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Crises, Capital Controls, and Financial Integration

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Abstract

This paper analyzes the effects of capital controls and crises on financial integration, using stocks from emerging economies that trade in both domestic and international markets. The cross-market premium (the ratio between the domestic and the international market price of cross-listed stocks) provides a valuable measure of how capital controls and crises affect international financial integration. The paper shows that, contrary to the common perception that capital controls can be easily evaded, they do affect the cross-market premium in a sustainable way. Controls on capital inflows put downward pressure on domestic markets relative to international ones, generating a negative premium. The opposite happens with controls on capital outflows. This signals the inability of market participants to engage in perfect arbitrage, due to the segmentation of domestic markets from international ones. Crises affect financial integration by generating more volatility in the premium and putting more downward pressure on domestic prices.

JEL Classification: F30; F36; G15

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I. INTRODUCTION

Since the early 1990s, emerging economies have been rapidly integrating with the international financial system. Financial integration has manifested in many ways, including financial liberalization of previously closed economies, larger cross-border capital flows, entry of foreign banks, and participation of domestic firms in international markets. In particular, as firms go abroad, part of the domestic market activity has migrated to international markets. Capital is raised in international markets and securities are traded in international stock exchanges, in addition to domestic ones.¹ This process of financial integration has been fueled by the belief that it encourages better allocation of resources and risks worldwide, and ultimately promotes higher growth.²

Two factors have emerged to threaten this financial integration. Firstly, a series of crises erupted when countries opened up to capital flows, which led to some reservations regarding the net benefits of outright financial liberalization.³ Secondly, capital controls have emerged as a way to mitigate financial integration.⁴ In times of crises, controls on capital outflows have been used to stem reserve losses, currency devaluations, and the collapse of the banking sector. Two such well-known cases are those of Malaysia during the East Asian crisis of 1997–1998 and Argentina during its 2001–2002 collapse.⁵ In tranquil times, controls have been used to avoid the currency and maturity mismatches that short-run foreign flows can produce, and to mitigate the currency appreciation that tends to negatively affect trade balance and domestic production. In fact, Chilean-style controls on capital inflows have regained interest in recent years, with appearances in Argentina, Colombia, Peru, and Thailand.⁶

This paper analyzes the effects of capital controls and crises on the integration of emerging economies with the international financial system.⁷ Specifically, using a large set of firms from emerging economies, we examined the percentage price difference between the stocks that traded domestically and the corresponding depositary receipts (DRs) that traded internationally. We call this price difference the *cross-market premium*. DRs are certificates traded in major financial centers (New York in this case). They are issued by a US depositary bank and they represent shares of ordinary stocks held by a custodian bank in the issuer's home country. The stocks and the DRs represent the same asset traded in two different markets, because underlying stocks can be easily transformed into DRs and vice versa. This characteristic allowed us to measure international financial integration through

¹ See Levine and Schmukler (2006 and 2007) and Gozzi, Levine, and Schmukler (2008a and 2008b), and the references therein.

² See Obstfeld (1994), Acemoglu and Zilibotti (1997), Fischer (1998), Rogoff (1999), and Summers (2000) for arguments in favor of financial integration.

³ See Henry (2006) and Kose et al. (2006) for comprehensive surveys on the literature of financial integration. See Bhagwati (1998), Rodrik (1998), Soros (2002), and Stiglitz (2002) for arguments against financial integration.

⁴ See Eichengreen et al. (1998), Cooper (1999), and Stiglitz (2000) for arguments against free capital flows. See Kawai and Takagi (2008) for a survey on the literature on managing capital inflows. Also, see Grenville (2008) for a discussion on the macroeconomic consequences of capital inflows and Schadler (2008) for an analysis of over 90 recent episodes of large capital inflows.

⁵ See Edison and Reinhart (2001) for a detailed study of the case of Malaysia, and de la Torre, Levy Yeyati, and Schmukler (2003) and Perry and Servén (2003) for analyses of the case of Argentina.

⁶ In 1991, Chile introduced unremunerated reserve requirements (URR) on capital inflows, the *encaje*, and was followed by Colombia in 1993, Thailand in 1995, and Argentina in 2005. In the midst of a fast appreciation of the Peruvian sol, Peru raised reserve requirements on bank deposits by offshore accounts to 120% in May 2008. Thailand has recently lifted controls in March of 2008. Le Fort and Lehmann (2003) and Cowan and De Gregorio (2005) study the Chilean case. In-depth analyses of the more recent episodes of controls on inflows are still missing.

⁷ We study the effects of crises originated both domestically and abroad.

the law of one price (LOOP), which stipulates that countries are integrated when the DRs in New York and the underlying stock are equally priced.

When there are no barriers to cross-country capital movement, arbitrage is expected to equalize the prices of the DR and the underlying shares. It follows that, in a fully integrated market, the cross-market premium should be approximately zero. However, full integration of capital markets can be disrupted by capital controls and crises.

Effective government controls on cross-country capital movement are expected to segment the markets, widening the cross-market premium. Controls on capital outflows put upward pressure on the underlying stock relative to the depositary receipt, since investors can purchase the security domestically and sell it at a discount in the international market, without having to pay tax to transfer funds outside the country. This positive cross-market premium could not be arbitrated away, because it would imply purchasing the DR in New York, selling it in the domestic market, and transferring the proceeds abroad. However, controls on capital outflows prevent the latter transaction. On the other hand, when the price in New York is higher than the domestic price (implying a negative cross-market premium), arbitrage can take place because investors can purchase the underlying stock domestically, sell it in New York, and transfer the funds back to the country. Note that capital controls limit the cross-border movement of funds, not stocks; therefore, arbitrageurs can transfer the stock from one market to another, with the goal of selling wherever the price is higher, but transferring proceeds from such transactions is governed by capital controls.

Controls on capital inflows have the opposite effect: they push up the relative price of depositary receipts (implying a negative cross-market premium), as investors buy them abroad and sell them domestically, avoiding the tax to enter the country. In this case, the negative cross-market premium could not be arbitrated away, because investors would have to purchase the underlying stock domestically, sell it in New York, and transfer the funds back into the country, but controls on capital inflows prevent the latter transaction. In sum, the cross-market premium reflects the effectiveness of capital controls and the price that investors are willing to pay to hold securities that can be freely transferred across borders when other restrictions are in place.

The impact of financial crises is more ambiguous. In principle, there are no obstacles to arbitrage; therefore, the cross-market premium would fluctuate around zero. However, the risks associated with swapping the underlying stock for the DR (and vice versa) increase due to transfer and convertibility risks, higher exchange rate volatility, and most importantly, reduced liquidity, which in turn induce market players to reduce their open positions at any point in time to a minimum.⁸ Consequently, one would expect crises to be associated with a more volatile cross-market premium that oscillates around zero, and that can turn positive or negative depending on the risks involved.

Recently, DRs have been used to assess the impact of capital controls and crises. Rabinovitch, Silva, and Susmel (2003) attribute the persistence of return differentials between ADRs and stocks in Chile to the presence of capital 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, Schmukler, and Van Horen (2004) interpret as a reflection of the strict controls on capital outflows and foreign exchange transactions imposed at the time. Pasquariello (2008) presented evidence of large return differentials during crises. In Levy Yeyati, Schmukler, and Van Horen (2008a), we investigated the statistical properties of the cross-market premium using linear and non-linear models to measure the no-arbitrage bands, the convergence speed to those bands, and the mean-reverting properties of the premium. We further studied the effect of capital

⁸ Levy Yeyati, Schmukler, and Van Horen (2008b) document the liquidity decline during periods of financial distress.

controls and liquidity on the cross-market premium, and analyzed the advantages of this measure of financial integration over alternative ones.

In this paper, we characterize the behavior of the cross-market premium around crises and changes in different types of capital controls by computing summary statistics and by using an event-study methodology. To do so, we worked with daily cross-market premium for a set of 98 stocks from nine emerging economies: Argentina, Brazil, Chile, Indonesia, Republic of Korea (hereafter Korea), Mexico, Russia, South Africa, and Venezuela. For all countries, except Argentina, we sampled the period 1990–2004. In the case of Argentina, we extended the sample period to 2007 in order to analyze the impacts of the controls on inflows introduced in 2005.

We found that capital controls were able to segment domestic markets from international ones. When binding (that is, when flows move against the controls), controls on outflows resulted in a positive premium, while controls on inflows resulted in a negative premium, as market participants were willing to engage in costly arbitrage only to a limited degree. Crises, on the other hand, while they did not tax arbitrage directly, affected financial integration by increasing volatility and by putting downward pressure on the domestic price, such that the underlying stock on average traded at a discount compared to the DR.

The remainder of the paper is organized as follows: section II discusses the methodology and data, section III analyzes the effects of capital controls on the cross-market premium, section IV illustrates the impact of crises on the premium, and section V gives a summary and conclusion.

II. METHODOLOGY AND DATA

Depository receipts (DRs, also known as American Depositary Receipts or ADRs) are shares of non-US corporations traded in the US, while the underlying shares are traded in the issuer's domestic market. DRs are issued by so-called depository banks in the US and represent a specific number of underlying shares remaining on deposit in so-called custodian banks in the issuer's home country.⁹ The depository bank can create a new DR by depositing the required number of shares in the custodian bank, after which, the dividends and other payments will be converted by the depository bank into US dollars and thus be made available to the holders in the US. 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, defined as the percentage difference between the dollar price of the stock in the domestic market and its corresponding DR, reflects the deviation between the home market price of the stock and its price in New York. The cross-market premium can be computed by converting the local currency price of the underlying stock to dollars, multiplying it by the number of underlying shares one DR represents, and then dividing it by the DR price.

When there are no barriers to cross-country capital movement between the domestic market and the US, there are no transaction costs. Furthermore, if the two markets close at the same time, arbitrage should be instantaneous and costless and prices should be equal. 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 underlying stock, and selling it. This will lower the price of the underlying stock and bring the premium back to zero. The reverse

⁹ Depository banks provide all the stock transfer and agency services in connection with a depository receipt program, and must designate a custodian bank to accept deposits of ordinary shares. A custodian holds the ordinary shares underlying the ADRs in the issuer's home market. When new ADRs are issued, the custodian accepts additional ordinary shares for safekeeping and when ADRs are canceled, the custodian releases the ordinary shares in accordance with instructions received from the depository. Depository banks are located in the US whereas the custodian bank is located in the home country of the underlying stock issuer.

holds when the price of the DR is higher. If a shock occurs too late in the day to be arbitrated away, closing prices will differ, but this difference will disappear quickly the next trading day.¹⁰ In reality however, instantaneous and costless arbitrage does not exist. Many factors can affect arbitrage, including capital controls and crises, as mentioned above.

In order to examine how the cross-market premium reacts to capital controls and crises, we conducted event studies. These studies allowed us to determine whether the cross-market premium behaved statistically differently after an event. We did this in two ways: first, we constructed a portfolio of stocks and studied its evolution, then at the stock level, we computed the estimated post-event deviations from the pre-event mean and variance values. We then reported the mean and variance differences and the number of stocks for which these differences were statistically significant.

We analyzed the following events: the imposition and lifting of capital controls, significant relaxations in the intensity of capital controls, and crises. In the case of capital controls, the event date (time zero) is marked as the date capital controls change (i.e., they are introduced, lifted, or relaxed). Six-month windows before and after the event were used to calculate the pre-event and post-event means. In the case of crises, we defined the event as the beginning of a crisis, and studied the behavior of the cross-market premium during the crisis period relative to the pre-crisis mean. The lengths of the post-crisis windows are equal and are determined by the duration of the crisis.

In terms of data, we worked with countries that experienced changes in capital controls or financial crises during the sample period, so that we were able to analyze the effects of both. We also worked with stocks with a long history of DR listings with important trading volume. Thus, we used publicly traded stocks in the US, either on the National Association of Securities Dealers Automated Quotation System (NASDAQ) or the New York Stock Exchange (NYSE). In total, we worked with 98 stocks (out of 133 DRs that trade in the NYSE and NASDAQ) from nine emerging economies: Argentina (8 stocks), Brazil (30 stocks), Chile (20 stocks), Indonesia (2 stocks), Korea (6 stocks), Mexico (23 stocks), Russia (2 stocks), South Africa (8 stocks), and Venezuela (3 stocks). The cross-market premium was calculated only on days when both the underlying stock and the DR were traded.¹¹

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 DR) came from Bloomberg. For Argentina, Brazil, Chile, and Venezuela we used the closing price both in the domestic market and in New York. For Asian markets, which are already closed when the New York stock market opens, as well as for Russia and South Africa, we instead used the closing price (and the exchange rate) in the domestic market and the opening price in New York, to minimize distortions due to time differences.

Before studying the effects of capital controls and crises on the integration of emerging economies in the next sections, it is useful to observe the behavior of the cross-market premium during tranquil (non-crisis) times when capital controls are absent. Table 1 presents summary statistics of the simple average of the cross-market premium of the stocks in each country's portfolio. A positive premium indicates that the price of the underlying stock exceeds that of the DR, while a negative premium indicates otherwise. The table shows that during tranquil times, the premium is generally close to zero. In all cases, except in Korea, the average premium is below 1%. The summary statistics of all stocks show a mean of 0.12%, with a standard deviation of 0.73. In other words, during tranquil times and under no controls, emerging economies seem well integrated with the international capital market.

¹⁰ The same should apply to temporary non-zero premia due to differences in trading hours between the domestic and the US stock market.

¹¹ For a detailed description of which companies are included in the respective portfolios and the period for which the cross-market premium is calculated, see Levy Yeyati, Schmukler, and Van Horen (2008a). In that paper, we also discuss the effects of using observations for which trading occurs in only one market.

Table 1: Cross-Market Premium Summary Statistics

Country	Mean	Median	Std. Dev.	5th Pctile	95th Pctile	Number of Observations
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

Note: The summary statistics are based on all available data excluding crisis periods and periods with capital controls. For Korea, the summary statistics are based on the average cross-market premium of the two stocks that were unaffected by the controls on inflows, Kookmin Bank and Hanaro Telecom.

Source: The data source is Bloomberg.

III. CAPITAL CONTROLS ON THE CROSS-MARKET PREMIUM

In this section, we analyze the effects of capital controls on the cross-market premium. Capital controls are diverse, differing across countries in intensity and over time. Furthermore, there are different types of controls; the most notorious difference is between controls on inflows (typically used to discourage short-term flows) and on outflows (to prevent capital flight in the midst of a crisis). Though the effects will depend on the type and intensity of controls, if the introduction of capital control impedes arbitrage and thus effectively segments markets, this should be reflected in the cross-market premium, as the law of one price ceases to hold.

When controls on inflows are in effect, purchasing the underlying stock to sell the DR would require paying an inflow cost to re-enter the funds into the country. As a result, relatively low domestic prices will not be arbitrated away and the underlying stock will be bought at a discount compared to the DR, as investors need to be compensated for the costs they incur by moving capital into the country. Thus, controls on inflows would introduce a negative cross-market premium. Under 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. This makes it difficult for investors to profit from relatively high domestic prices, introducing a positive cross-market premium. Given that arbitrage takes place mostly within a day (as documented in Levy Yeyati, Schmukler, and Van Horen 2008a), we expect that controls would have an effect right after they are imposed (or lifted), not before, even when anticipated.

A. Brief Chronology of Capital Controls

Periods of capital controls are relatively easy to detect, as governments impose them through laws and a number of public institutions document them. Below we provide a brief summary of the capital controls in the countries under study, during the periods analyzed in this paper. Six countries in our sample experienced a period in which capital restrictions

potentially affected the behavior of stock markets: Argentina, Chile, Indonesia, Korea, South Africa, and Venezuela.¹²

Argentina. When the financial and currency crises of 2001 became unsustainable, Argentina introduced controls on capital outflows on 2 December 2001, as well as restrictions on cash withdrawals from commercial banks (the so called “corralito”). Both foreign and domestic investors 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 with some restrictions on capital outflows. Virtually all controls were eliminated in June 2003. However, authorities re-imposed controls on inflows of foreign capital in 2005. These controls consisted of two restrictions: the amount entering the country must remain within Argentina for 365 days and 30% 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. These controls were still in effect at the end of the sample period for Argentina.

Chile. In 1991, Chile had already introduced controls on inflows in the form of an Unremunerated Reserve Requirement (URR), but these controls only affected the DR market from July 1995 onwards. This was due to a 30% non-earning reserve deposit that had 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 10% in June 1998. In August, a few months later, the URR was eliminated for secondary DRs, and in September of the same year, reserve requirements on all inflows were eliminated.¹³

Indonesia. The Indonesian capital market was largely liberalized when the first publicly traded DR was introduced by an Indonesian company. However, foreigners were only allowed to purchase up to 49% of all companies’ listed shares. In September 1997, this restriction was lifted and foreign investors were allowed to purchase unlimited domestic shares, with the exception of banking shares.

Korea. When the first publicly traded DR was introduced in the Korea, there were restrictions on foreign investments in the stock markets. In particular, there was a ceiling on the share of foreign investor ownership, which was gradually increased over time. In May 1998, the government lifted the foreign investment restrictions on Korean securities, with the exception of 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, requiring the approval of the issuing company’s board. In November 2000, Korea changed its regulations so that underlying shares could be converted to DRs without board approval as long as “the number of underlying shares that can be converted into DRs” is less than “the number of underlying shares that have been converted from DRs.”¹⁴ For four of the stocks in our country portfolio, SK Telecom, Kepco, Posco, and KT Corp, this rule has often prevented arbitrage: in effect, these stocks still faced controls on capital inflows at the end of the sample period (2004). Two other stocks in our portfolio, Kookmin Bank and Hanaro Telecom, were unaffected by the rules during the period covered by our sample, so controls were not effectively in place. These two stocks were not used in the event studies that are

¹² The sources for these measures are: Bloomberg, Clarin (newspaper, Argentina), IFC Emerging Markets Factbook, IMF Annual Report on Exchange Arrangements and Exchange Restrictions, Korea’s Financial Supervisory Service’s Regulation on Supervision of Securities Business, and Kaminsky and Schmukler (2008).

¹³ In fact, the URR was set to zero, but the mechanism was left in place until it was finally eliminated in 2002.

¹⁴ See Articles 7–9 of the Financial Supervisory Service’s Regulation on Supervision of Securities Business.

presented in the next section. In order to examine the impact of the gradual relaxation of the controls, we divided the control period of Korea into three distinct sub-periods. The first period, which lasted until January 1999, was termed “very restrictive.” The second period, which lasted from January 1999–November 2000, when free conversion started to be allowed but conditioned by the rule, was termed “restrictive.” The third period, which started in November 2000 and lasted until the end of the sample period was termed “less restrictive.”

South Africa. A dual exchange rate system that effectively controlled capital outflows was already in place from 1961–1995, although it was temporarily abandoned from 1983–1985. The dual exchange rate informally existed during the “blocked rand” system (1961–1976) and the “securities rand” system (1976–1979), until it evolved 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 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 were able to obtain rands in two ways: the direct channel (the official commercial exchange rate) or by buying “blocked rands” through the indirect channel.¹⁵ 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 greatly modify the restrictions imposed on residents, but introduced some changes to boost non-residents’ investment in South Africa.¹⁶

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.¹⁷

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.

Venezuela. The country experienced two periods of controls on capital outflows. The first one started in June 1994, when the foreign exchange market 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 non-resident investment, excluding flows related to the repayment of external debt. Furthermore, the measures restricted the availability of foreign exchange for import payments. In May 1996, these controls were abolished, and by January 2003, exchange rate trading was suspended and limits to dollar purchases were introduced. Originally, the measure was introduced as a temporary measure, but remained in place at the end of our sample period (2004) and was accompanied by a new set of stringent capital controls introduced in January 2003.

¹⁵ The latter means purchasing South African assets listed in London with foreign currency and selling them in the Johannesburg stock market to obtain blocked rands in order to buy other South African securities.

¹⁶ The “securities rand” was then traded in Johannesburg directly, making it unnecessary to obtain stocks through the London stock exchange.

¹⁷ The financial rand applied to the local sale or redemption proceeds of South African securities and other investments in South Africa owned by non-residents, capital remittances by emigrants and immigrants, and approved outward capital transfers by residents.

B. Effects of Capital Controls

To examine the impact of capital controls on financial market integration we performed event studies on a stock level basis.¹⁸ Table 2 presents the summarized results of the event study tests for capital control events, showing the number of cases in which the post-event mean is significantly different from the pre-event mean. The event studies examined whether the post-event mean was significantly different from the pre-event mean. The event date is marked as the date that capital controls change. Pre- and post-event periods are equal in length and add up to a 260-day window. Event studies were done at the stock level but are presented at the country level, averaging across stocks. The upper row displays event study results with respect to controls on outflows, while the bottom row shows the events with respect to controls on inflows. Mean and variance significance tests were done at a 10% significance level.

Table 2: Event Studies–Capital Controls

Controls on Outflows								
Event	Country	Number of Stocks Tested	Post and Pre Event Mean Difference	Number of Stocks w/ Positive Mean Difference	Number of Stocks w/ Negative Mean Difference	Post and Pre Event Variance Difference	Number of Stocks w/ Positive Variance Difference	Number of Stocks w/ Negative Variance Difference
Introduction	Argentina	6	10.13	6	0	56.97	6	0
	Venezuela	1	25.85	1	0	683.92	1	0
Lifting	Argentina South	8	-0.81	0	6	-6.53	0	6
	Africa	3	-15.86	0	3	-21.21	0	3
Controls on Inflows								
Event	Country	Number of Stocks Tested	Post and Pre Event Mean Difference	Number of Stocks w/ Positive Mean Difference	Number of Stocks w/ Negative Mean Difference	Post and Pre Event Variance Difference	Number of Stocks w/ Positive Variance Difference	Number of Stocks w/ Negative Variance Difference
Introduction	Argentina	7	-0.63	0	7	-0.72	0	2
	Chile	10	-1.59	0	10	-0.47	1	3
Lifting	Chile	17	2.53	17	0	4.48	9	1
	Indonesia	2	-1.74	0	2	9.28	2	0
Relaxation High to Medium to Low	Korea	3	11.77	3	0	66.77	2	0
		4	0.92	2	1	-14.06	0	3

Notes:

1. Pre- and post-event periods are equal in length and add up to a 260-day window.
2. Event studies are done at the stock level but are presented at the country level, averaging across stocks.
3. The upper panel displays event study results with respect to controls on outflows, while the bottom panel shows the events with respect to controls on inflows.

Source: The data source is Bloomberg.

¹⁸ In some cases, the underlying stock or the DR trades very infrequently in either the pre- or post-event period, limiting the number of observations. When less than 15 observations are available to calculate the mean, the stock is not used in the event study.

In addition, we show the behavior of the average cross-market premium changes in controls on outflows (Figure 1) and changes in controls on inflows (Figure 2).¹⁹ Figures 1 and 2 display, on a per country basis, the behavior of the cross-market premium before and after the introduction and lifting of capital controls on outflows. The solid line on each graph represents the average cross-market premium across stocks and the dashed line represents the pre- and post-event mean of the average cross-market premium. The horizontal axis represents the number of days prior to or elapsed from the event. For both Figures 1 and 2, we used a 130-day window.

Figures 1 and 2, and Table 2 suggest a common pattern. Before capital controls on outflows were introduced, the cross-market premium was close to zero with a very low volatility, however it rose significantly after controls were imposed. For example, in Argentina the average cross-market premium went from -0.02% to 11.54%. In the case of Venezuela, it went from -1.29% to 24.56%. When controls were lifted, the reverse happened; for example, when Argentina removed the controls on capital outflows, the mean of the average premium decreased from 2.33% to 0.76%. In the case of South Africa, the mean of the average premium decreased by 15.79%, from 17.71% to 1.92%. This result is highly consistent across stocks (as noted in Table 2). The introduction of capital controls significantly increased the cross-market premium for all stocks tested. The lifting of controls resulted in a drop of the premium in all but two stocks (in the case of Argentina).

Note that the premium during the period of capital controls was not only relatively volatile, but also displayed persistence. This persistence reflects capital flowing into and out of the country, since during the periods shown, the intensity of the controls did not change. That is, given a certain restriction to shift funds abroad, the cross-market premium seemed to reflect the pressure exerted by investors by shifting (or trying to shift) funds abroad in any way possible, which was especially evident in the case of Argentina. The mean of the premium six months after controls were imposed was 11.54%. However, the mean had already dropped to only 2.33% in the six months prior to the lifting of the same controls.²⁰ When Argentina imposed controls it was in the midst of its crisis, so these controls became very binding, which explained the very large and sudden shift in the cross-market premium (reaching highs of 32.82 on 7 December 2001 and 34.3 on 20 December 2001). When the controls were abolished, the desire to shift funds out of the country was substantially less, explaining the much lower premium at this time.²¹

As expected, the introduction of controls on inflows had exactly the opposite effect compared to the introduction of controls on outflows: the cross-market premium turned negative. In Argentina, the average cross-market premium dropped to -0.31 from 0.21. While in Chile, the drop was even more pronounced as it fell to -1.63 from 0.03.

When controls on inflows were lifted in Chile, the average cross-market premium again immediately started to oscillate around zero. In the case of Indonesia however, the average cross-market premium fell instead of rising when controls on inflows were lifted. This suggests that the limits on foreign participation may not have been binding at the time, and allowed domestic investors to perform arbitrage. A ceiling on foreign investment did not affect arbitrage by foreign investors as long as foreign participation was well below the limit.

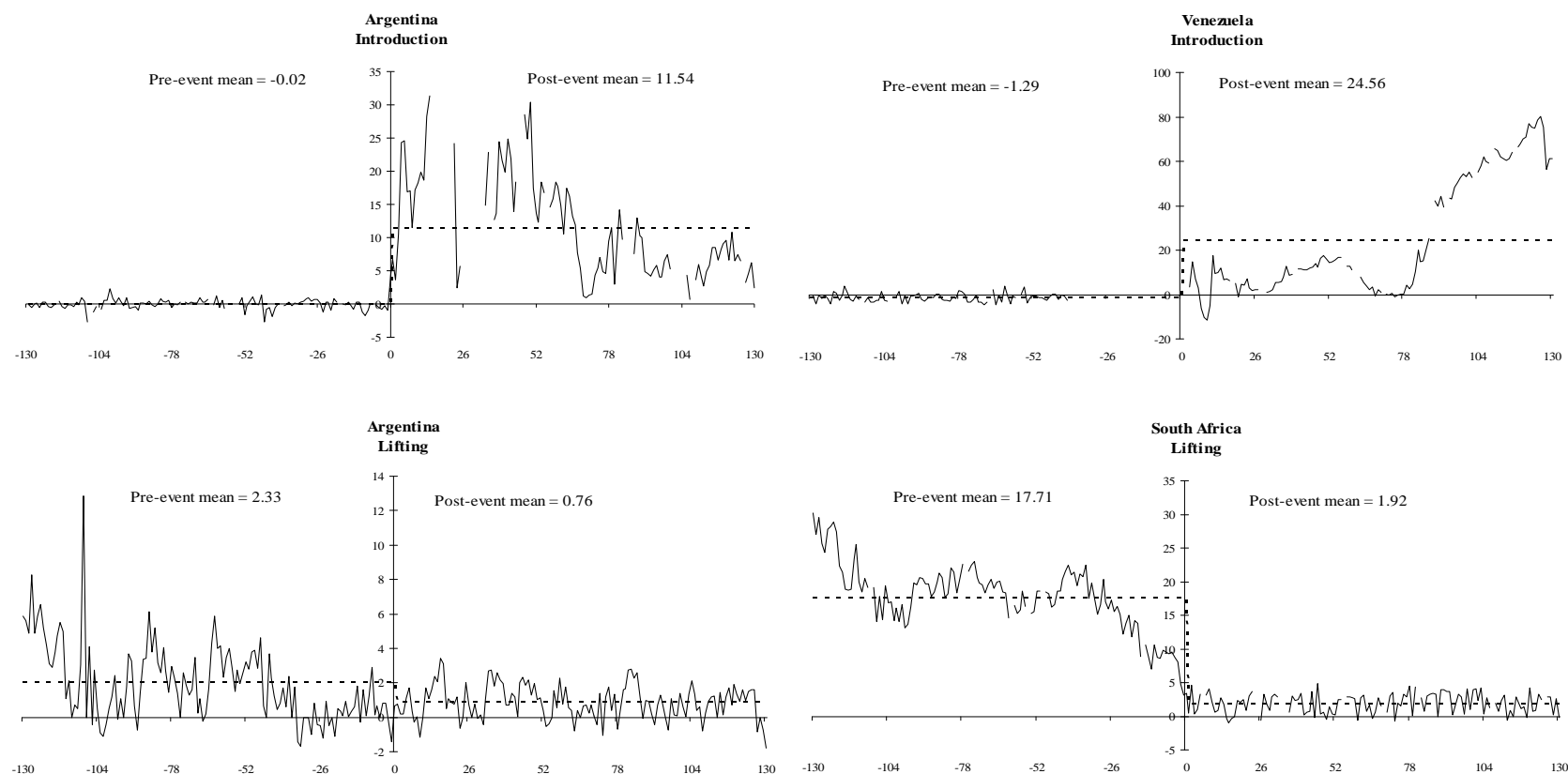
¹⁹ Note that Tables 2 and 4 show the average change of the mean across stocks (the cross-market premium mean difference is first calculated per stock and then averaged across stocks per country and event). Meanwhile, the figures display the change of the mean of the average cross-market premium (the cross-market premium is first averaged across stocks per country and then the pre- and post-event mean difference is calculated). As a result, the mean change for each event differs slightly between the table and the figures.

²⁰ The average cross-market premium equals 11.54 between December 2001 and May 2002 (the six-month period after the introduction of capital controls), compared to 2.33 between December 2002 and June 2003.

²¹ Consider that although controls are in place, investors might find ways to shift funds in and out of the country. For example, in the case of controls on capital outflows, investors can purchase stocks or bonds domestically and sell them abroad. The cross-market premium reflects the implicit price investors pay for these transactions, among other things. See Levy Yeyati, Schmukler, and Van Horen (2008a).

Moreover, in the case of Indonesia, the restrictions on capital movement did not seem to be binding.²² In contrast, in Korea, a similar ceiling combined with a rule restricting the convertibility of the DRs impeded arbitrage, regardless of whether the ceiling was binding. However, when controls on inflows were changed to a less stringent level, the cross-market premium in Korea reacted and the discount became smaller. The evidence that the discount was much lower in Argentina and Chile than in Korea directly reflected the different nature of the restrictions: quantitative limits that prevented arbitrage in Korea, and an implicit tax that weakened arbitrage in Argentina and Chile.

²² See Levy Yeyati, Schmukler, and Van Horen (2008a).

Figure 1: Event Studies—Capital Controls on Outflows**Notes**

1. The event date is marked as time zero, is defined as the day controls are introduced in the two upper panels and the day controls are lifted in the two bottom panels.
2. The solid line on each graph represents the average cross-market premium across stocks.
3. The dashed line represents the pre- and post-event mean of the average cross-market premium.
4. The horizontal axis represents the number of days prior to or elapsed from the event.
5. A 130-day window was used.

Source: The data source is Bloomberg and other reports (see main text).

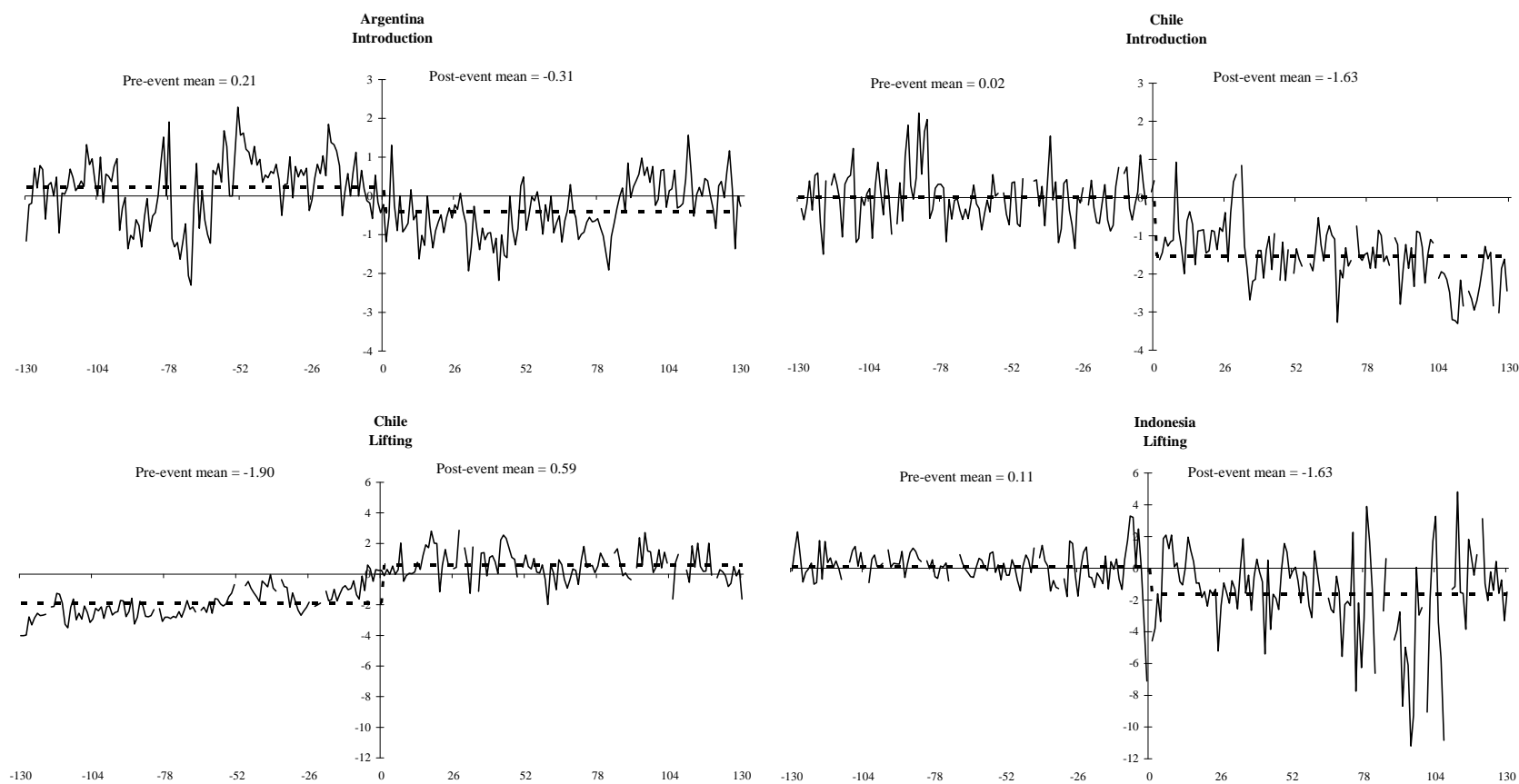
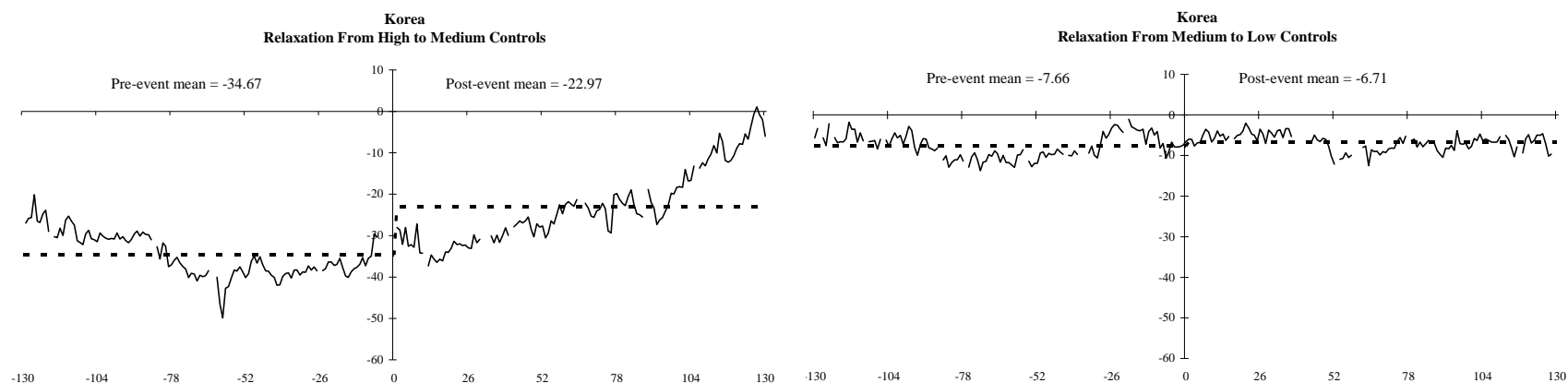
Figure 2: Event Studies–Capital Controls on Inflows

Figure 2: Event Studies—Capital Controls on Inflows (cont'd.)**Notes:**

1. The event date is marked as time zero, is defined as the day controls are introduced in the two upper panels and the day controls are lifted in the two bottom panels.
2. The solid line on each graph represents the average cross-market premium across stocks.
3. The dashed line represents the pre- and post-event mean of the average cross-market premium.
4. The horizontal axis represents the number of days prior to or elapsed from the event.
5. A 130-day window was used.

Source: The data source is Bloomberg and other reports (see main text).

Note that “tax” on inflows effectively decreased the price investors were willing to pay for the underlying stock, as investors add the entry tax to the price of the domestic stock when comparing it to the price of the “un-taxed” DR.

As with controls on outflows, the results were highly consistent across stocks. The introduction of controls on inflows in Argentina and Chile generated discounts for all stocks. On the other hand, the lifting of controls in Chile raised the cross-market premium for all stocks, and the cross-market premium of Indonesian stocks significantly dropped when the controls were lifted. In Korea, the discount for all but two stocks significantly decreased when the intensity of the controls was reduced.

In summary, our results provide evidence that capital controls do affect the size and persistence of deviation of the cross-market premium from zero and cause the law of one price to break down. In other words, regulations on capital movement can prevent investors from engaging in arbitrage-related activities, effectively segmenting the domestic market from the international capital market.

IV. CRISES AND THE CROSS-MARKET PREMIUM

The impacts of financial crises are more ambiguous. They can temporarily influence the level of financial integration, as the risk associated with swapping the underlying stock for the DR and vice versa increases due to higher volatility of exchange rates and risks of transfer and convertibility. On the other hand, an increase in the variability of the premium could simply reflect the greater price volatility that characterizes episodes of financial turmoil, even if the degree of arbitrage remains unaltered. However, before studying the effects of crises on the cross-market premium, it is necessary to define crises periods, which are less trivial than supposed.

A. Crisis Periods

Times of crises are difficult to pin down. Perhaps what makes this task particularly challenging is the lack of an uncontroversial operational definition of crises. Aside from the problem of not having a uniform criterion to define crises, as there are various methodologies and ad hoc criteria used to identify crises, the literature concentrates on determining the beginning of crises, but not their end. For our purpose, it was essential to accurately determine the duration of crises in order to correctly specify the periods we wished to analyze.

To define crises, we followed the approach adopted by Broner, Lorenzoni, and Schmukler (2004), which determined *ex ante* certain criteria to identify the beginning and end of crises according to the behavior of certain market indicators. Their methodology allowed us to distinguish country-specific crisis periods (which could be of domestic or foreign origin), without having had to resort to the use of *ex post* data. We used two different procedures to identify crisis periods: one based on the exchange market pressure (EMP) index and the other based on the local stock market index.²³ As crisis dating is arbitrary, we performed a robustness exercise.

The EMP index is computed as the weighted average of the daily changes in the interest rate and the log difference of the exchange rate, with weights equal to the reciprocal of the standard deviation of the respective variables.²⁴ A crisis initiates when the EMP volatility (its 15-day rolling standard deviation) 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

²³ To define crisis periods, Broner, Lorenzoni, and Schmukler (2004) use the 9-year bond spread, which is not readily available for all countries in our sample.

²⁴ Ideally, one would also like to include the change in reserves; unfortunately, these data are not available on a daily frequency for the countries in our sample.

one standard deviation. A crisis ends the first date after which the EMP volatility drops below the threshold and remains there for three months.

When using stock market prices, crises begin when the stock market index starts a decline of at least five consecutive weeks that reaches a cumulative drop in excess of 25%. A crisis ends on the first date after which the index grows for at least four consecutive weeks.

The exchange and interest rate series came from Bloomberg and Datastream and the local stock market index series came from the Emerging Market Database (EMDB). The interest rates used varied according to data availability, in all cases however, all available market-determined interest rates behaved similarly over the sample period.²⁵ Table 3 reports the crisis periods identified by both procedures. The EMP crisis period was identified using an EMP index, the weighted average of the daily changes in the interest rate and exchange rate. The crises considered did not coincide with periods in which capital control modifications took place (e.g., Argentina's stock market crisis in 2001–2002 coincided with the introduction of capital controls, so this case was excluded from the analysis; the same applies to the 1997 crisis in Korea).

Table 3: Crisis Periods

	EMP Crises		Stock Market Crises	
	Start date	End date	Start date	End date
Argentina				
Crisis 1			24 Jul. 1998	09 Oct. 1998
Brazil				
Crisis 1	13 Jan. 1999	24 Feb. 1999	07 Aug. 1998	05 Mar. 1999
Crisis 2			17 Aug. 2001	21 Feb. 2003
Indonesia				
Crisis 1	15 Aug. 1997	12 Nov. 1998	08 Aug. 1997	09 Oct. 1998
Crisis 2			16 Jul. 1999	03 Dec. 1999
Mexico				
Crisis 1	20 Dec. 1994	02 Jun. 1995	09 Dec. 1994	15 Mar. 1996
Crisis 2			24 Jul. 1998	16 Oct. 1998
Russia				
Crisis 1	25 May. 1998	11 Nov. 1998	01 May. 1998	16 Apr. 1999
Thailand				
Crisis 1	17 Jun. 1997	08 Jul. 1998	03 Oct. 1997	16 Jan. 1998
Crisis 2			24 Apr. 1998	09 Oct. 1998

Notes:

1. This table uses two different procedures, one based on the exchange market pressure (EMP) index and the other based on the local stock market index.
2. The crises considered do not coincide with periods in which capital control modifications take place.
3. The following rates were used: seven-day interbank rate (Argentina), the bank deposit certificate rate (Brazil), the 30-day CD rate (Chile, Venezuela), the interbank call money rate (Indonesia, Korea, Russia), the 90-day bank deposit rate (Mexico), and the three-month discount rate (South Africa).

Source: The exchange and interest rate series came from Bloomberg and Datastream and the local stock market index series came from the Emerging Market Database (EMDB).

²⁵ The following rates were used: seven-day interbank rate (Argentina), the bank deposit certificate rate (Brazil), the 30-day CD rate (Chile, Venezuela), the interbank call money rate (Indonesia, Korea, Russia), the 90-day bank deposit rate (Mexico), and the three-month discount rate (South Africa).

B. Effects of Crises

As in the case of capital controls, we examined the impact of crises on financial integration by performing event studies. Table 4 presents the results of the event study tests for crisis events; it also shows the number of cases in which the post-event mean is significantly different from the pre-event mean. The event studies examined whether the post-event mean was significantly different from the pre-event mean. The pre- and post-event periods are equal to each other, with the length varying on a per country basis. The upper panel displays the event study results when the crisis dates were based on the EMP criteria. The lower panel shows the event study results based on the stock market criteria. Mean and variance significance tests were done at a 10% significance level. The upper panel of the table provides the results using the EMP crisis definition; the lower panel shows the results using the SM crisis definition (discussed below).

Table 4: Event Studies–Crises

EMP Crises							
Country	Number of Stocks Tested	Post and Pre Event Mean Difference	Number of Stocks w/ Positive Mean Difference	Number of Stocks w/ Negative Mean Difference	Post and Pre Event Variance Difference	Number of Stocks w/ Positive Variance Difference	Number of Stocks w/ Negative Variance Difference
Brazil	11	-1.35	1	4	1.82	2	0
Indonesia	2	-1.75	0	2	12.42	2	0
Mexico	8	-1.39	0	4	8.10	8	0
Russia	2	-2.29	0	2	37.15	2	0

Stock Market Crises							
Country	Number of Stocks Tested	Post and Pre Event Mean Difference	Number of Stocks w/ Positive Mean Difference	Number of Stocks w/ Negative Mean Difference	Post and Pre Event Variance Difference	Number of Stocks w/ Positive Variance Difference	Number of Stocks w/ Negative Variance Difference
Argentina	7	-0.03	0	0	1.13	4	0
Brazil - 1	3	0.06	1	0	6.55	3	0
Brazil - 2	17	-0.05	3	5	3.69	6	4
Indonesia - 1	2	-1.94	0	2	11.82	2	0
Indonesia - 2	2	-1.09	0	1	-1.01	0	0
Mexico-1	9	-0.58	0	5	3.59	8	0
Mexico-2	12	0.20	3	0	7.03	8	0
Russia	2	-1.98	0	2	26.59	2	0

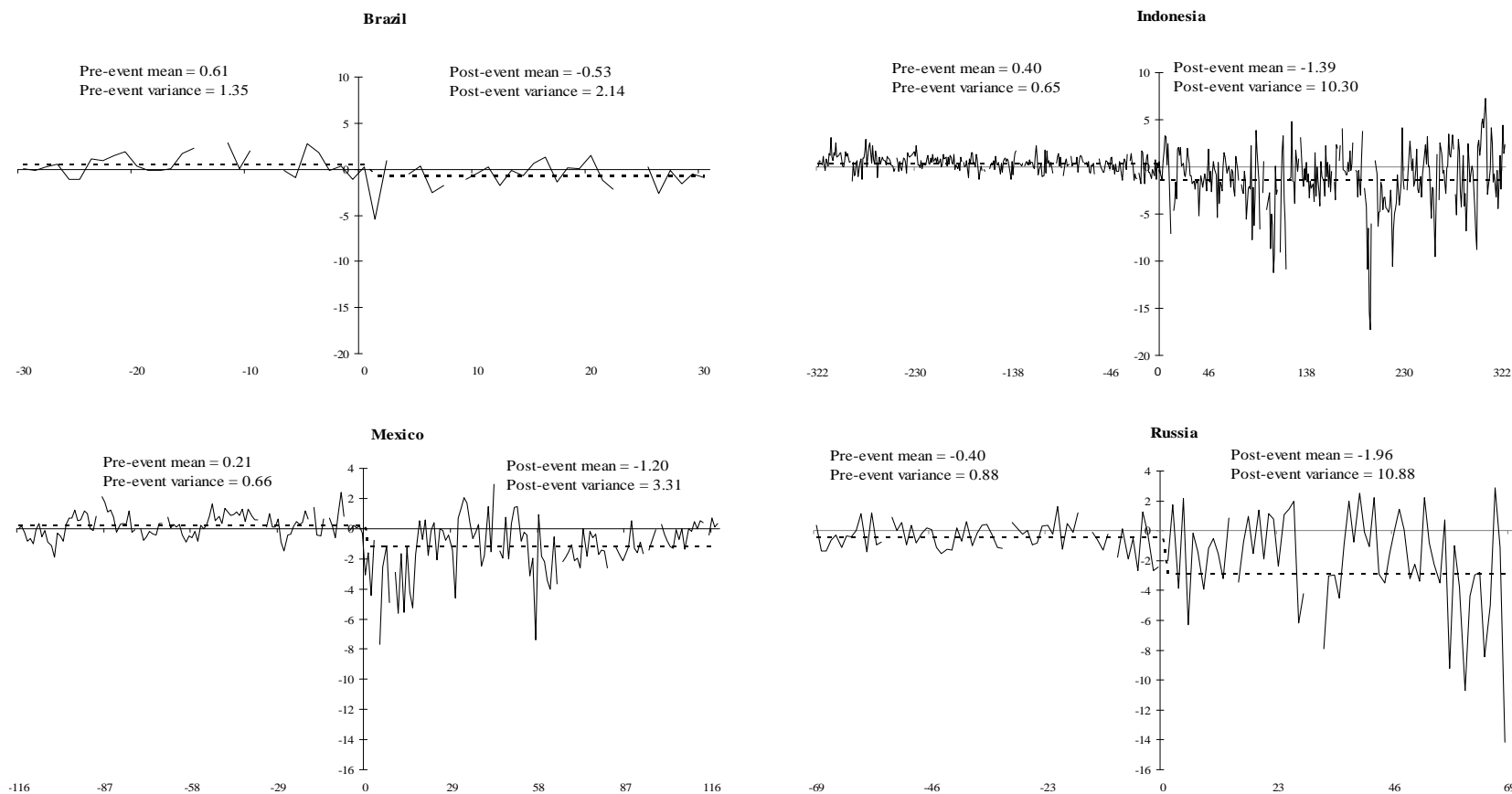
Notes:

1. The event date is marked as the date the crisis starts.
2. The post-event period used to calculate the mean is equal to the crisis period and the pre-event period is of equal length. The length of the window varies for each country.
3. Mean and variance significance tests were done at a 10% significance level.

Source: The data source is Bloomberg.

In addition, Figure 3 shows the behavior of the average cross-market premium for Brazil, Indonesia, Mexico, and Russia, countries that experienced a crisis (as determined by our EMP definition) during our sample period. Since there was a large change in the variance, Figures 3 and 4 also report the pre- and post-event variance. They also display, on a per country basis, the behavior of the cross-market premium before and during crisis periods. The event date, marked as time zero, is the day the crisis started based on the EMP criteria.

Figure 3: Event Studies–EMP Crises



Notes:

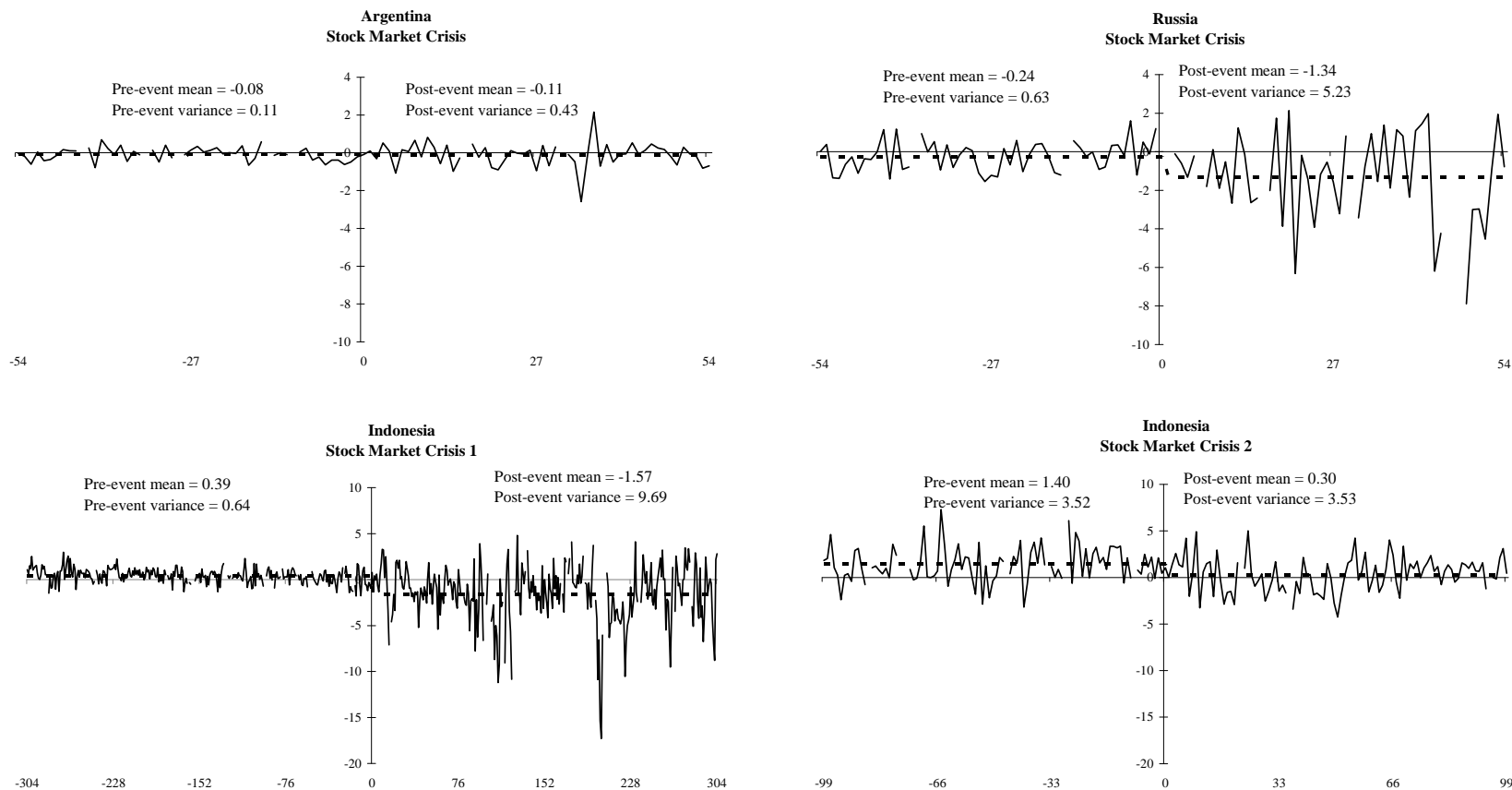
1. The solid lines on each graph represent the average cross-market premium across stocks.
2. The dashed lines represent the pre- and post-event mean of the average cross-market premium.
3. The horizontal axis represents the number of days prior to or following the event.
4. Although the length of the window varies, the pre-event and post-event periods are equal for each country.

Source: The data sources are Bloomberg and other reports (see main text).

The charts indicate that in all four cases the mean of the cross-market premium becomes negative during the crisis. In Indonesia for example, the pre-event mean equals 0.40, while the post-event mean equals -1.39. Similarly, in Mexico the mean of the average cross-market premium dropped to -1.20 during the crisis, compared to 0.21 in the pre-crisis period. The results in the upper panel of Table 4 show that most stocks indeed experienced a significant drop in the cross-market premium during the crisis period. The country with the weakest result is Brazil, where only 4 out of 11 stocks showed a significant drop in the mean. This result can be explained by the fact that it was hard to detect a clear crisis period in Brazil, as there was a prolonged period of turbulence, but there was only a limited period of severe exchange in market pressure. There was a decrease in the average mean, and compared with tranquil times, the volatility of the premium significantly increased during crises. In Russia for example, the variance increased from 1.67 before the crisis to 38.82 after the crisis. Also in Indonesia, the premium became much more volatile, with the variance increasing from 1.20 to 13.62 (Table 4). Volatility also increased in Mexico and Brazil, albeit at a more modest level

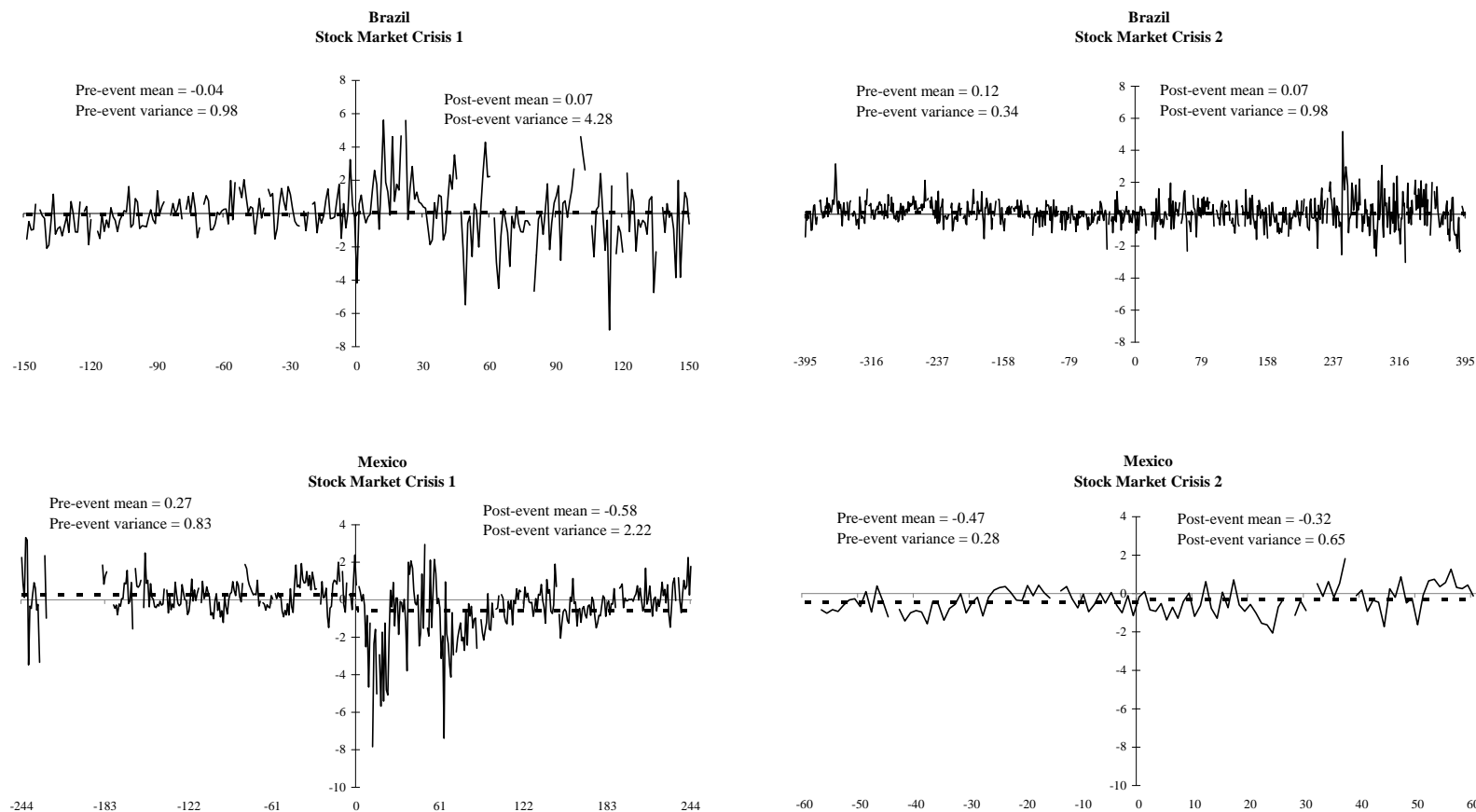
Thus, the results indicate that during crises, the cross-market premium becomes more volatile and continues to oscillate around zero, while the average premium drops. This implies that markets do not segment during crises. However, the risks associated with swapping the underlying stock for the DR and vice versa increased due to exchange rate, transfer, and convertibility risks. Moreover, the typical decline in liquidity in periods of financial distress tended to reduce traders' inventories and added to price volatility, thus inhibiting immediate arbitrage. This is in line with the findings in Levy Yeyati, Schmukler, and Van Horen (2008b), where we documented, using an event-study approach, an increase in trading costs (e.g., bid-ask spreads widen) in times of crisis. The negative cross-market premium suggests that these risks are more pronounced for the underlying stock and, as a result, investors demand a discounted price for this stock.

As a robustness test, we performed the same event studies using the stock market crisis definition. The results in the bottom panel of Table 4 and in Figures 4a and 4b, which display, per country, the behavior of the cross-market premium before and during crisis periods, largely confirmed our previous results. During crisis periods, the premium continued to oscillate around zero, indicating that the markets remain integrated. However, volatility substantially increased in all but one case. The results on the drop of the mean of the cross-market premium during crises were however, less pronounced in this case. Still, in the vast majority of cases, where there existed a significant negative difference between pre- and post-event mean.

Figure 4a: Event Studies—Stock Market Crises (Argentina, Russia, and Indonesia)**Notes:**

1. The solid lines on represent the average cross-market premium across stocks.
2. The dashed lines represent the pre- and post-event mean of the average cross-market premium.
3. The horizontal axis represents the number of days prior to or following the event.

Source: The data sources are Bloomberg and other reports (see main text).

Figure 4b: Event Studies—Stock Market Crises (Brazil and Mexico)**Notes:**

1. The solid lines on represent the average cross-market premium across stocks.
2. The dashed lines represent the pre- and post-event mean of the average cross-market premium.
3. The horizontal axis represents the number of days prior to or following the event.

Source: The data sources are Bloomberg and other reports (see main text).

In summary, the result showed that contrary to the introduction of capital controls, the occurrence of a crisis did not break down arbitrage. However, investors appear to have demanded a risk premium for the underlying stock to compensate them for the risks associated with selling the stock in the local market.

V. CONCLUSIONS

This paper showed that capital controls and crises do affect the integration of capital markets using data from firms from emerging economies that simultaneously trade their stocks in domestic and international stock markets.

First, the paper showed that the cross-market premium accurately reflected the effective impact of controls on cross-border capital movement on international arbitrage. More specifically, controls, if effective, affect the size and sign of the difference in prices between the underlying stocks and their DRs in New York. By raising the costs of shifting funds across borders, regulations on capital movement prevent investors from engaging in arbitrage-related activities. Controls on inflows depress the price of the underlying stocks in domestic markets, as investors need to pay a tax to purchase relatively undervalued assets, as opposed to buying the DRs. Conversely, controls on capital outflows increase the price of the underlying stocks, as investors are restricted from transferring the proceeds from the sale of those assets abroad.

These controls on cross-country capital movement have been frequently used to prevent crises and inhibit capital outflows once crises occur. While these controls have been criticized many times for being easy to evade, this paper showed that even when they did not fully preclude cross-border flows, they appear to work as intended and segment markets effectively—where effectiveness 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.

Second, as expected, the paper showed that crises were reflected in capital markets. When crises erupt, the cross-market premium becomes volatile, reflecting the shocks that markets receive and the difficulties in performing instantaneous arbitrage. Contrary to periods of capital controls however, arbitrage is still possible during crises, as is evident from the fact that the cross-market premium oscillates around zero. Nevertheless, the decrease in the average premium during crises, including the fact that the underlying stock tends to trade at a slight discount, suggests that the risks of holding the underlying stock compared to the DR increases.

Ultimately, the paper illustrated that cross-market premium could be used as a tool to measure capital market integration, particularly during periods of capital controls and crises. For example, to the extent that there is market segmentation, this measure reflects the intensity of the segmentation and the force of capital flows. As the case of the Republic of Korea proves, the premium diminished when controls on capital outflows became less restricted. Moreover, when investors were pushing to get out of Argentina at the beginning of the 2001 crisis, the cross-market premium sharply increased, and as markets calmed down, the premium subsided. Nevertheless, even when markets are not segmented, this measure can show the shocks markets suffer, as reflected in the crisis periods. In the end, this measure might become a useful tool for policymakers to monitor market sentiment in economies with assets traded both domestically and abroad.

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