Controls on capital outflows would exert upward pressure on the price of the underlying stock relative to the depositary receipt, since investors can purchase the security domestically and sell it in the international market, without paying the tax to move funds outside the country. That is, though controls on outflows restrict the transfer of funds abroad, stocks can still be moved from the domestic market to the international one, effectively allowing investors to obtain cash outside the country through the sale of those securities. A higher price of the underlying stock would not be arbitraged away because it would involve the purchase of the DR abroad and the sale of the underlying stock in the domestic market. As controls on capital outflows restrict transferring the proceeds from that sale abroad, the price difference would persists. The asymmetry arises because arbitrage can take place when the DR is more expensive than the underlying stock, since there are no restrictions to enter funds into the country. Namely, the premium is expected to fluctuate above zero; negative premia will be arbitraged away.

Under controls on capital inflows, the opposite effects occur. These controls would push up the relative price of the DRs, as investors buy them abroad and sell them domestically, avoiding the tax to enter funds into the country. In this case, a lower price of the underlying stock in the domestic market would not be arbitraged away because controls on inflows hamper the ability to transfer funds into the country to purchase these

[3] Errunza and Losq (1989) describe some other channels through which capital controls may affect asset prices. They argue that, from a global diversification perspective, capital controls impede investors to hold directly country-specific risk. This would affect the price of securities after controls are dismantled, due to the probable rebalancing of investors' portfolios towards more efficient ones.

cheaper securities. The asymmetry here arises because a higher price of the underlying stock will be arbitraged away, as investors can purchase the DR and sell it domestically. As such, the cross-market premium would reflect the effectiveness of capital controls and the price investors are willing to pay to hold a security that can be freely transferred across borders, when other restrictions are in place.[4] While the analysis of differentials in the pricing of DRs and the underlying shares has received attention for a while (see, among others, Eun et al. 1995, Alaganar and Bhar, 2001, and Gagnon and Karolyi, 2004), a systematic analysis of LOOP and its link to liquidity and capital controls, as studied in this paper, has been missing.

In our empirical estimations, we analyze systematically the distribution of daily cross-market premia since 1990 for a large set of stocks (98 in total) from nine emerging economies: Argentina, Brazil, Chile, Indonesia, Korea (South), Mexico, Russia, South Africa, and Venezuela. The paper uses two methodologies to examine financial integration through the convergence to LOOP by two identical assets trading in domestic stock markets and at the New York Stock Exchange. First, we use the more traditional autoregressive (AR) models to estimate the convergence speed of a shock to the cross-market premium. Higher convergence speeds reflect a quicker convergence to LOOP by the underlying stocks and the DR, and hence stronger financial integration. Second, we use non-linear threshold autoregressive (TAR) models. Typical transaction costs such as brokerage fees, or control induced costs such as Chilean-type unremunerated reserve requirements (or, more generally, any tax-like control on capital flows), can be expressed as a percentage of the amount invested, that is, a discount that requires a compensating premium. TAR models implicitly characterize this premium by estimating at what point it is profitable to engage in arbitrage. Therefore, they provide a natural way to measure transaction costs-based segmentation in financial markets, and constitute a clear alternative for the more traditional AR models.

[4] Depositary receipts have been used recently to assess the impact of capital controls. Rabinovitch et al. (2003) attribute the persistence of return differentials between ADRs and stocks in Chile to the presence of controls. Melvin (2003) and Auguste et al. (2006) examine the large ADR discounts that built in the midst of the Argentine crisis in early 2002, which Levy Yeyati et al. (2004) interpret as a reflection of the strict controls on capital outflows and foreign exchange transactions imposed at the time. We explore this hypothesis in more depth here.

The view that a minimum return differential is required to induce arbitrage (hence, the non-linearities in cross-market premia) dates back, at least, to the work of Einzig (1937, p. 25).[5] 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. Obstfeld and Taylor (1997) use similar models to document the presence of non-linearities in the convergence process of international prices. In this paper, we employ TAR models 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. We interpret both the band-width and the convergence speed as (inverse) measures of integration.[6]

The main results of this paper are the following. First, we show evidence of strong financial integration: the cross-market premium is close to zero, with rapid convergence to zero and very narrow no-arbitrage bands.[7] Second, non-linear models seem to capture well the behavior of the premium, in line with the hypothesis of a no-arbitrage band due to transaction costs. 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, convergence speed is more rapid and the no-arbitrage bands are narrower, the more liquid a stock is. This suggests that large companies, the ones that typically have liquid stocks, are well integrated with the international financial system. Fourth, regulations on cross-border capital movement effectively segment stock markets, weakening arbitrage across markets. The presence of controls is directly

[5] The importance of non-linearities in the behavior of asset prices has received ample attention in the literature. For example, Froot and Obstfeld (1991) construct a model in which government intervention leads to non-linearities in the pricing of the foreign exchange rate. Sercu et al. (1995) build a model with a no-arbitrage band for the nominal exchange rate around its purchasing power parity value.

[6] Although TAR models have mostly been used in the PPP literature, more recently the model has also been applied to financial data. Rabinovitch et al. (2003), for example, use a TAR model as an approximation for the arbitrage adjustment mechanism between the local and ADR markets for Argentine and Chilean stocks. Canjels et al. (2004) use a TAR model to study the efficiency of the dollar-sterling gold standard and provide insights into the evolution of market integration in the classical gold standard. In addition, several studies have applied TAR models to study the behavior of interest rates (Balke and Wohar, 1998, Mancuso et al., 2003, and Juhl et al., 2006, among others).

[7] Narrow refers to levels comparable with standard transaction fees, which are typically small. By rapid, we mean less than one day. During tranquil periods and in the absence of controls, rapid convergence means that deviations from the law of one price that may appear at close-of-business prices are traded away during the following day's intraday trading.

reflected in the intensity of integration, in the form of wider bands and more persistent deviations (less rapid convergence when outside the band), except where controls are not binding. As expected, both controls on capital inflows and outflows have asymmetric but opposite effects on the cross-market premium. Controls on outflows induce positive premia, while controls on inflows generate negative premia. The effects vary with the intensity of the controls. In all, the results show that arbitrage works well for liquid (typically large) companies from emerging economies that are fully integrated with the international financial system, but that this integration is easily disrupted as stocks become less liquid or governments introduce restrictions on capital movements.

Some additional contributions to the literature are worth mentioning here. The cross-market premium used in this paper offers a number of advantages as a measure of financial integration over many other measures proposed in the literature. First, it allows testing LOOP based on two truly identical assets, avoiding the problems generated by different index composition across countries. For example, stock market indexes are composed of assets with different degrees of liquidity and from different sectors, for which effective integration (and, as a result, the speed of convergence of prices in different locations) may differ. Second, the cross-market premium is free from the idiosyncratic risk related to default risk. In other words, depositary receipts do not involve different securities, but rather claims on the same stock of shares traded in the local market issued by the same company. The underlying shares move between the domestic market and the international market following arbitrage activity. Since the depositary receipt is a claim on the underlying share, holders of depositary receipts have the same legal rights as holders of equity and are entitled to the same cash flows. Third, because it is a market-based measure, no empirical model needs to be imposed on the data. Fourth, 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. Fifth, the measure is amenable to the use of TAR models. Linear models tend to understate the convergence speed when there are non-linearities in the data (the more so the wider the no-arbitrage bands).[8] Finally, the use of individual identical assets avoids any potential aggregation bias that working with indexes might induce.[9]

By using the cross-market premium, this paper also extends the literature on price-based measures of international financial integration, which can be broadly divided into two strands.[10] A first one analyzes integration by estimating return correlations across markets. Although very useful to understand the scope for international risk diversification, this work is often based on a comparison of price indexes, which can be problematic (as discussed above). Furthermore, when based on capital asset-pricing models the studies of return correlations test simultaneously the extent of integration as well as the applicability of a particular model, taking the underlying shocks as given and time invariant.[11] A second strand of the literature studies financial integration by testing LOOP in capital markets in various ways.[12] In response to the composition problem associated with price indexes, some papers specifically focus on the evolution of the premium of emerging market closed-end country funds over the value of their underlying portfolio. 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.[13] Alternatively, Froot and Dabora (1999) examine

[8] See Imbs et al. (2003) for single-good price comparisons.
[9] Imbs et al. (2005) argue that this bias explains the slow convergence to the purchasing power parity (PPP) literature.
[10] In addition to price-based measures, stock-based measures of financial integration have spawned a large body of empirical work. A thorough survey of the vast literature on measuring financial integration far exceeds the scope of this paper. A comprehensive overview of the main operational measures of financial integration is provided by Obstfeld and Taylor (2002) and Prasad et al. (2003), among others.
[11] Studies based on stock market indexes include, among many others, Cashin et al. (1995), Soydemir (2000), Masih and Masih (2001), Scheicher (2001), and Chen et al. (2002). Capital asset-pricing models to test for market integration have been applied by Bekaert and Harvey (1995), Bekaert et al. (2005), and Carrieri et al. (2007), among others.
[12] 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 and default risk. Note that, in the case of DRs, the price difference between the two stocks is not affected by expected exchange rate fluctuations, as arbitrage takes place almost immediately. This contrasts with interest rate parity conditions, which look at a much longer horizon. In frequently traded stocks, a trader would trade away a price difference within the day. Any exchange rate fluctuation beyond that timeframe is irrelevant. Moreover, there are liquid exchange rate forwards that can be used to hedge exchange rate risk, especially at short horizons.
[13] Closed-end funds cannot be redeemed for the underlying shares, impeding perfect arbitrage. This introduces a distinction between the fund and the underlying portfolio, which is behind the persistent closed-end fund premium. This feature of closed-end funds contrasts with the case analyzed in this paper,

the price behavior of pairs of stocks of large Siamese twins (corporates that pool cash flows and fix their distribution) traded in different countries, and find that price deviations of these "nearly identical" stocks are habitat dependent.[14]

The remainder of the paper is organized as follows. Section 2 discusses the link between the cross-market premium and financial integration. Sections 3 and 4 discuss the data and methodology. Section 5 characterizes the behavior of the cross-market premium and studies how the premium is related to liquidity. Section 6 examines how controls on cross-border capital movement affect financial integration and to what degree the cross-market premium provides a good measure of integration. Section 7 offers some concluding remarks.

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 is issued by a so-called depositary bank in the U.S. and represents a specific number of underlying shares remaining on deposit in a custodian bank in the issuer's home market.[15] A new DR can be created by depositing the required number of shares in the custodial account. The dividends and other payments will be converted by

in which full arbitrage can be easily performed and a much smaller price divergence is found. Many papers have been written on the closed-end fund puzzle in the U.S.; see for example Lee et al. (1990 and 1991). Other papers focus on international closed-end funds, such as Frankel and Schmukler (1998 and 2000) and Levy Yeyati and Uribe (2000).

[14] An example is Royal Dutch/Shell, which has two shares traded in different markets (Royal Dutch in Amsterdam and Shell in London). It is one firm, but as cash flows are split unevenly, the market value of Royal Dutch must theoretically be 1.5 higher than that of Shell. However, in practice, even though arbitrage is possible, the market value of both stocks has fluctuated far above and below the theoretical difference. One partial explanation for this phenomenon is that Royal Dutch was for a long time a member of the S&P 500 index, while Shell was not, implying that index funds tracking the S&P500 were forced to buy Royal Dutch, even when it was more expensive (Lamont and Thaler, 2003).

[15] Depositary banks provide all the stock transfer and agency services in connection with a depositary receipt program, and must designate a custodian bank to accept deposits of ordinary shares. When new ADRs are issued, the custodian accepts additional ordinary shares for safekeeping. When ADRs are canceled, the custodian releases the ordinary shares in accordance with instructions received from the depositary.

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.

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,

$$x_t = \frac{S_t r P_t^{und} - P_t^{dr}}{P_t^{dr}}, \tag{1}$$

with x_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 assets can be transferred freely between the domestic market and the U.S., transaction costs are negligible, and the two markets close at the same time, arbitrage should be instantaneous and costless. If the price of the underlying stock is higher than the price 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 price of the DR is higher. In principle, the premium will be equal to zero. If a shock occurs too late during the day to be arbitraged away, closing prices will differ, but this difference will disappear quickly the next trading day.[16]

In reality, however, there is no instantaneous and costless arbitrage. If an investor decides to transform underlying stocks into DRs and sell them in the U.S., he has to incur transaction costs. These typically include a broker's fee and a transaction fee to buy the underlying stock and transform it into the DR, plus 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 to transfer the funds back to the domestic market. A U.S.

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

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. These transaction costs incurred include both fixed as well as variable costs. While the fixed costs can be dwarfed by increasing the transaction size, the existence of variable costs can generate a "no-arbitrage band" within which price deviations are not large enough to induce arbitrage. Higher (variable) transaction costs induce the widening of the no-arbitrage band and, thus, weaker integration.

Fixed (or even less than linearly proportional) transaction costs per share are enough to generate non-arbitrage bands. Broker fees are typically proportional (albeit less than linearly) to the size of the trade, as large transactions command smaller per-share fees than smaller ones, diluting their incidence only partially. In addition, there are liquidity and counterparty risks that translate in an expected cost that is proportional to size, and is most notably expressed in the bid-ask spread charged by market makers. Bid-ask spreads are constant per-share arbitrage costs faced by investors, which by themselves could explain a (narrow) non-arbitrage band.

3. Data

To analyze the behavior of the cross-market premium, we start from a representative sample of emerging economies around the world that offer stocks with a long history of DR listings. These are Argentina, Brazil, Chile, Indonesia, Korea (South), Mexico, Russia, South Africa, and Venezuela. Most of these economies experienced the introduction (or lifting) of capital controls during the sample period.

We restrict our attention to stocks that are publicly traded both domestically and either on the NASDAQ or the New York Stock Exchange (NYSE) (the so-called level 2 and level 3 ADRs). From this set, we exclude the following stocks: (i) stocks that have less than two years of data (to impose some minimum data requirement), (ii) stocks for which the DR or the underlying security *never* trades (that is, we exclude stocks that always trade just on the domestic or the New York market, for which we would not be able to compute the cross-market premium), and (iii) stocks that present irregular patterns in the time series (like stocks that display large unexplained shifts in trading volume).[17] Aside from these criteria, we impose a minimum number of observations to estimate reliably the AR and TAR models; namely, stocks that have at least 100 and 500 observations for the AR and TAR estimates, respectively. This selection process leaves us with 98 stocks to compute AR estimates and 78 stocks to compute also TAR estimates. We collect data since 1990. For all countries, we have data up to 2004. However, for the case of Argentina, we also use data up to 2007 (in a separate section), to take into account the changes in the capital controls regime.[18]

To study the behavior of the cross-market premium we use two types of observations. On the one hand, we use observations that exhibit *contemporaneous* trading, that is, observations corresponding to dates in which trading takes place in both markets (the domestic market and New York). On the other hand, we use all observations, that is, days in which the asset is traded in both markets (contemporaneous trading days) plus days in which no trade takes place in one of the markets (non-contemporaneous trading days).[19]

The decision to include or exclude information from non-contemporaneous trading days is a critical one given that many DRs from emerging economies display infrequent trading. While trading frequency per se should not be a concern for our purposes, adding non-contemporaneous trading can potentially lead to results for individual stocks that are difficult to explain (an issue that has been typically overlooked by the literature). In particular, the inclusion of observations with no trading in one of the markets may create variations in the cross-market premium that are entirely explained by the fact that, in the absence of trading, the last traded price is repeated for non-trading days. In those cases, price disparities would reflect non-trading activity prices (specifically, valuations corresponding to different points in time) rather than differential

[17] For example, we have found in some cases that trading volume suddenly increases sharply and continues for the rest of the sample period at the higher (average) volume. This change reflects a regime shift and does not consist of a few outliers. In some cases, we could find a logical explanation for this type of change and could control for it (for example, a stock split). However, in other cases we could not find such an explanation. In those cases, we excluded the stock from the sample.

[18] Appendix Table 1 reports the companies that are included in the respective portfolios and the period for which the premium is calculated. Note that only a very limited number of stocks traded in the early 1990s. In the vast majority of countries, firms did not cross-list through ADRs prior to 1994 or even later.

[19] All observations also include days in which neither the DR nor the underlying asset trades. However, those days are very rare in our sample and including them does not affect the results.

valuation at the same time (the concept underlying the definition of the cross-market premium). In practice, it is very common that investors and traders in less developed or more illiquid financial markets face situations in which the price that appears on the screen represents the latest transaction recorded but hardly the price for which the trader can obtain a firm bid or ask. Therefore, in cross-market trading, the price difference across markets of the same assets can simply reflect different dates in the latest transaction in each market (reflecting, in turn, the variation of the actual price of the asset over time). Assuming that these cross-market differences in the latest recorded prices are not traded away by the arbitrageur because of the presence of transaction costs (the implicit assumption in our estimation of non-arbitrage bands) would lead to overstate the incidence of those costs in stocks with no trading in one market. If it were to trade, the arbitrageur would get a different price than the quoted one, probably with a narrower cross-market premium. On the other hand, when there is trading in both markets during the day, the cross-market premium for that day should closely reflect the contemporaneous transaction costs. In sum, in our analysis, we use both premium series (i.e., one only including the contemporaneous trading days and one including all days), but take into account that the inclusion of days with trading in only one market would tend to overstate transaction costs, the more so the higher the prevalence of these observations.

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.[20]

[20] Asynchronous trading hours always present a problem when studying comovements of equity prices in different countries and are dealt with in different ways. For example, Bracker et al. 1999 use leads and lags to account for asynchronous trading when studying the comovement of daily returns of ADRs and their underlying stocks. Karolyi and Gagnon (2004) use as control variable the number of time-zones that separate markets when testing whether the return differential between the underlying stocks and the ADRs differs from zero. Pasquariello (2008) uses weekly returns instead of daily returns to limit the impact of

4. Methodology

Financial integration through the law of one price can be measured using two models. The first consists of a traditional autoregressive (AR) model. Higher convergence speeds reflect a quicker convergence to LOOP and hence stronger financial integration. We estimate the persistence of shocks applying the Augmented Dickey-Fuller model, with one autoregressive component and other lagged differences. That is, we estimate the following model:

$$\begin{aligned} \Delta x_t &= \beta x_{t-1} + \sum_{j=1}^{k} \phi_j \Delta x_{t-j} + \varepsilon_t, \\ \sigma_t^2 &= \alpha_0 + \sum_{j=1}^{p} \alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^{q} \lambda_j \sigma_{t-j}^2, \end{aligned} \qquad (2)$$

where β measures the change in the premium to differences between the price of the underlying stock and the price of the DR. Put differently, β provides a measure of the speed of convergence of the premium back to its mean. σ_t^2 is the variance of the process.

The model includes GARCH effects to account for the heteroskedasticity prevalent in the data. Lags are included so that no serial correlation or heteroskedasticity is present in the residuals. In other words, in each AR model the number of lags and GARCH terms vary such that there is no serial correlation and heteroskedasticity left in the residuals.

We use the parameter of the autoregressive factor β to calculate the "half-life" of the AR models, estimated as $\ln(0.5)/\ln(1+\beta)$. However, since we compute AR(p) processes, $\ln(0.5)/\ln(1+\beta)$ is only an approximation of the half-life; this expression assumes a monotonic rate of decay, which does not necessarily occur in higher order AR models.[21] Still, we think that $\ln(0.5)/\ln(1+\beta)$ is a useful measure in our case. First, it is a monotonic transformation of β. Therefore, this measure provides a useful characterization of the convergence of the premium for different stocks. Second, using the impulse response to estimate the half-life (often viewed as the best approach to

---

asynchronous trading. Other studies (e.g., Yang, 2007) use open and close prices to account for asynchronous trading hours.

[21] Naturally, for the stocks for which the actual modes is AR(1), this expression is in fact the precise measure of the half-life.

calculate the half-life of an AR(p) model) is not very informative given our data. For the vast majority of stocks convergence takes place very rapidly; typically, most of the reaction occurs within a day (unlike the findings in the PPP literature, for example). Therefore, given the daily frequency of time series, using the impulse response function results in most of our estimated half-lives being equal to one day. This leaves hardly any variation across stocks and prevents us from using the variation that exists in our estimates to test for the impact of liquidity and capital controls on financial market integration.[22]

The second type of model we apply is the non-linear threshold autoregressive (TAR) model. The existence of (variable) transaction costs implies that two different regimes exist, an arbitrage and a no-arbitrage regime. If 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 go back inside the band.[23] 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 prices to converge. As the TAR model assumes a discrete change in the AR process once a certain threshold is crossed, this model provides a natural choice to characterize the type of regime changes that we expect to be prevalent in the DR market. To the extent that high transaction costs, and hence a broader band of no-arbitrage, are associated with a lower level of financial integration, the estimated width of the no-arbitrage bands provides a measure of effective integration.[24]

The TAR model 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-

[22] Furthermore, impulse responses are also problematic because in AR(p) processes the reaction over time is not monotonic. For example, the function can decay in the immediate short run and rise later on. Therefore, looking at when the shock is first reduced by half does not guarantee that the shock has been mostly dissipated.

[23] 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.

[24] The implication of the presence 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 et al. (1995) and Michael et al. (1997) analyze real exchange rates and develop a theory suggesting that the larger the deviation from PPP, the stronger the tendency for real exchange rates to move back to equilibrium.

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 estimate 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 account for the heteroskedasticity prevalent in the data.

The resulting specification is the following:

$$
\begin{aligned}
&\Delta x_t = (I_{in})\beta_{in}x_{t-1} + (I_{out})\beta_{out}\Phi(x_{t-1},c) + \sum_{j=1}^{k}\phi_j \Delta x_{t-j} + \varepsilon_t, \\
&\sigma_t^2 = \alpha_0 + \sum_{j=1}^{p}\alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^{q}\lambda_j \sigma_{t-j}^2, \\
&\Phi(x_{t-1}, c^{up}) = x_{t-1} - c^{up} \text{ if } x_{t-1} > c^{up}, \\
&\Phi(x_{t-1}, c^{low}) = x_{t-1} + c^{low} \text{ if } x_{t-1} < c^{low}, \\
&c^{up} > 0 \text{ and } c^{low} < 0, \\
&I_{out} = 1 \text{ if } x_{t-1} > c^{up} \text{ or } x_{t-1} < c^{low}; \text{ zero otherwise}, \\
&I_{in} = 1 \text{ if } c^{low} < x_{t-1} < c^{up}; \text{ zero otherwise.}
\end{aligned}
\qquad (3)
$$

This model is known as the TAR(k,2,d), where k is the autoregressive length, *2* is the number of thresholds, and d is the arbitrary delay parameter (also called 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. c^{up} is the upper threshold and c^{low} is the lower threshold. We assume that the constants in both regimes are zero. For each country, we estimate a different model, where k, p, and q are set in such a way that the residuals do not contain any serial correlation or heteroskedasticity up to lag 10 (p is the number of ARCH terms and q is the number of GARCH terms).

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:[25]

$$La = -\sum_t \frac{1}{2}\left(\log(2\pi) + \log(\sigma^2) + \varepsilon_t^2\right)/\sigma^2 \ . \qquad (4)$$

The Null is an AR(*p*) model and Ln is its likelihood function similar to *La*. Lags and GARCH terms are the same in both the TAR and AR models, and are specified in such a way that for the optimal threshold no serial correlation or heteroskedasticity is left in the error terms.

As the threshold is not defined under the null, standard inference is invalid and LLR does not follow the usual χ^2 distribution. To derive the critical values of the LR test, we follow Obstfeld and Taylor and use Monte Carlo simulations. First, the AR(*p*) null model is estimated on the actual data $(x_1,.....,x_T)$. Then, 600 simulations of the model are generated. Each starts 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 that the significance test described above has the important limitation of low power. As shown by Johansson (2001), the probability that the TAR model is mistakenly rejected is high. The method introduced by Hansen (1997) and used, for example, by Imbs et al. (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 rejection of the TAR model with caution. Nonetheless, since we also run all

[25] 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 in 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 another 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.

our estimations using a simple AR model, we can easily verify that the conclusions are not model-dependent.[26]

5. The Cross-Market Premium and Financial Integration

In this section, we study the behavior of the cross-market premium during “tranquil” (non-crisis) times, in the absence of capital controls. The Appendix explains the methodology used to identify crisis episodes. The results using just the crisis periods are reported in the working paper version of this paper, Levy Yeyati et al. (2006), since those merit a separate analysis. Capital control periods are easier to single out, and are described in the next section.

Table 1 presents a first glance at the data, where we show summary statistics of the simple average of the cross-market 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 upper panel shows the summary statistics of the premium calculated for all days in the sample period. The bottom panel shows summary statistics of the cross-market premium based on days for which there is contemporaneous trading in both markets. The table shows that the country average premium is in general close to zero. The largest average premium is in Korea, with 1.69 percent followed by Mexico with 1.23; in all other cases, this number is below one percent. The summary statistics of all stocks shows a mean premium of 0.53 percent, with a standard deviation of 0.74.

Naturally, the premium when all days are included should be higher than the one when only days with contemporaneous trading are taken into account, as the former includes observations when we know that active arbitrage does not take place. Table 1 shows that, for contemporaneous trading days, the premium is on average 0.12 percent for all stocks and the standard deviation is 0.73 percent.[27] Especially in countries where a relative large part of the stocks are characterized by limited trading in either the domestic market and/or in the United States, like Mexico and Brazil, we see a sharp decrease in the

[26] In the paper, we estimate a different TAR for no-control and control periods, as convergence of a regression for all periods with some shift parameter to account for the regime change (a priori, a natural alternative) would be extremely difficult and imprecise.

[27] For all stocks included in our sample, the mean of the absolute value of the premium on non-trading days exceeds the one on trading days.

average premium and its standard deviation when only contemporaneous trading days are included in the sample. In other words, the summary statistics suggest that including information based on non-contemporaneous trading day activity creates a downward bias in the magnitude of financial integration. That is, by using all days we are introducing days in which arbitrage does not take place, so the premium will tend to diverge away from zero.[28]

To complement the evidence presented in Table 1 we compare the premium of two typical firms (Figure 1). The top graph displays the daily premium of the Brazilian Ambev, a firm whose DR trades infrequently (a case of both contemporaneous and non-contemporaneous trading days). The bottom graph shows the premium of Fomento Economico Mexicano, a firm whose DR and underlying stock trade almost every day (a case of contemporaneous trading). Comparing the two premium series, one can observe a substantial difference. In the first case, the premium oscillates around zero but with a wide standard deviation. Due to the presence of non-contemporaneous days, there are periods with no arbitrage pressure, in which the premium can diverge from zero for a long time. In case of the firm with contemporaneous trading, the premium oscillates around zero with a small standard deviation, as price differences can be quickly arbitraged away due to the daily trading in both markets.

5.1. AR and TAR Estimates

To formally examine the extent of financial market integration through LOOP, we estimate AR and TAR models for each stock using both all days and only contemporaneous trading days. Table 2 provides the country averages of these results. The estimates for the individual stocks are reported in Appendix Table 2.[29,30]

[28] From a different perspective, one could argue that just using contemporaneous trading days biases upward the degree of financial integration.

[29] 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.

[30] For brevity, not all estimated parameters are included in Appendix Table 2. However, we find that, as expected, in almost all cases β_{in} is not significantly different from zero, providing an indication that inside the band of no-arbitrage the premium follows a random walk. Furthermore, the estimated sum of the ARCH and GARCH parameters lies between 0.90 and 0.99, with a value of 0.95 for the majority of stocks. In addition, the estimated P-values of the LLR indicate that in less than half of the cases the TAR is the preferred model. However, as explained in the previous section, this test has low power, so it is difficult to

Table 2 shows that, taking both samples of days, the average half-life (from the AR models) ranges from 0.73 in Argentina to 2.61 in Mexico. Including only contemporaneous trading days, the average half-lives tend to be lower in the majority of countries. A similar pattern is observed in the case of the TAR estimates. These results show again that using all days in the estimations (that is, including non-contemporaneous trading days) produces a downward bias in the magnitude of financial integration.

Table 2 also provides country averages of the estimated TAR thresholds. The average band of no-arbitrage ranges from 0.11 percent in Russia to 0.68 percent in Venezuela (for the case of contemporaneous trading days). This implies, in particular, that the cross-market premium in Venezuela can move, on average, between –0.68 and 0.68 percent without arbitrage taking place in the market. Once outside the inaction-band, arbitrage takes place very rapidly: the typical half-life is less than a day. It is important to note that these results do not imply that Russia is more integrated with the U.S. than Venezuela. As shown in the next section, deviations from the law of one price are affected by stock liquidity. Thus, to study the relative integration of different countries one has to compare stocks with similar liquidity, a comparison difficult to make with our sample.

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. Moreover, the wider the band-width, the higher the persistence estimated by the linear model, as Figure 2 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 et al. (2003) for goods markets.

conclude that the TAR model should not be used. In fact, the evidence from Figure 2 suggests how the presence of non-linearities might affect linear estimations.

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.[31] To see whether this is indeed the case, we examine how the AR half-lives and the TAR band-width and half-lives are associated with the liquidity of the stock. We use two measures of liquidity, one based on trading value, the other one on trading frequency.[32] In the first case, liquidity is measured as the log of the average of the mean value traded of the underlying stock and the DR. The second measure defines liquidity as the number of contemporaneous trading days (i.e. the number of days both the underlying stock and the DR were traded) over all days during the sample period.

Figure 3 reports the regression results and the partial regression plots of regressing the half-life estimates by the AR model on liquidity. In the top panel, we show the regression based on half-lives estimated using the cross-market premium for all days. In the lower panel, the regression results are based on the cross-market premium using only information from contemporaneous trading days. In all regressions we control for country-specific fixed effects and a constant. The results indicate that a significant negative correlation between AR half-lives and liquidity exists; illiquid stocks, as characterized by a low trading value or infrequent trading, are associated with more persistent price deviations.[33] This relation is stronger when all trading days are included, suggestion that including non-contemporaneous trading days in the estimation leads to an overestimation of the trading costs.

Figure 4 shows the regression results and partial regression plots for the same regression using the estimated TAR band-width and half-life, using all days and contemporaneous trading days. The upper panels (within each sub-sample of days) reveal the presence of a significant negative correlation between band-width and liquidity. Furthermore, the lower panels show that band reversion, once outside the no-arbitrage regime, takes place more slowly (half-lives are longer) for illiquid stocks. In sum, the size

[31] 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.
[32] Trading value equals the number of stocks traded in a certain day multiplied by the quoted price. See Levine and Schmukler (2006) for alternative measures of liquidity and their relation with value traded.
[33] These results are robust to including market capitalization of the stock as an additional control variable.

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. As expected, the negative correlations are stronger when using all days than when using only contemporaneous trading days.

6. Time-Varying Financial Integration: Capital Controls

The imposition of controls on cross-border capital movements 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. This section centers on how the behavior of the cross-market premium differs when controls are introduced, and how this behavior depends on the nature of the control.[34]

6.1. Capital Controls and the Cross-Market Premium

In the presence of controls on capital outflows, an international investor seeking to buy the DR to sell the underlying stock would need to repatriate the proceeds from this sale and incur a cost κ. Conversely, when controls on inflows are in effect, purchasing the underlying stock to sell the DR would require paying an inflow cost λ.

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) boundary of the no-arbitrage band, keeping the other boundary unchanged, and causing the premium to be, on average, positive (negative).

[34] We only look at controls that directly affect the possibility of arbitrage when they actually restrict the movement of capital across borders. It is difficult to control for the expectations of future capital controls, but given that arbitrage is very rapid, we believe this aspect should be negligible for our computations. For example, the cross-market premium in Argentina became positive only when the country restrictions on capital outflows were actually imposed, even though they were largely anticipated (Schmukler and Serven, 2002).

6.2. Capital Controls: What and When?

First, it is important to define what we understand by capital controls and how we identify the periods when they are in place. Capital control periods are relatively easy to detect. Governments impose them through regulation.[35] Moreover, a number of public institutions document them. Appendix Table 3 describes the capital controls imposed in each of the countries we study. Our measures build on those provided by Kaminsky and Schmukler (2008) and use additional information from a variety of sources (listed in the table). 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 inflows) and those on outflows (to prevent the capital flight in the midst of a crisis). We focus our attention solely on controls that may affect the cross-market premium.[36]

Six countries in our sample experienced a period when capital restrictions affected the behavior of stock markets: Argentina, Chile, Indonesia, Korea, South Africa, and Venezuela. Argentina introduced controls on capital outflows in December 2001 together with restrictions on cash withdrawals from commercial banks (the so called “corralito”) as an attempt to stop capital flight. The majority of these controls stayed in place until December 2002, when the corralito was lifted and the bulk of the restrictions were 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. During the first half of 2003, virtually all controls on outflows 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.

[35] In practice, de jure capital controls create price differences only when they are de facto binding (the cross-market premium identifies those cases). Otherwise, their presence is immaterial.

[36] While capital controls are imposed and lifted with varying financial conditions, they do not seem to be endogenous to the behavior of the cross-market premium. Governments have tended to impose capital controls on outflows to reduce capital flight, and controls on capital inflows to prevent exchange rate appreciations, rather than as a response to stock market fluctuations. Moreover, as Appendix Table 3 shows, controls are not always imposed (or lifted) around crises.

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 place when the first DR started trading; this restriction was lifted in September 1997. However, a ceiling on foreign investment would not affect arbitrage by foreign investors as long as foreign participation is below the 50 percent limit. There is some casual evidence on this: foreign ownership of publicly listed companies in Indonesia was 30 percent in 1993 and 25 percent in 1997 (Asian Development Bank, 2000). 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 has continued to be in place. Cross-listed stocks using DRs faced an additional restriction: until January 1999, the conversion of underlying shares into 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 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."[37] 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 effectively not 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

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

controls on outflows was introduced in January 2003, and was still in place at the end of the sample period.

6.3. Summary Statistics

Figure 5 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. Moreover, 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 above.

Figure 5 shows that during no-control periods the cross-market premium oscillates around zero. Indeed, in countries where no controls were introduced during the sample period (Brazil, Mexico, and Russia) the premium never diverges from zero for an extended period. By contrast, the average premium turns positive in periods when capital outflows are restricted (Argentina, South Africa, and Venezuela) and negative in periods of controls on inflows. As expected, the exception is Indonesia, where the limits on foreign participation appear to have been non-binding at the time, and where domestic investors could still do the arbitrage pushing the cross-market premium towards zero. By contrast, in Korea, where a similar ceiling is combined with a rule restricting the convertibility of the DRs, arbitrage is impeded 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, and 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. According to the figure, that is roughly two percent.

Table 3 displays summary statistics of the average cross-market premium during no-control and control times.[38] The table complements Figure 6. The presence of controls on outflows is associated with a sizeable positive premium, ranging from 6.4 percent in

[38] For Korea, the statistics are derived from the average premium of the unrestricted stocks (no-control period) and the average premium of the restricted stocks (control periods).

the case of Argentina to over 50 percent in the case of Venezuela. By contrast, controls on inflows are characterized by a substantial discount, ranging from -2.1 in Chile to -31.2 percent in 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.

In addition, a comparison with no-control times shows that the volatility of the premium increases significantly during control periods, as expected. In particular, the volatility and the mean of the average premium are positively correlated. Thus, the volatility is, 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 more persistent) deviations from LOOP. In the following sections, we explore this preliminary evidence more closely.

6.4. Integration during Control Periods

For the AR model, we expect the persistence to be much higher when controls on inflows or on outflows 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 we estimate is specified as follows:

$$\begin{aligned} x_t &= \gamma_0 + \gamma_1 D_{cont} + \delta\, x_{t-1} + \delta_{cont} x_{t-1} D_{cont} + \sum_{j=1}^{k}\left(\varphi_j \Delta x_{t-j} + \varphi_{cont,j} \Delta x_{t-j} D_{cont}\right) + \varepsilon_t, \\ \sigma_t^2 &= \alpha_0 + \lambda D_{cont} + \sum_{j=1}^{p} \alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^{q} \lambda_j \sigma_{t-j}^2. \end{aligned} \quad (5)$$

D_{cont} is a dummy equal to one during the control period and zero otherwise. *k* is the autoregressive length, *p* the number of ARCH terms, and *q* the number of GARCH terms. 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.

While we expect persistence to be positively affected by both controls on inflows and outflows, we expect the impact on the band of no-arbitrage to differ between the two types of controls. When (binding) controls on capital outflows are introduced, the premium can become 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 no-control 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 equal to the value estimated for the no-control period, and estimating the remaining threshold. Thus, the impact of controls should be reflected in an asymmetric widening of the band.[39]

Table 4 shows the simple averages of the half-lives and volatility changes from the AR model and the estimated thresholds and half-lives from the TAR model.[40] AR estimates indicate that deviations from LOOP are, as expected, much more persistent in the periods when capital controls are in effect. (The results for individual stocks in each country are comparable.) The notable exception is, again, Indonesia, where half-lives are virtually identical, suggesting that arbitrage was taking place as in the no-control period. In addition, our results show that periods of controls on outflows are 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 no-control period. This, once more, is consistent with the finding that controls did not impede arbitrage at the time.

The TAR results show that the upper threshold goes up when controls on outflows are introduced (Argentina and South Africa). For example, in Argentina the average upper threshold equals 0.29 in the no-control period but increases to 7.85 when controls on outflows are in effect. By contrast, the introduction of controls on inflows in Chile

---

[39] Estimating both thresholds simultaneously in a precise way is exceedingly difficult. Given the variations in the data during the control periods and the length of the time series, several of the models would fail to converge. More critically, on theoretical grounds, we expect only one band to vary when controls on capital inflows or outflows take effect; there is no reason for the other band to be different. Note, however, that the band is not imposed to be asymmetric; the estimated band could be equal to the band estimated during the no-control period.

[40] For Korea, we cannot make a comparison between no-control 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 contemporaneous trading days in the control period.

lowers the average floor of the band from -0.23 to -3.11. Indonesia, by contrast, yields mixed 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.

6.5. Case Study: Argentina 2000-2007

To complement the analysis above, Argentina offers an ideal case to evaluate the behavior of the cross-market premium in the presence of capital controls. The country witnessed a dramatic episode of capital flight in 2001-2002, but imposed controls on outflows only by the end of 2001, which allows us to identify the effect of controls on the cross-market premium beyond the influence of the crisis event. Moreover, in mid-2005, and in the context of renewed capital inflows and a strong rebound of asset prices already underway by end-2003, the country imposed tax-like controls on inflows in the form of two restrictions: the amount entering the country must remain within Argentina for 365 days, and 30 percent of the total amount must be deposited in a local bank in the form of usable funds for the bank's minimum reserve requirement. These controls are still in place.

To take advantage of this unique situation in which one country introduced both types of controls, we extended the sample period for Argentina until June 2007.[41] Figure 6 shows the evolution of the average premium for Argentina over the period 2000-2007. As expected we see that the premium oscillates around zero in no-control periods, becomes positive when controls on outflows are present, and slightly negative when controls on inflows are in effect. Indeed, when looking at the summary statistics (upper part of Table 5) the mean of the premium in the no-control period equals 0.32, during controls on outflows the average premium amounts to 5.97, while in the control on inflows period the average premium is negative at -0.62. The evidence that the premium resulting from the controls on outflows is much higher than the discount characterizing the control on inflows is a direct reflection of the type of control: qualitative controls on outflows preventing arbitrage and an implicit tax on inflows weakening arbitrage.

[41] To keep the number of stocks constant over the sample period, we only use stocks that were traded over the entire sample period (2000-2007). These are BBVA Banco Frances, IRSA Inversiones y Representaciones, Petrobas Energia, Telecom Argentina, and Transportadora de Gas del Sur.

To examine further the impact of controls on financial market integration, we estimate AR and TAR models for the three different periods (Table 5, lower panel). The AR model is very similar to model (4) except that in this case two control dummies are introduced: one to capture the impact of controls on outflows on the persistence of a shock and another one to capture the impact of controls on inflows. The results, presented in the bottom part of Table 5 indicate that, as expected, the persistence of a shock is much higher in the control period.[42]

In addition, we estimate a TAR model to see whether the band of no-arbitrage is affected by the introduction of controls. We use the same procedure as highlighted in the pervious section. First, the model is estimated for the no-control period. Next, the model is estimated for both control periods, where the lower (upper) band is set equal to the value estimated in the no-control period in the case of controls on outflows (inflows). The results confirm our previous findings: the upper band increases when controls on outflows are in effect, and the lower band increases (becomes more negative) when controls on inflows are present.[43] Furthermore, although the persistence is highest during the control on outflows, when non-linearities are taken into account, the half-life once outside the band of no-arbitrage is almost equal for both types of controls.

7. Conclusions

This paper exploited the fact that firms from emerging economies simultaneously trade their stocks in domestic and international stock markets to assess the degree of financial integration and to analyze what factors can affect it. In particular, the paper studied international integration through the lens of LOOP, captured in the cross-market premium between two identical assets. This measure is free from the comparability and aggregation problems that characterized previous attempts to gauge the extent of financial integration. We performed the estimations using linear AR and non-linear TAR models.

[42] Note that the average AR half-life is different than the one presented in Table 4. This is because the sample period is different, the number of stocks in the sample is smaller, and the estimated model includes a second control dummy.

[43] The change in sample period and the smaller number of stocks in the sample explain why the TAR estimates for the no-control and control (on outflows) periods are different from the ones shown in Table 4.

Our estimates suggest the presence of non-linearities in the behavior of the cross-market premium, in the form of no-arbitrage bands driven by transaction costs.

We found that integration is stronger for more liquid stocks. For those stocks, transaction costs (including the associated liquidity risk) are likely to be smaller. This result suggests that liquid firms (typically large ones) are those that are able to integrate well. Moreover, to the extent that investors demand a liquidity premium to hold firms for which arbitrage is relatively expensive, liquid firms are the ones that might benefit the most from the internationalization process. This result adds fresh evidence to the research that looks at firm-level data related to financial globalization (particularly at the differences within countries between firms with and without international activity), by studying the behavior of firm attributes such as trading activity, valuation, and capital structure. These studies along with the results presented in this paper suggest that the degree and effects of international financial integration vary substantially across countries and firms. Large, liquid firms are more connected to the international financial system than small, illiquid firms, and can potentially benefit the most from the internationalization process.

The paper also showed that the cross-market premium reflects accurately the effective impact on international arbitrage of controls on cross-border capital movement. Controls do affect the size and persistence of deviations from LOOP by generating an asymmetric but opposite effect in the non-arbitrage bands. Controls on capital outflows induce a positive premium by raising the upper non-arbitrage band, while controls on capital inflows produce a negative premium by lowering the lower non-arbitrage band. In other words, regulations on capital movement prevent investors from engaging in arbitrage activity, raising the costs of shifting funds across borders. These controls have been used frequently to prevent crises and inhibit capital outflows once crises occur. The paper showed that those controls, even when they do not fully preclude cross-border flows, appear to work as intended and segment markets in practice. Indeed, it is only in the presence of these flows (and in proportion to their intensity) that the controls are reflected in the cross-market premium: de jure restrictions should induce a cross-market premium only when they are binding.[44]

Ultimately, this paper provided a direct measure of de facto integration, through which the effectiveness of restrictions on capital movement and the impact of factors (such as liquidity) that affect financial integration can be assessed more precisely. In addition, it offers a simple but accurate gauge of the effectiveness of capital controls, still a highly debated and topical issue, particularly now that many developing countries are adopting (or pondering) capital controls as a way to mitigate the appreciation of their exchange rates.

[44] Effectiveness here is understood as the success in producing the desired market segmentation. Whether or not this segmentation is beneficial to the economy is an altogether different question that exceeds the scope of this paper.

References

Alaganar, V., Bhar, R., 2001. Diversification Gains from ADRs and Foreign Equities: Evidence from Australian Stocks. Journal of International Financial Markets, Institutions, and Money 11, 97-113.

Asian Development Bank, 2000. Asian Development Outlook 2000. Oxford University Press, Hong Kong.

Auguste, S., Dominguez, K., Kamil, H., Tesar, L., 2006. Cross-Border Trading as a Mechanism for Capital Flight: ADRs and the Argentine Crisis. Journal of Monetary Economics 53, 1259-1295.

Balke, N., Wohar, M., 1998. Nonlinear Dynamics and Covered Interest Rate Parity. Empirical Economics 23, 535-559.

Bekaert, G., Harvey, C., 1995. Time-Varying World Market Integration. Journal of Finance 50, 403-444.

Bekaert, G., Harvey, C., Ng, A., 2005. Market Integration and Contagion. Journal of Business 78, 39-70, previous version appeared as NBER Working Paper 9510.

Bracker, K., Docking, D., and Koch, P., 1999. Economic Determinants of Evolution in International Stock Market Integration. Journal of Empirical Finance 6, 1-27.

Broner, F., Lorenzoni, G., Schmukler, S., 2004. Why Do Emerging Markets Borrow Short Term? World Bank Policy Research Working Paper 3389 and NBER Working Paper 13076.

Canjels, C., Prakash-Canjels, G., Taylor, A. M., 2004. Measuring Market Integration: Foreign Exchange Arbitrage and the Gold Standard, 1879-1913. The Review of Economics and Statistics 86, 868-882.

Carrieri, F., Errunza, V., Hogan, K., 2007. Characterizing World Market Integration through Time. Journal of Financial and Quantitative Analysis 41, 511-540.

Cashin, P., Kumar, M., McDermott, C., 1995. International Integration of Equity Markets and Contagion Effects. IMF Working Paper 95/110.

Chen, G., Firth, M., Rui, O., 2002. Stock Market Linkages: Evidence from Latin America. Journal of Banking and Finance 26, 1113-1141.

Chortareas, G., Driver, R., 2001. PPP and the Real Exchange Rate-Real Interest Rate Differential Puzzle Revisited: Evidence from Non-Stationary Panel Data. Bank of England Working Paper 138.

Einzig, P., 1937. The Theory of Forward Exchange. Macmillian, London.

Errunza, V., Losq, E., 1989. Capital Flow Controls, International Asset Pricing, and Investors' Welfare: A Multi-Country Framework. The Journal of Finance 44, 1025-1037.

Eun, C., Claessens, S., Jun, K. W., 1995. Pricing Externalities in the World Financial Markets: Theory and Policy Implications. Pacific-Basin Finance Journal 3, 31-55.

Frankel, J., Schmukler, S., 1998. Crisis, Contagion and Country Funds. In: Glick, R. (ed.) Managing Capital Flows and Exchange Rates. Cambridge University Press.

Frankel, J., Schmukler, S., 2000. Country Funds and Asymmetric Information. International Journal of Finance and Economics 5, 177-195.

Froot, K., Dabora, E., 1999. How Are Stock Prices Affected by the Location of Trade. Journal of Financial Economics 53, 189-216.

Froot, K., Obstfeld, M., 1991. Exchange-Rate Dynamics under Stochastic Regime Shifts: A Unified Approach. Journal of International Economics 31, 203-229.

Gagnon, L., Karolyi, G., 2004. Multi-Market Trading and Arbitrage. Mimeo, Queen's University and Ohio State University.

Gozzi, J. C., Levine, R., Schmukler, S., 2008a. Internationalization and the Evolution of Corporate Valuation. Journal of Financial Economics 88, 607-632.

Gozzi, J. C., Levine, R., Schmukler, S., 2008b. Patterns of International Capital Raisings. World Bank Policy Research Working Paper 4687.

Hansen, B., 1997. Inference in TAR models. Studies in Non-Linear Dynamics and Econometrics 2, 1-14.

Imbs, J., Mumtaz, H., Ravn, M., Rey, H., 2003. Non-Linearities and Real Exchange Rate Dynamics. Journal of the European Economic Association 1, 639-649.

Imbs, J., Mumtaz, H., Ravn, M., Rey, H., 2005. PPP Strikes Back: Aggregation and the Real Exchange Rate. Quarterly Journal of Economics 120, 1-43.

Johansson, M., 2001. TAR Models and Real Exchange Rates. Working Paper Lund University Department of Economics 2001:21.

Juhl, T., Miles, W., Weidenmier, M., 2006. Covered Interest Arbitrage: Then vs. Now. Economica 73, 341-352.

Kaminsky, G., Schmukler, S., 2008. "Short-Run Pain, Long-Run Gain: The Effects of Financial Liberalization," Review of Finance-Journal of the European Finance Association 12, 253-292.

Lamont, O., Thaler, R., 2003. Anomalies, The Law of One Price in Financial Markets. Journal of Economic Perspectives 17, 191-202.

Lee, C., Shleiffer A., Thaler, R., 1990. Anomalies: Closed-End Mutual Funds. Journal of Economic Perspectives 4, 153-164.

Lee, C., Shleiffer A., Thaler, R., 1991. Investor Sentiment and the Closed-end Fund Puzzle. Journal of Finance 46, 75-109.

Levine, R., Schmukler, S., 2006. Internationalization and Stock Market Liquidity. Review of Finance-Journal of the European Finance Association 10, 153-187.

Levine, R., Schmukler, S., 2007. Migration, Spillovers, and Trade Diversion: The Impact of Internationalization on Domestic Stock Market Liquidity. Journal of Banking & Finance 31, 1595-1612.

Levy Yeyati, E., Schmukler, S., Van Horen, N., 2004. The Price of Inconvertible Deposits: The Stock Market Boom during the Argentine Crisis. Economic Letters 83, 7-13.

Levy Yeyati, E., Schmukler, S., Van Horen, N., 2006. International Financial Integration through the Law of One Price. World Bank Policy Research Working Paper 3897.

Levy Yeyati, E., Uribe, A., 2000. Crisis, Contagion and the Closed-End Country Fund Puzzle. IMF Staff Papers 47, 54-89.

MacDonald, R., Nagayasu, J., 2000. The Long-Run Relationship between Real Exchange Rates and Real Interest Rate Differentials: A Panel Study. IMF Staff Papers 47, 116-128.

Mancuso, A., Goodwin, B., Grennes, T., 2003. Nonlinear Aspects of Capital Market Integration and Real Interest Rate Equalization. International Review of Economics and Finance 3, 283-303.

Masih, R., Masih, A. 2001. Long and Short Term Dynamic Causal Transmission amongst International Stock Markets. Journal of International Money and Finance 20, 563-587.

Melvin, M., 2003. A Stock Market Boom during a Financial Crisis? ADRs and Capital Outflows in Argentina. Economics Letters 81, 129-136.

Meese, R., Rogoff, K., 1988. Was It Real? The Exchange Rate-Interest Differential Relation over the Modern Floating-Rate Period. Journal of Finance 43, 933-948.

Michael, P., Nobay, R., Peel, D., 1997. Transaction Costs and Nonlinear Adjustment in Real Exchange Rates: An Empirical Investigation. Journal of Political Economy 105, 862-879.

Obstfeld, M., Taylor, A., 1997. Non-linear Aspects of Goods-Market Arbitrage and Adjustment: Heckscher's Commodity Points Revisited. Journal of the Japanese and International Economies 11, 441-479.

Obstfeld, M., Taylor, A., 2002. Globalization and Capital Markets. In Bordo, M. D., Taylor, A. M., Williamson, J. G., (eds). Globalization and Capital Markets. University of Chicago Press.

Pasquariello, P., 2008. The Anatomy of Financial Crises: Evidence from the Emerging ADR Market. Journal of International Economics, forthcoming.

Peel, D., Taylor, M., 2002. Covered Interest Rate Arbitrage in the Interwar Period and the Keynes-Einzig Conjecture. Journal of Money, Credit, and Banking 34, 51-75.

Prasad, E., Rogoff, K., Wei, S. J., Kose, M., 2003. Effects of Financial Globalization on Developing Countries: Some Empirical Evidence. International Monetary Fund Occasional Paper 220.

Rabinovitch, R., Silva, A., Susmel, R., 2003. Returns on ADRs and Arbitrage in Emerging Markets. Emerging Markets Review 4, 225-247.

Scheicher, M., 2001. The Comovements of Stock Markets in Hungary, Poland, and the Czech Republic. International Journal of Finance and Economics 6, 27-39.

Schmukler, S., Serven, L., 2002. Pricing Currency Risk under Currency Boards. Journal of Development Economics 69, 367-391.

Sercu, P., Uppal, R., Van Hulle, C., 1995. The Exchange Rate in the Presence of Transaction Costs: Implications for Tests of Purchasing Power Parity. Journal of Finance 50, 1309-1319.

Soydemir, G., 2000. International Transmission Mechanism of Stock Market Movements: Evidence from Emerging Equity Markets. Journal of Forecasting 19, 149-176.

Tong, H., Lim, K., 1980. Threshold Autoregression, Limit Cycles and Cyclical Data. Journal of the Royal Statistical Society 42, 245-292.

Tong H., 1983. Threshold Models and Non-linear Time Series Analysis. Lecture Notes in Statistics Volume 21. Springer-Verlag, Heidelberg.

Tong, H., 1978. On a Threshold Model. In Chen, C. H. (ed.). Pattern Recognition and Signal Processing. Sijthoff and Noordoff, Amsterdam.

Yang, S., 2007. Intra-Day Return and Volatility Dynamics between Japanese ADRs and their Underlying Securities. Applied Financial Economics 1, 837-853.

Appendix: Crisis Periods

Crises times are difficult to pin down because of the lack of an uncontroversial operational definition of crises. 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 the end of the crisis. To do so, we follow the approach adopted by Broner et al. (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 pressure. This approach allows us to distinguish country-specific crisis periods without resorting to the use of ex-post data.

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). The working paper version of this paper, Levy Yeyati et al. (2006), reports the crisis periods identified by our methodology and further details.

Table 1
Summary Statistics - Cross-Market Premium

The table shows summary statistics for 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 DR in New York. The countries' summary statistics are the simple average of the premium of the stocks in each country's portfolio. "All Stocks" reflects the simple average of all the stocks in the sample. In the top panel, statistics are based on all observations of the premium within the sample period. In the bottom panel, statistics are based only on the days on which both the underlying stock and the DR are traded, the contemporaneous trading days.

All Days

Country	Mean	Median	Std. Dev.	5th Pctile	95th Pctile	Obs.
Argentina	0.07	0.01	0.81	-1.05	1.43	2,296
Brazil	0.45	0.18	1.85	-1.84	3.62	2,503
Chile	0.41	0.36	0.90	-0.84	1.86	1,705
Indonesia	0.63	0.56	1.93	-2.35	3.98	1,447
Korea	1.69	1.40	3.92	-3.93	8.19	1,082
Mexico	1.23	1.20	1.65	-1.34	3.97	2,540
Russia	0.05	0.14	1.92	-3.27	3.04	1,504
South Africa	-0.24	-0.17	1.28	-2.40	1.66	2,187
Venezuela	-0.09	-0.15	3.23	-5.14	5.76	1,630
All Stocks	0.53	0.46	0.74	-0.52	1.82	2,716

Contemporaneous Trading Days

Country	Mean	Median	Std. Dev.	5th Pctile	95th Pctile	Obs.
Argentina	0.06	0.00	0.72	-0.97	1.35	2,138
Brazil	0.11	0.03	1.27	-1.76	2.15	2,301
Chile	0.29	0.25	0.73	-0.82	1.54	1,617
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	0.19	0.16	0.81	-1.05	1.55	2,379
Russia	0.11	0.23	1.52	-2.50	2.30	1,371
South Africa	-0.09	-0.13	1.45	-2.33	2.45	2,032
Venezuela	0.00	-0.06	2.84	-4.43	4.95	1,440
All Stocks	0.12	0.12	0.73	-0.74	0.96	2,618

Table 2
AR and TAR Estimates

This table reports the per-country average half-life based on AR and TAR models and TAR thresholds. The country estimates correspond to the simple average of the AR half-lives and TAR thresholds and half-lives of all the stocks in each country's portfolio. "All Stocks" is the simple average of the half-lives and thresholds of all stocks in the sample. Half-lives are equal to ln(0.5)/ln(1-beta). "Thres" stands for the threshold estimated by the TAR model. Thresholds are expressed in percentage terms and reflect both the lower and the upper band. Half-life of the TAR model reflects the half-life of a shock when outside the band of no-arbitrage. Both AR and TAR models are corrected for heteroskedasticity and serial correlation. In the top panel, models are estimated using all observations of the premium within the sample period. In the bottom panel, models are estimated using only days on which both the underlying stock and the DR are traded, the contemporaneous trading days. Mexican stock Grupo Mex Desa is not included in the AR summary statistics because it is an outlier.

All Days

Country	AR Half-Life	TAR Thres	TAR Half-Life
Argentina	0.74	0.07	0.65
Brazil	0.94	0.16	0.71
Chile	1.55	0.44	0.76
Indonesia	1.64	0.13	1.52
Korea	1.34	0.32	1.11
Mexico	2.61	0.27	0.71
Russia	0.75	0.11	0.59
South Africa	1.67	0.32	0.97
Venezuela	2.49	0.67	1.22
All Stocks	1.54	0.25	0.78

Contemporaneous Trading Days

Country	AR Half-Life	TAR Thres	TAR Half-Life
Argentina	0.73	0.25	0.50
Brazil	0.78	0.17	0.61
Chile	1.06	0.35	0.64
Indonesia	1.64	0.17	1.42
Korea	1.22	0.22	1.65
Mexico	1.40	0.20	0.63
Russia	0.89	0.11	0.60
South Africa	1.06	0.22	0.93
Venezuela	1.26	0.68	0.91
All Stocks	1.04	0.23	0.70

Table 3
Summary Statistics - No Control and Control Periods

The table compares the summary statistics of the cross-market premium over no control and control periods for the subsample of countries that experienced a period of capital controls. 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 DR in New York. The countries' summary statistics are based on the simple average of the cross-market premium of the stocks in each country's portfolio. In the case of Korea, the summary statistics for the tranquil period are derived from the average cross-market premium of the unrestricted stocks and the ones for the different control periods are derived from the average cross-market premium of the restricted stocks. For Korea, three control periods are distinguished. The first period of high restrictions lasts until January 1999, the second period of intermediate restrictions extends from January 1999 to November 2000, and the third period of low restrictions covers November 2001 onwards (see main text and Appendix Table 3). ***, **, and * indicate whether the mean is statisically different from the mean in the tranquil period at one, five, or ten percent significance level, respectively.

Pooled data

Period	Mean		Median	Std. Dev.	5th Pctile	95th Pctile	Obs.
No Control	0.29		0.12	2.02	-2.44	3.63	9,484
Control Inflows	-10.94	***	-3.34	13.95	-38.74	1.10	3,733
Control Outflows	31.16	***	30.60	20.97	1.29	64.20	1,963

By Country

Country	Period	Mean		Median	Std. Dev.	5th Pctile	95th Pctile	Obs.
Argentina	No Control	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
Chile	No Control	0.09		0.07	0.62	-0.85	1.13	1,587
	Control Inflows	-2.07	***	-2.11	0.84	-3.31	-0.70	750
Indonesia	No Control	0.58		0.53	1.89	-2.32	3.88	1,315
	Control Inflows	0.48		0.50	1.19	-1.48	2.30	689
Korea	No Control	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
South Africa	No Control	-0.09		-0.13	1.45	-2.33	2.45	2,032
	Control Outflows	33.58	***	33.65	14.04	11.76	55.73	1,277
Venezuela	No Control	0.00		-0.06	2.84	-4.43	4.95	1,440
	Control Outflows	50.50	***	57.46	26.85	1.40	87.60	319

Table 4
AR and TAR Estimates - No Control and Control Periods

The table shows AR and TAR estimates comparing no control and control periods for the subsample of countries that experienced a period of capital controls. The AR estimates reflect the simple averages of the estimated half-lives and volatility for the stocks in each country's portfolio that are traded during the time controls were in effect. "Volatility" in the AR model reflects the impact of the control period on the conditional variance. The TAR estimates reflect the simple averages of the estimated thresholds and half-lives for the same stocks. "Thres-Up" refers to the upper threshold estimated by the TAR model and "Thres-Low" refers to the lower threshold. In the no control period, both thresholds are assumed to be the same. In the control period, the threshold that should not be affected by the controls (the floor in the case of controls on outflows and the ceiling in the case of controls on inflows) is set equal to the value estimated in the no control period. Thresholds are expressed in percentage terms. Half-life of the 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 AR and TAR models are corrected for heteroskedasticity and serial correlation.

Country	Period	AR Average Half-Life	AR Avg. Volatility Increase	TAR Average Thres-Up	TAR Average Thres-Low	TAR Average Half-Life
Argentina	No Control	1.02		0.29	-0.29	0.69
	Control Outflows	10.01	2.71	7.85	-0.29	3.65
Chile	No Control	0.84		0.23	-0.23	0.56
	Control Inflows	3.42	-0.26	0.23	-3.11	1.08
Indonesia	No Control	1.31		0.17	-0.17	1.42
	Control Inflows	1.31	-1.25	0.17	-1.19	1.04
South Africa	No Control	0.92		0.09	-0.09	0.71
	Control Outflows	44.46	1.55	53.36	-0.09	4.28
Venezuela	No Control	1.17		-	-	-
	Control Outflows	53.92	1.53	-	-	-

Table 5
Capital Controls in Argentina - 2000-2007

The top panel shows summary statistics of the cross-market premium of Argentina over the period 2000-2007. The summary statistics are based on the simple average of the premium of BBVA Banco Frances, IRSA Inversiones y Representaciones, Petrobas Energia, Telecom Argentina and Transportadora de Gas del Sur. Statistics are based only on the days on which both the underlying stock and the DR were traded. The bottom panel shows the average AR and TAR estimates for the 5 stocks in the portfolio comparing the no control period with the control on inflows and the control on outflows period. The sample period ends June 2007 (instead of June 2004 as is the case in the previous tables). "Thres-Up" refers to the upper threshold estimated by the TAR model and "Thres-Low" refers to the lower threshold. In the no control period, both thresholds are assumed to be the same. In the control period, the threshold that should not be affected by the controls (the floor in the case of controls on outflows and the ceiling in the case of controls on inflows) is set equal to the value estimated in the no control period. Thresholds are expressed in percentage terms. 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 AR and TAR models are corrected for heteroskedasticity and serial correlation.

Summary Statistics

Country	Mean	Median	Std. Dev.	5th Pctile	95th Pctile	Obs.
No Control	0.32	0.25	0.89	-1.08	1.91	957
Control Outflows	5.97	4.68	6.22	-0.85	18.43	342
Control Inflows	-0.62	-0.61	0.91	-2.12	0.93	497

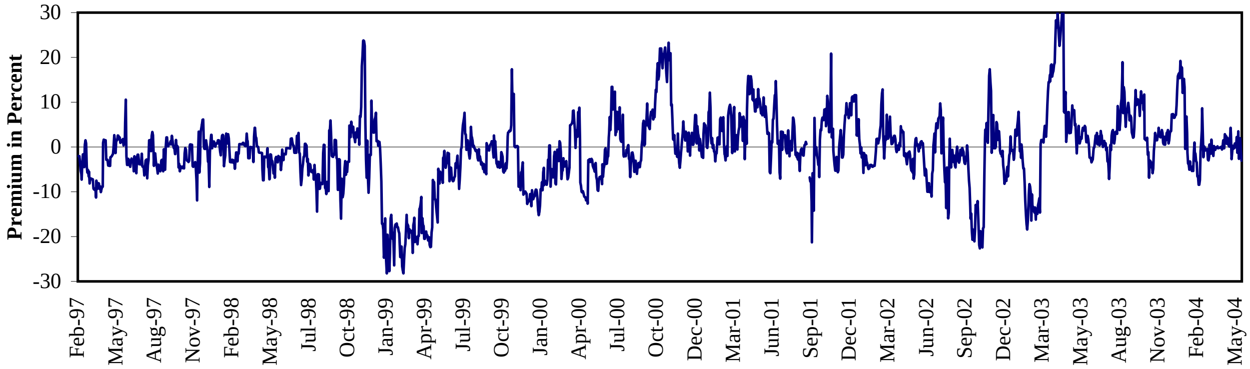
AR and TAR Results

Period	AR Average Half-Life	TAR Average Thres-Up	TAR Average Thres-Low	TAR Average Half-Life
No Control	0.87	0.33	-0.33	0.75
Control Outflows	4.09	11.42	-0.33	2.10
Control Inflows	2.04	0.33	-0.72	2.07

Figure 1
Cross-Market Premium: Two Cases

The graphs show the cross-market premium of two types of stocks. The top panel indicates the behavior of the premium of a firm with several days without contemporaneous trading. The bottom panel shows the premium of a firm with only contemporaneous trading days, i.e. each day both stock markets were open both the underlying stock and the DR traded. 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 DR in New York. A positive premium implies that the price of the underlying stock is higher than the DR price.

Ambev (Brazil)



Fomento Economico Mexicano (Mexico)

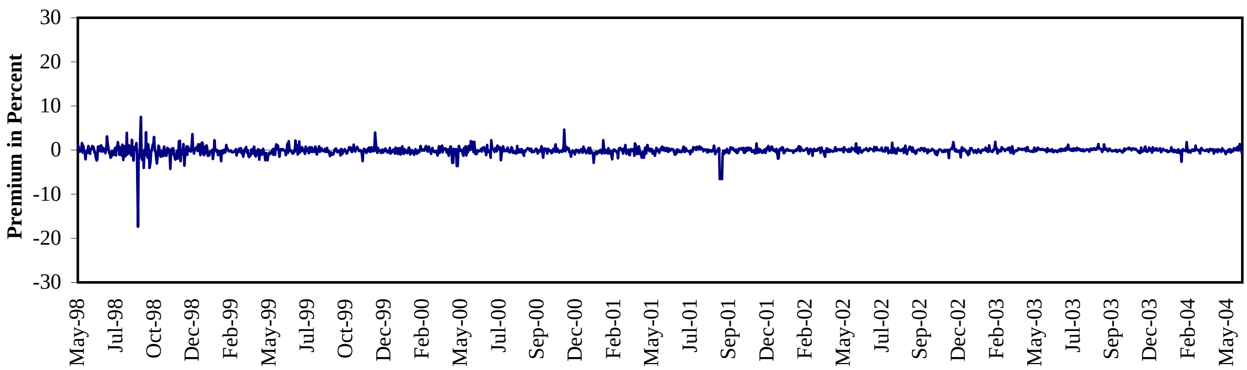


Figure 2
Non-Linearities in the Evolution of the Premium

The top panel displays the correlation between the estimated half-lives of the AR model and the estimated thresholds. The bottom panel displays the correlation between the estimated half-lives of the AR model and the reduction in half-lives when non-linearities are taken into acocunt. Half-lives are equal to ln(0.5)/ln(1-beta), with the half-life of the TAR model reflecting the half-life of a shock when outside the band of no-arbitrage. Correlation coefficients with p-values in brackets are shown in the graphs.

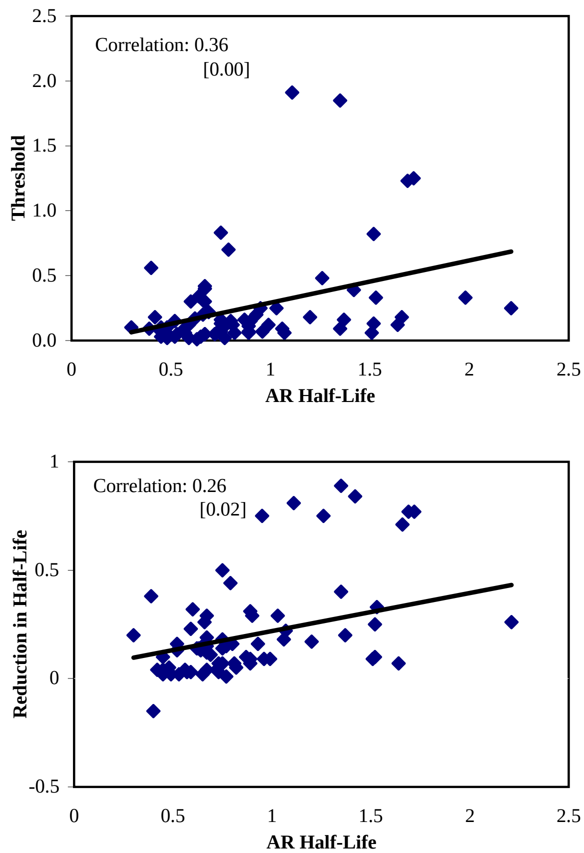
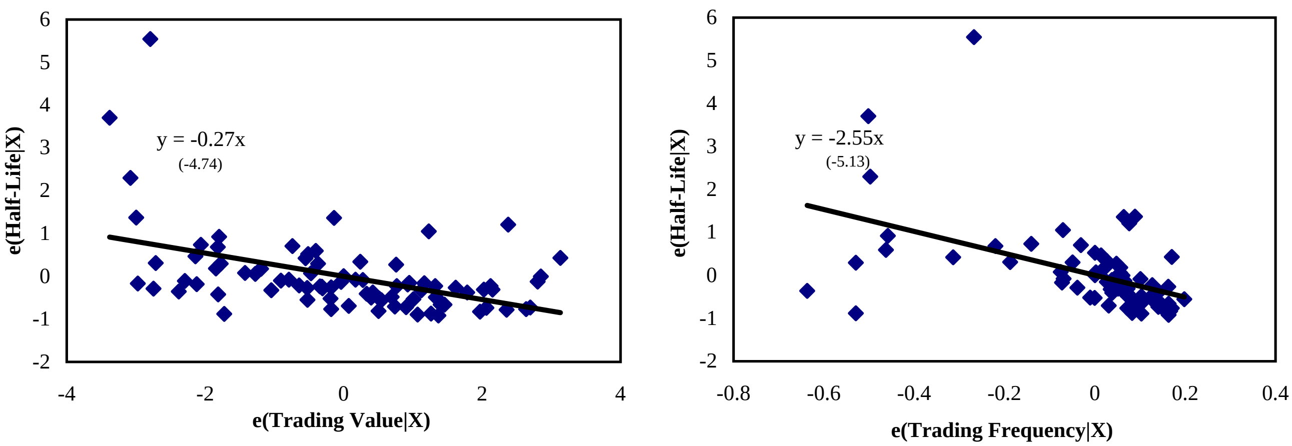


Figure 3

Liquid versus Illiquid Stocks - AR model

The scatters show the partial regression plots from regressing the estimated AR half-life on stock liquidity, country dummies and a constant. In the left-hand side scatters, liquidity is measured by the trading value which equals the log of the average of the mean value traded of the underlying stock and the DR. In the right-hand side scatters, liquidity is measured by trading frequency calculated as the ratio of the number of contemporaneous trading days to the total number of days during the sample period. In the top panel, the half-lives are estimated taken into account all days in the sample period; in the bottom panel, only days in which both the underlying stock and the DR are traded are used. Half-lives are equal to ln(0.5)/ln(1-beta). The trendlines represent the regression estimates, t-values are presented in parentheses.

All Days



Contemporaneous Trading Days

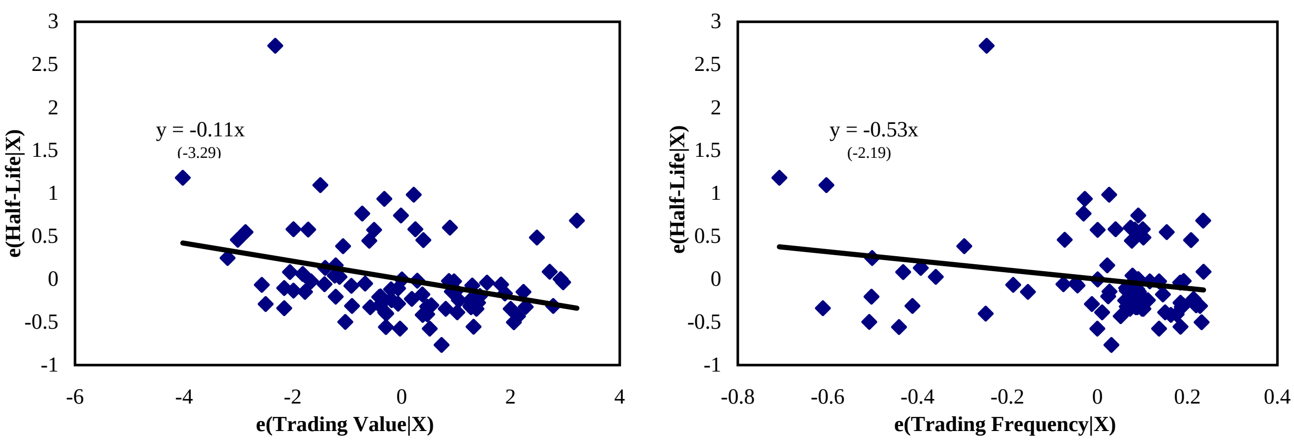
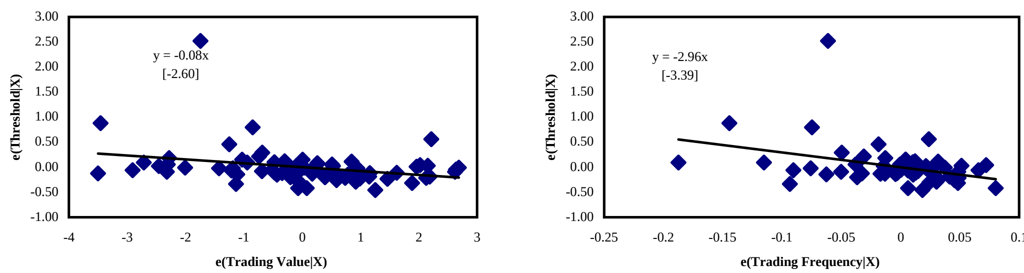


Figure 4
Liquid versus Illiquid Stocks - TAR model

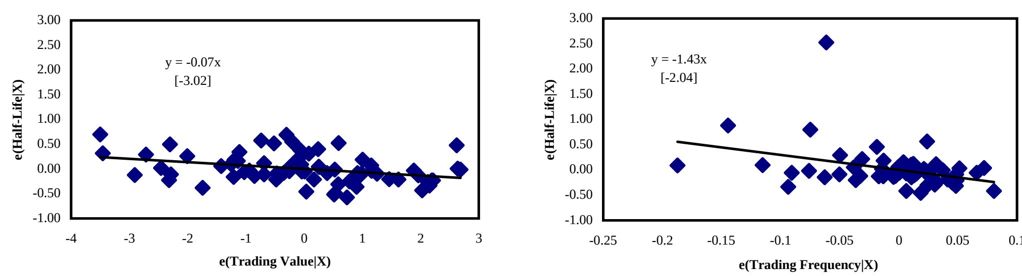
The scatters show the partial regression plots from regressing the estimated threshold and TAR half-life on stock liquidity, country dummies and a constant, respectively. In the left-hand side scatters, liquidity is measured by the trading value which equals the log of the average of the mean value traded of the underlying stock and the DR. In the right-hand side scatters, liquidity is measured by trading frequency calculated as the ratio of the number of contemporaneous trading days to the total number of days during the sample period. In the top panel, the half-lives are estimated taken into account all days in the sample period; in the bottom panel, only days in which both the underlying stock and the DR are traded are used. Half-life implies the half-life of a shock when outside the band of no-arbitrage and is equal to ln(0.5)/ln(1-beta). The trendlines represent the regression estimates, t-values are presented in parentheses.

All Days

TAR - Threshold

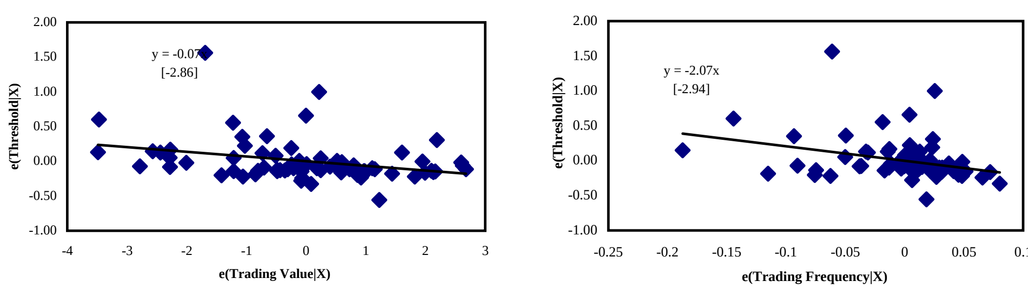


TAR - Half-Life



Contemporaneous Trading Days

TAR - Threshold



TAR - Half-Life

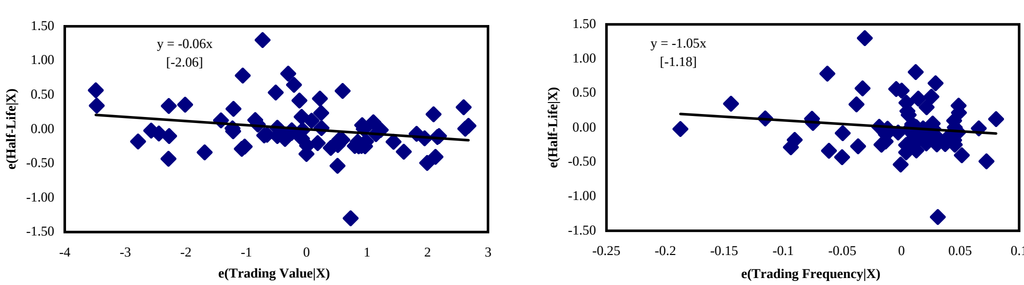


Figure 5
Cross-Market Premium per Country

The graphs show the simple average of the premium of all the stocks in the portfolio of each country. The premium is defined as the percentage difference between the dollar price of the stock in the domestic market and the price of the corresponding DR in New York. As explained in the main text for Korea we include a graph showing the average premium of restricted stocks and one for unrestricted stocks. For the restricted stocks three control periods are distinguished. The first (highly restrictive) period lasts until January 1999, the second (medium restrictive) period from January 1999 until November 2000, and the third (low restrictive) period from November 2000 onwards. The shaded areas indicate control periods.

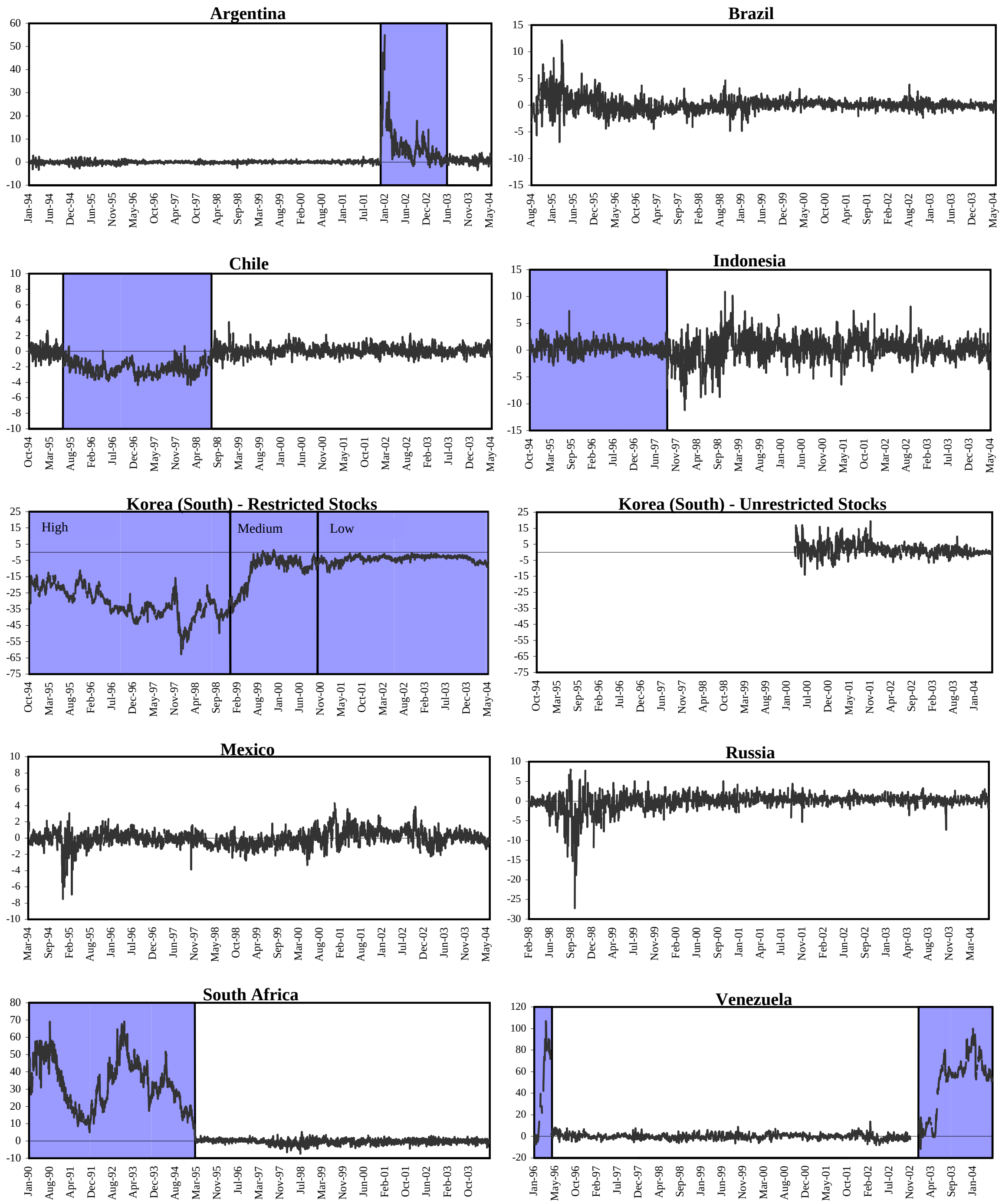
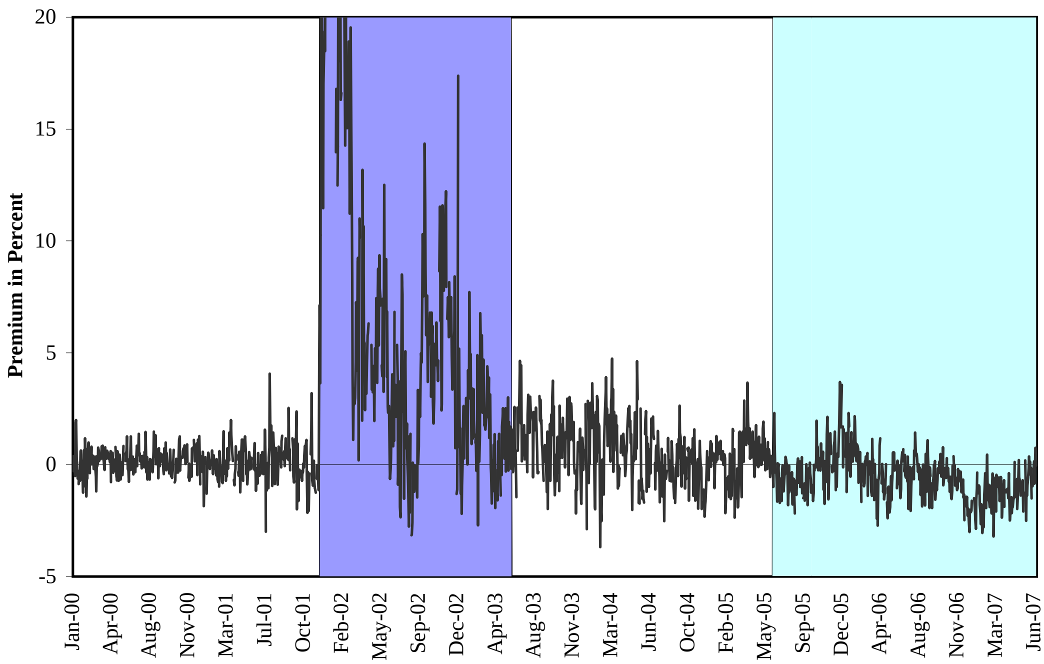


Figure 6
Capital Controls in Argentina - 2000-2007

The graph shows the behavior of the simple average of the premium of Banco Frances, IRSA Inversiones y Representaciones, Petrobas Energia, Telecom Argentina, and Transportadora de Gas del Sur over the period 2000-2007. The premium is defined as the percentage difference between the dollar price of the stock in the domestic market and the price of the corresponding ADR in New York. The dark shaded area indicates the control on outflows period and light shaded area the control on inflows period.



Appendix Table 1
Firms in Sample

Firm Name	Abbreviation	Sample Period	Firm Name	Abbreviation	Sample Period	Firm Name	Abbreviation	Sample Period
Argentina			**Chile**			**Mexico**		
BBVA Banco Frances	bfr	1/12/1994-5/31/2004	Banco Bilbao	bb	6/20/1996-5/31/2004	Emp Ica	ica	11/01/2003-5/31/2004
IRSA Inversiones y Representaciones	irs	1/20/1994-5/31/2004	Banco de Chile	bch	3/19/2002-5/31/2004	Fomento Economico Mexicano	fmx	5/11/1998-5/31/2004
MetroGAS	mgs	1/25/1995-12/31/1998	Banco Santander Chile	san	5/22/1997-5/31/2004	Gruma	gmk	11/6/1998-5/31/2004
Petrobas Energia	pze	1/26/2000-5/31/2004	Cristal Chile	cgw	6/15/1994-5/31/2004	Grupo Aeroport	asr	9/28/2000-5/31/2004
Telecom Argentina	teo	12/9/1994-5/31/2004	Compania Cervecerias Unidas	cu	10/17/1994-5/31/2004	Grupo Casa Saba	sab	4/6/1994-12/31/1997
Telefonica de Argentina	tar	3/8/1994-12/31/2000	Distribucion y Servicio D&S	dys	10/8/1997-5/31/2004	Grupo Elektra	ekt	12/5/1994-5/31/2004
Transportadora de Gas del Sur	tgs	1/4/1995-5/31/2004	Embotelladora Andina	akoa	4/7/1997-5/31/2004	Grupo Imsa	imy	12/11/1996-12/31/1999
YPF	ypf	1/12/1994-12/31/2000	Embotelladora Andina-preferred	akob	4/7/1997-5/31/2004	Grupo Industrial Maseca (Gimsa)	msk	5/17/1994-12/31/1999
			Enersis	eni	10/17/1994-5/31/2004	Grupo Mex Desa	gmd	4/6/1994-5/23/2000
Brazil			Endesa - Chile	eoc	10/17/1994-5/31/2004	Grupo Radio	rc	4/6/1994-5/31/2004
Acucar	cbd	5/29/1997-5/31/2004	Gener	gnr	10/17/1994-12/31/2000	Grupo Simec	mcm	10/11/1996-12/31/2001
Ambev	abvc	2/18/1997-5/31/2004	Lan Airlines	lfl	1/1/1999-12/31/2001	Grupo Televisa	tv	3/23/1994-5/31/2004
Aracruz Celulose	ara	8/2/1994-5/31/2004	Masisa	mys	10/17/1994-5/31/2004	Grupo Tmm	tmm	1/3/1994-5/31/2004
Banco Itau Holding Financeira	itu	2/19/2002-5/31/2004	Provida	pvd	11/17/1994-5/31/2004	Indus Bachoc	iba	09/19/1997-5/31/2004
Brasil Telecom	btm	11/16/2001-5/31/2004	Quimica y Minera	sqma	4/9/1999-5/31/2004	Intl Ceramic	icm	12/9/1994-1/1/2000
Braskem	bak	1/1/2000-5/31/2004	Quinenco	lq	6/25/1997-5/31/2004	Savia	saj	4/6/1994-12/31/2000
CEMIG	cig	9/18/2001-5/31/2004	Sociedad Quimica y Minera	sqm	10/17/1994-5/31/2004	Vitro	vto	1/3/1994-5/31/2004
Companhia Siderurgica Nacional	sid	1/1/1999-5/31/2004	Supermercados Uni	unr	5/9/1997-4/1/2003			
Companhia Vale do Rio Doce	rio	3/21/2002-5/31/2004	Telefonica CTC Chile	ctc	10/17/1994-5/31/2004	**Russia**		
Copel	elp	7/30/1997-5/31/2004	Vina Concha y Toro	vco	10/17/1994-5/31/2004	Rostelecom	ros	2/17/1998-5/31/2004
Embraer	erj	7/20/2000-5/31/2004				Tatneft	tnt	3/30/1998-12/31/2002
Embratel	emt	11/16/1998-5/31/2004	**Indonesia**					
Gerdau	ggb	3/10/1999-5/31/2004	Indosat	iit	10/19/1994-5/31/2004	**South Africa**		
Net Servicios	net	11/06/1996-5/31/2004	Telekomunikasi Indonesia	tlk	11/14/1995-5/31/2004	Anglogold Ashanti	au	1/1/1990-5/31/2004
Perdigao	pda	10/20/2000-5/31/2004				Drdgold	dro	1/1/1998-5/31/2004
Petroleo Brasileiro	pbr	8/10/2000-5/31/2004	**Korea**			Gold Fields	gfi	8/1/1990-5/31/2004
Petroleo Brasileiro - preferred	pbra	2/22/2001-5/31/2004	Hanaro Telecom	han	3/29/2000-12/31/2003	Harmony Gold Mining	hmy	1/1/1997-5/31/2004
Sabesp	sbs	5/10/2002-5/31/2004	Kepco	kep	10/27/1994-5/31/2004	Highveld Steel	hsv	1/3/1994-5/31/2004
Sadia	sda	4/10/2001-5/31/2004	Kookmin Bank	kb	11/9/2001-5/31/2004	Randgold and Exploration Company	ran	3/12/1997-12/31/2000
Tele Centro Oeste Celular	tro	11/16/1998-5/31/2004	KT Corporation	ktc	5/25/1999-5/31/2004	Sappi	spp	1/1/2000-5/31/2004
Tele Leste Celular	tbe	11/16/1998-5/31/2004	Posco	pkx	10/14/1994-5/31/2004	Sasol	ssl	1/1/1996-5/31/2004
Tele Nordeste Celular	tnd	11/16/1998-5/31/2004	SK Telecom	skm	6/27/1996-5/31/2004			
Tele Norte Celular	tcn	11/16/1998-5/31/2004				**Venezuela**		
Tele Norte Leste (Telemar)	tne	11/16/1998-5/31/2004	**Mexico**			Cantv	vnt	1/3/1997-5/31/2004
Telemig Celular	tmb	11/16/1998-5/31/2004	America Movil - series A	amo	2/7/2002-5/31/2004	Corimon	cmn	7/28/1997-5/31/2004
Telesp	tsp	6/1/2001-5/31/2004	America Movil - series L	amx	2/7/2002-5/31/2004	Mavesa	mav	31/6/1996-3/28/2001
TIM	tsu	11/16/1998-5/31/2004	Cemex	cx	5/8/2002-5/31/2004			
Ultrapar	ugp	10/13/1999-5/31/2004	Coca-cola Femsa	kof	4/6/1994-12/31/1998			
Unibanco - Uniao de Bancos	ubb	1/1/2000-5/31/2004	Controladora Comercial Mexicana	sim	12/8/1994-12/31/1997			
Votorantim Celulose e Pape	vcp	4/13/2000-5/31/2004	Desc	des	7/14/1994-5/31/2004			

Appendix Table 2
AR and TAR Estimations - All Stocks

The table shows AR and TAR estimates for all stocks in each country's portfolio for the tranquil period. AR models are based on all observations of the premium within the sample period (fourth column) and exclusively use observations of the premium when both the underlying stock and the DR are traded (fifth column). Similarly TAR models are estimated using all observations of the premium within the sample period (column six and seven) and using only observations of the premium when both stocks are traded (column eight and nine). "Thres" refers to the threshold estimated by the TAR model. Thresholds are expressed in percentage terms, and reflect both the lower as well as the upper band. 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 AR model (in general the observations of the TAR 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. In some cases it was impossible to correct for heteroskedasticity and/or serial correlation, so no half-lives could be estimated. ***, **, * refer to significance at the one, five, and ten percent level, respectively.

Country	Stock	Obs.	AR Half-Life All Days	AR Half-Life Trading Days	TAR Thres All Days	TAR Half-Life All Days	TAR Thres Trading Days	TAR Half-Life Trading Days
Argentina	ypf	1,785	0.43***	0.39***	0.11	0.22***	0.09	0.01***
	pze	720	1.08***	1.72***	0.03	1.05***	1.25	0.95***
	teo	2,054	0.58***	0.59***	0.05	0.54***	0.02	0.56***
	tar	1,728	0.42***	0.30***	0.10	0.32***	0.10	0.1***
	tgs	2,033	0.91***	0.89***	0.05	0.84***	0.11	0.8***
	bfr	2,275	0.61***	0.63***	0.01	0.60***	0.01	0.49***
	mgs	1,002	1.04***	0.67***	0.16	0.94***	0.40	0.48***
	irs	2,043	0.81***	0.67***	0.05	0.71***	0.05	0.63***
Brazil	pbr	976	0.80***	0.77***	0.11	0.72***	0.11	0.62***
	pbra	790	0.92***	0.73***	0.15	0.70***	0.06	0.66***
	rio	523	2.13***	1.26***	0.72	0.48***	0.48	0.51***
	itu	579	0.43***	0.42***	0.18	0.22***	0.18	0.38***
	tsp	763	1.10***	1.35***	0.15	0.97***	0.15	0.97***
	erj	983	0.54***	0.60***	0.05	0.50***	0.30	0.28***
	tne	1,385	0.69***	0.62***	0.17	0.58***	0.17	0.48***
	sid	1,346	0.60***	0.52***	0.03	0.58***	0.03	0.36***
	ara	2,464	1.20***	1.37***	0.02	1.23***	0.16	1.17***
	ggb	1,348	0.52***	0.45***	0.03	0.50***	0.07	0.41***
	vcp	1,049	0.67***	0.65***	0.26	0.50***	0.03	0.63***
	cig	640	2.28***	1.51***	0.28	1.40***	0.06	1.42***
	ubb	1,140	0.69***	0.57***	0.04	0.67***	0.06	0.54***
	cbd	1,785	0.84***	0.75***	0.31	0.66***	0.83	0.25***
	bak	1,138	0.64***	0.48***	0.10	0.59***	0.10	0.43***
	tro	1,383	0.66***	0.49***	0.04	0.63***	0.04	0.47***
	emt	1,378	0.76***	0.45***	0.04	0.90***	0.03	0.43***
	elp	1,704	1.07***	1.20***	0.18	0.91***	0.18	1.03***
	tmb	1,393	0.64***	0.53***	0.05	0.62***	0.05	0.51***
	ugp	1,171	1.39***	1.35***	0.21	1.21***	0.09	0.95***
	tsu	1,386	0.65***	0.56***	0.08	0.60***	0.08	0.52***
	tnd	1,393	0.59***	0.69***	0.09	0.55***	0.22	0.58***
	tbe	1,393	0.74***	0.64***	0.34	0.60***	0.34	0.51***
	tcn	1,395	0.81***	0.67***	0.18	0.73***	0.30	0.55***
	abvc	116		1.95***				
	pda	923	1.22***	0.57***				
	sbs	489	1.42***	0.73***				
	sda	811	0.82***	0.44***				
	btm	655	0.56***	0.43***				
	net	1,891	1.97***	0.70***				
Chile	san	1,485	1.06***	0.89***	0.02	1.15***	0.07	0.82***
	eni	1,670	1.29***	1.03***	0.25	0.83***	0.25	0.74***
	eoc	1,668	0.89***	0.80***	0.21	0.67***	0.15	0.64***
	ctc	1,692	0.77***	0.75***	0.12	0.73***	0.13	0.57***
	akoa	1,470	1.63***	0.87***	0.53	0.73***	0.16	0.77***
	dys	1,511	0.75***	0.66***	0.43	0.30***	0.31	0.40***
	cu	1,695	1.00***	0.77***	0.02	1.07***	0.02	0.76***
	lfl	772	1.61***	1.11***	2.96	0.38***	1.91	0.30***
	sqm	1,661	1.17***	0.66***	0.13	0.85***	0.20	0.50***
	lq	1,506	1.34***	1.52***	0.29	1.10***	0.13	1.42***
	mys	1,681	0.90***	0.79***	0.10	0.92***	0.70	0.35***
	gnr	813	0.64***	0.52***	0.18	0.40***	0.15	0.39***
	akob	1,521	1.04***	0.69***				
	bb	275		1.10***				
	pvd	1676	1.85***	2.01***				
	bch	565	2.15***	0.52***				
	sqma	1337	0.67***	0.57***				
	cgw	1771	2.13***	1.11***				
	unr	1184	7.10***	3.79***				
	vco	1691	1.47***	1.02***				
Indonesia	tlk	1,432	1.12***	1.06***	0.18	1.00***	0.09	0.88***
	iit	1,441	2.16***	2.21***	0.07	2.03***	0.25	1.95***
Korea	kb	638	0.63***	0.45***	0.10	0.54***	0.10	0.35***
	han	727	2.04***	1.98***	0.53	1.69***	0.33	2.95***
Mexico	amo	588	2.72***	1.53***	0.15	1.41***	0.33	1.20***
	amx	567	1.78***	1.66***	0.18	1.19***	0.18	0.95***

Appendix Table 2 (cont'd)
AR and TAR Estimations - All Stocks

Country	Stock	Obs.	AR Half-Life All Days	AR Half-Life Trading Days	TAR Thres All Days	TAR Half-Life All Days	TAR Thres Trading Days	TAR Half-Life Trading Days
Mexico	cx	531	0.58***	1.07***	0.06	0.45***	0.06	0.85***
	tv	2,511	0.62***	0.67***	0.08	0.48***	0.05	0.52***
	fmx	1,561	0.52***	0.48***	0.04	0.51***	0.02	0.45***
	kof	1,112	0.63***	0.59***	0.07	0.63***	0.12	0.36***
	ekt	2,331	0.66***	0.75***	0.12	0.56***	0.07	0.61***
	imy	783	0.80***	0.67***	0.42	0.65***	0.42	0.38***
	msk	1,327	0.99***	1.42***	0.25	0.76***	0.39	0.58***
	mcm	674	0.58***	0.40***	0.56	0.83***	0.56	0.55***
	sim	1,348	0.93***	0.95***	0.18	0.49***	0.25	0.20***
	sab	852	1.11***	0.73***	1.07	0.57***	0.06	0.70***
	saj	1,635	1.12***	0.96***	0.35	0.75***	0.07	0.87***
	asr	947	1.77***	0.58***				
	gmk	1,442	2.27***	1.11***				
	tmm	669		1.36***				
	iba	1,736	2.03***	0.83***				
	des	2,451	15.40***	11.01***				
	ica	2,430	1.16***	0.95***				
	vto	1,698		1.44***				
	gmd	1,461	-693.49***	2.07***				
	icm	1,200	3.65***	1.06***				
	rc	2,502	12.98***	0.67***				
Russia	tnt	1,102	0.69***	0.89***	0.06	0.54***	0.06	0.58***
	ros	1,447	0.80***	0.90***	0.15	0.63***	0.15	0.61***
South Africa	ssl	1,930	1.13***	0.93***	0.22	0.96***	0.20	0.77***
	au	2,172	1.01***	0.72***	0.03	0.89***	0.05	0.68***
	gfi	2,178	1.18***	0.81***	0.43	0.76***	0.12	0.74***
	hmy	1,770	0.79***	0.75***	0.17	0.72***	0.16	0.68***
	spp	1,119	0.78***	0.82***	0.06	0.66***	0.06	0.77***
	dro	1,508	1.59***	1.64***	0.12	1.52***	0.12	1.57***
	ran	858	1.50***	1.52***	1.20	1.29***	0.82	1.27***
	hsv	2,173	5.37***	1.31***				
Venezuela	vnt	1,448	1.39***	0.99***	0.21	1.12***	0.12	0.90***
	mav	1,347	3.21***	1.69***	1.12	1.31***	1.23	0.92***
	cmv	1,300	2.86***	1.11***				

Appendix Table 3
Summary of Capital Control Measures

Argentina

On December 2, 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. However, in 2005, the Argentine government instated controls on inflows of foreign capital, in the form of two restrictions. First, the amount entering the country must remain within Argentina for 365 days. Second, 30 percent of the total amount must be deposited in a local bank in the form of usable funds for the bank's minimum reserve requirement. These restrictions were enforced when local businesses obtained loans not falling within the exceptions of the decree (such as financing of foreign trade and direct investment), or when foreign investors bought public or private stocks or bonds in the secondary market.

Chile

Chile introduced controls on inflows in the form of an unremunerated reserve requirements (URR) already in 1991, but these controls only affected the DR market from July 1995 onwards. 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).

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. 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. Cross-listed stocks using DRs faced an additional restriction: until January 1999, the conversion of underlying shares into 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 could be converted into DRs" was less than "the number of underlying shares that had been converted from DRs."

South Africa

A dual exchange rate system was in place from 1961 to 1995 (though temporarily abandoned from 1983 to 1985), effectively working as a control on capital outflows. The dual exchange rate existed informally during the "blocked rand" system (1961-1976) and the "securities rand" system (1976-1979), evolving into a formal dual exchange system called the "financial rand" system (1979-1983 and 1985-1995). The blocked rand system introduced restrictions on the repatriation of funds invested in South Africa by non-residents, while residents were already prohibited to transfer funds abroad. The proceeds of sales of South African assets by non-residents could not be transferred abroad and instead had to be deposited in "blocked rand" accounts at commercial banks within South Africa. Therefore, non-residents could obtain rands in two ways, the direct channel (the official commercial exchange rate) or through the indirect channel buying "blocked rands." Since the blocked rand exchange rate traded at a discount to the commercial exchange rate, the indirect mechanism was mostly used. The securities rand system did not modify greatly the restrictions imposed on residents, but introduced some changes to boost non-residents' investment in South Africa. The "financial rand" system put in place a formal dual exchange rate system with a "commercial rand" subject to intervention by the monetary authorities and a free-floating "financial rand" (which traded at a discount to the commercial rand). The financial rand was applied to all current account transactions and the commercial rand to capital account transactions for non-residents. In March 1995, the financial rand system was abolished and all exchange rate controls were lifted. Only then were non-residents able to invest and repatriate funds, and transfer capital and current gains without restrictions.

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).

Venezuela

The country experienced two episodes of controls on capital outflows. The first one started in June 1994, when 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 restrictions were introduced as a temporary measure, but were still in place at the end of our sample period, accompanied by a new set of stringent capital controls introduced in January 2003.

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, newspaper Clarin (Argentina), and information from country experts working at the IMF and the World Bank.