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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 international financial integration, using data on stocks from emerging economies that trade in domestic and international markets. The cross-market premium (the ratio between the domestic and international market price of cross-listed stocks) provides a valuable measure of how capital controls and crises affect integration. The paper shows that, contrary to the common perception that capital controls can be easily evaded, they do affect the cross-market premium. 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 induced by capital controls. Crises affect financial integration by generating more volatility in the cross-market premium and putting more downward pressure on domestic prices.

This paper—a product of the Development Economics Research Group—is part of a larger effort in the department to understand financial integration and financial crises. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at sschmukler@worldbank.org.

Crises, Capital Controls, and Financial Integration

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1. Introduction

Since the early 1990s, emerging economies have been integrating rapidly 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 being 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 driven by an expectation that it fosters a better allocation of resources and risk around the world, and ultimately promotes higher growth.[2]

Two factors have emerged to threaten this financial integration. First, as countries opened up to capital flows, a series of crises erupted, leading many to question the net benefits of outright financial liberalization.[3] Second, capital controls have emerged as a way to mitigate financial integration.[4] During bad times, controls on capital outflows have been used as a way to stem reserve losses and currency devaluations, and eventually the collapse of the banking sector: Two well-known cases are those of Malaysia during

[1] See Levine and Schmukler (2006 and 2007) and Gozzi, Levine, and Schmukler (2008a and 2008b), and 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.

the East Asian crisis of 1997-1998 and Argentina during its 2001-2002 collapse.[5] During good 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 tend to affect negatively the 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]

In this paper, we analyze the effects of capital controls and crises on the integration of emerging economies with the international financial system.[7] Specifically, for a large set of firms from these economies, we examine the percentage price difference between the stocks that trade domestically and the corresponding depositary receipts (DRs) that trade internationally. We call this price difference the *cross-market premium*. DRs are certificates traded in major financial centers (New York in our case) that are issued by a depositary bank in the U.S. and represent shares of the ordinary stocks held by a custodian bank in the issuer's home country. As these underlying stocks can be easily transformed into DRs and vice versa, the stock and the DR represent the same asset traded in two different markets. This characteristic allows us to measure international financial integration through the law of one price (LOOP), which stipulates that countries are integrated when the DRs in New York and the underlying stock are priced equally.

[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.

When there are no barriers to cross-country capital movement, arbitrage is expected to equalize the prices of the DR and the underlying share. 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.

Government controls on cross-country capital movement, to the extent that they are effective, 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, but without paying the tax to move funds outside the country. This positive cross-market premium could not be arbitraged 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 movement of funds across borders, not stocks; therefore, arbitrageurs can transfer the stock from one market to the other to sell it wherever the price is higher, but the proceeds from those transactions can be transferred only to the extent that capital controls permit it.

Controls on capital inflows would have the opposite effect, pushing 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 arbitraged 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 would prevent this latter transaction. In sum, 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.

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 risk associated with swapping the underlying stock for the DR (and vice versa) increases due to transfer and convertibility risks, higher exchange rate volatility, and, most importantly, reduced liquidity, which in turn move 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.

Depositary receipts have been used recently to assess the impact of capital controls and crises. Rabinovitch, Silva, and Susmel (2003) attribute the persistence of return differentials between ADRs and stocks in Chile to the presence of 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) presents evidence of large return differentials during crises. In Levy Yeyati, Schmukler, and Van Horen (2008a), we

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

investigate 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. In that paper, we study the effects of capital controls and liquidity on the cross-market premium and analyze 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, presenting summary statistics and using an event-study methodology. To do so, we use daily cross-market premia for a set of 98 stocks from nine emerging economies: Argentina, Brazil, Chile, Indonesia, Korea (South), Mexico, Russia, South Africa, and Venezuela. For all countries, except Argentina, we use a sample period between 1990 and 2004. In the case of Argentina, we extend the sample to 2007 to be able to analyze the impact of the controls on inflows that were introduced in 2005.

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

The remainder of the paper is organized as follows. Section 2 discusses the methodology and data. Section 3 analyzes the effects of capital controls on the cross-

market premium. Section 4 shows the impact of crises on the premium. Section 5 concludes.

2. Methodology and Data

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 so-called custodian bank in the issuer's home country.[9] The depositary bank can create a new DR by depositing the required number of shares in the custodian bank. The dividends and other payments will be converted by the depositary 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, 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), 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 it by the number of underlying shares one DR represents, and then dividing it by the DR price.

[9] 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. 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 depositary. Depositary banks are located in the U.S. whereas the custodian bank is located in the home country of the underlying stock issuer.

When there are no barriers to cross-country capital movement between the domestic market and the U.S., transaction costs are zero, 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 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.[10] In reality, however, instantaneous and costless arbitrage does not exist. Many factors can affect arbitrage, including capital controls and crises, as mentioned above.

To examine how the cross-market premium reacts to capital controls and crises, we conduct event studies. These studies allow us to determine whether the cross-market premium behaves statistically differently after an event. We do this in two ways. First, we construct a portfolio of stocks and study its evolution. Second, at the stock level, we compute the estimated post-event deviations from the pre-event mean and variance values. We then report these mean and variance differences and the number of stocks for which these differences are statistically significant.

We analyze the following events: the imposition of capital controls, the 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). A six-month window before

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

and after the event is used to calculate the pre- and post-event means. In the case of crises, we define the event as the beginning of a crisis, and study the behavior of the cross-market premium during the crisis period relative to the pre-crisis mean. The length of the window is determined by the duration of the crisis; the pre-crisis window is equal to the post-crisis one.

In terms of data, we work with countries that have experienced the introduction (or lifting) of capital controls and/or financial crises during the sample period, such that we are able to analyze the effects of both. We also work with stocks with a long history of DR listings with important trading volume. Thus, we use stocks that are publicly traded in the United States, either on the NASDAQ or the New York Stock Exchange (NYSE). In total, we work with 98 stocks (out of 133 DRs that trade in the NYSE and NASDAQ) from nine emerging economies: Argentina (8 stocks), Brazil (30), Chile (20), Indonesia (2), Korea (6), Mexico (23), Russia (2), South Africa (8), and Venezuela (3). The cross-market premium is calculated only on days when both the underlying stock and the DR trade.[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 depositary 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 the New York stock market opens, as well as for Russia and South Africa, we use instead the closing price (and the exchange

[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.

rate) in the domestic market and the opening price in New York, to keep distortions due to time differences to a minimum.

Before studying the effect 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, in the absence of capital controls. 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, a negative premium points to the opposite. The table shows that during tranquil times, the premium is in general close to zero. In all cases, except Korea, the average premium is below one percent. The summary statistics of all stocks show a mean of 0.12 percent, 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.

3. Capital Controls and the Cross-Market Premium

In this section, we analyze the effects of capital controls on the cross-market premium. Capital controls are diverse. They differ in intensity, across countries, and over time. Furthermore, there are different types of controls, the most notorious difference being between controls on inflows (typically used to discourage short-term flows) and those on outflows (to prevent capital flight in the midst of a crisis). If the introduction of a 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. However, the effect will depend on the type of control and its intensity.

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 arbitraged away and the underlying stock will only 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 relative 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.

3.1. Brief Chronology of Capital Controls

Periods of capital controls are relatively easy to detect. Governments impose them through regulation. Moreover, 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]

[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).

Argentina. When the financial and currency crises of 2001 became unsustainable, Argentina introduced controls on capital outflows on December 2, 2001, together with restrictions on cash withdrawals from commercial banks (the so called "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, as capital returned to Argentina, the authorities imposed controls on inflows of foreign capital in 2005. These consist 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 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 (2007).

Chile. Chile introduced controls on inflows in the form of an Unremunerated Reserve Requirement (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).[13]

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

Korea (South). When the first publicly traded DR was introduced, there existed restrictions on foreign investment in the stock markets. In particular, there was a ceiling on the share of foreign investor ownership. This ceiling was 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 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 to take place: 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

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

Telecom), however, were unaffected by the rule during the period covered by our sample, so that controls were not effectively in place. These two stocks are not used in the event studies presented in the next section. To examine the impact of the gradual relaxation of the controls, we divide the control period of Korea into three distinct sub-periods. 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 started to be allowed but conditioned by the rule. The third period, less restrictive, goes from November 2000 to the end of the sample period.

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."[15] Since the blocked rand exchange rate traded at a discount to the commercial exchange rate, the indirect mechanism was used mostly. The securities rand system did not modify greatly the restrictions imposed on

[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.

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 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 measure was introduced as a temporary measure, but was still 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.

[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.

3.2. Effects of Capital Controls

To examine the impact of capital controls on financial market integration we perform event studies on a stock level basis.[18] The results of these tests are summarized in Table 2, showing the number of cases in which the post-event mean is significantly different from the pre-event mean. In addition, we show the behavior of the average cross-market premium around changes in controls on outflows (Figure 1) and changes in controls on inflows (Figure 2).[19]

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

[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.

[19] Note that Table 2 and Table 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.

Note that the premium during the period of capital controls is not only relatively volatile, but also displays some persistence. This persistence likely reflects capital flowing into and out of the country, since during the periods shown the intensity of the controls does not change. That is, given a certain restriction to shift funds abroad, the cross-market premium seems to reflect the pressure that investors exert by shifting (or trying to shift) funds abroad in any way they can. This is especially evident in the case of Argentina. The mean of the premium in the six months after controls are imposed equals 11.54 percent. However, the mean had already dropped to only 2.33 percent 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 explains the very large and sudden shift in the cross-market premium (reaching highs of 32.82 on December 7, 2001 and 34.3 on December 20, 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 has exactly the opposite effect compared to the introduction of controls on outflows: the cross-market premium turns negative. In Argentina, the average cross-market premium drops to -0.31 from 0.21. While in Chile, the drop is even more pronounced: falling to -1.63 from 0.03.

When controls on inflows are lifted in Chile, the average cross-market premium immediately starts to oscillate around zero again. In the case of Indonesia, however, the

[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 an out of the county. 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).

average cross-market premium falls instead of rising when controls on inflows are lifted. This suggests that the (relatively loose) limits on foreign participation may not have been binding at the time allowing domestic investors to perform arbitrage. A ceiling on foreign investment does not affect arbitrage by foreign investors as long as foreign participation is well below the limit. Moreover, in the case of Indonesia, the restrictions on capital movement seemed to be not binding.[22] By contrast, in Korea, a similar ceiling combined with a rule restricting the convertibility of the DRs impedes arbitrage, regardless of whether the ceiling is binding. However, when controls on inflows are changed to a less stringent level, the cross-market premium in Korea reacts and the discount becomes smaller. The evidence that the discount is much lower in Argentina and Chile than in Korea directly reflects the different nature of the restrictions: quantitative limits that prevent arbitrage in Korea, and an implicit tax that weakens arbitrage in Argentina and Chile. Note that a "tax" on inflows effectively decreases the price investors are willing to pay for the underlying stock, as investors will 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 are highly consistent across stocks. The introduction of controls on inflows in Argentina and Chile generates a discount for all stocks. The lifting of controls in Chile raises the cross-market premium for all stocks, while the cross-market premium of Indonesian stocks drops significantly when controls are lifted. In Korea, for all but two stocks the discount decreases significantly when the intensity of the controls is reduced.

Summarizing, 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

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

one price to break down. In other words, regulations on capital movement can prevent investors from engaging in arbitrage activity, effectively segmenting the domestic market from the international capital market.

4. Crises and the Cross-Market Premium

The impact of a financial crisis is more ambiguous. It can temporarily influence the level of financial integration, as the risk associated with swapping the underlying stock for the DR and vice versa increases, due to higher exchange rate volatility, as well as transfer and convertibility risk. On the other hand, an increase in the variability of the premium could simply reflect the greater price volatility that characterizes episodes of financial turmoil, even if the degree of arbitrage remains unaltered. However, before studying the effects of crises on the cross-market premium, it is necessary to define the crises periods, something that is less trivial than what might be thought of at first sight.

4.1. Crisis Periods

Crisis times are difficult to pin down. Perhaps what makes this task particularly challenging is the lack of an uncontroversial operational definition of crises. The literature has applied different methodologies using various ad-hoc criteria to identify crises. Besides the problem of not having a uniform criterion to define crises, the literature concentrates on determining the beginning of crises, but hardly their end. For our purpose, it is essential to determine accurately the duration of crises, such that the periods we analyze are correctly specified.

To define crises, we follow the approach adopted by Broner, Lorenzoni, and Schmukler (2004), which determines ex-ante certain criteria to identify the beginning and end of crises according to the behavior of certain market indicators. Their methodology allows us to distinguish country-specific crisis periods (which could be of domestic or foreign origin), without resorting to the use of ex-post data. We use two different procedures to identify crisis periods: one based on the exchange market pressure (EMP) index and one based on the local stock market index.[23] As crisis dating is arbitrary, we perform 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 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 are defined as follows. Stock market 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 come from Bloomberg and Datastream and the local stock market index series come from the Emerging Market Database (EMDB).

[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.

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).[25] Table 3 reports the crisis periods identified by both procedures. The crises considered do 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 Korean 1997 crisis).

4.2. Effects of Crises

As in the case of capital controls, we examine the impact of crises on financial integration by performing event studies. Table 4 provides a summary of the results, also displaying the number of cases in which the post-event mean is significantly different from the pre-event mean. 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). In addition, Figure 3 shows the behavior of the average cross-market premium for each country that experienced a crisis (as determined by our EMP definition) during our sample period (Brazil, Indonesia, Mexico, and Russia). Since there is a large change in the variance, Figures 3 and 4 also report the pre- and post-event variance.

The charts indicate that in all four cases the mean of the cross-market premium becomes negative during the crisis. For example, in Indonesia, the pre-event mean equals 0.40, while the post-event mean equals -1.39. Similarly, in Mexico the mean of the

[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).

average cross-market premium drops 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 experience 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 show a significant drop in the mean. This result can be explained by the fact that it is 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 market pressure. In addition to a decrease in the average mean, the comparison with tranquil times shows that the volatility of the premium increases significantly during a crisis. For example, in Russia the variance increases from 1.67 before the crisis to 38.82 after the crisis. Also in Indonesia, the premium becomes much more volatile, with the variance increasing from 1.20 to 13.62 (Table 4). In Mexico and Brazil volatility increases, 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 risk associated with swapping the underlying stock for the DR (and vice versa) increases, due to exchange rate, transfer, and convertibility risks. Moreover, the typical decline in liquidity in periods of financial distress tends to reduce traders' inventories and adds to price volatility, inhibiting immediate arbitrage. This is in line with the findings in Levy Yeyati, Schmukler, and Van Horen (2008b), where we document, using an event-study approach, that trading costs increase (e.g., bid-ask spreads widen) in crisis times. 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 perform the same event studies using the stock market crisis definition. The results in the bottom panel of Table 4 and in Figures 4.A and 4.B, largely confirm our previous results. During crisis periods, the premium continues to oscillate around zero, indicating that the markets remain integrated. However, volatility increases substantially in all but one case. The results on the drop of the mean of the cross-market premium during crises are less pronounced, however, in this case. Still, in the vast majority of cases, where there exists a significant difference between pre- and post-event mean, this difference is negative.

Summarizing, the result shows that contrary to the introduction of capital controls, the occurrence of a crisis does not break down arbitrage. However, investors seem to demand a risk premium for the underlying stock to compensate them for the risks associated with selling the stock in the local market.

5. Conclusions

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

First, the paper showed that the cross-market premium reflects accurately the effective impact on international arbitrage of controls on cross-border capital movement. 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 activity. Controls on inflows depress the price of the underlying

stocks in domestic markets, as investors need to pay a tax to purchase those 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 sending 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 many times criticized for being easy to evade, the paper showed that these controls, even when they do not fully preclude cross-border flows, appear to work as intended and segment markets effectively – where effectiveness is understood as 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, the paper showed that crises, as expected, are reflected in capital markets. When crises erupt, the cross-market premium becomes volatile, reflecting the shocks that markets receive and the difficulty 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 (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 showed that a measure like the cross-market premium could be used as a tool to measure capital market integration, in particular during periods of capital controls and crises. For example, to the extent that markets are segmented, this measure reflects the intensity of the segmentation and the force of capital flows. As the

case of Korea illustrates, when controls on capital outflows became less restricted the premium diminished. Moreover, when investors were pushing to get out of Argentina at the beginning of the 2001 crisis, the cross-market premium increased sharply. 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 in economies with assets traded domestically and abroad to monitor market sentiment.

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Table 1

Cross-Market Premium Summary Statistics

This table shows summary statistics for the cross-market premium, 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. 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. (See Section 3.1 for a more detailed discussion.)

Country	Mean	Median	Std. Dev.	5th Pctile	95th Pctile	No. 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

Event Studies - Capital Controls

This table presents the results of the event study tests for capital control events. The event studies examine whether the post-event mean is significantly different from the pre-event mean. The cross-market premium is measured as the percentage difference between the price in the domestic market and the price in New York. The event date is marked as the date capital controls change (for example, they are introduced or lifted). Averages are based on the average premium across stocks. Pre- and post-event periods are equal in length and add up to a 260-day window. Event studies are done at the stock level but are presented at the country level, averaging across stocks. 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. Mean and variance significance tests are done at a ten percent significance level.

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	8	-0.81	0	6	-6.53	0	6
	South 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	Korea							
High to Medium		3	11.77	3	0	66.77	2	0
Medium to Low		4	0.92	2	1	-14.06	0	3

Table 3

Crisis Periods

This table reports crisis periods determined using two different procedures. The EMP crisis period is identified using an exchange market pressure (EMP) index, defined as the weighted average of the daily changes in the interest rate and exchange rate. The crisis period begins when the volatility of EMP (15-day rolling standard deviation) exceeds a threshold level (set equal to the mean EMP volatility plus one standard deviation), and ends on the first date after which the EMP volatility stays below the threshold for at least three consecutive months. The stock market crisis is based on the local stock market index. The crisis period begins when the stock market index starts a decline of at least five consecutive weeks that reaches a cumulative drop in excess of 25%, and ends on the first date after which the index grows for at least four consecutive weeks. The crises considered do not coincide with periods in which capital control modifications take place (e.g., Argentina's stock market crisis in 2001/2002 coincided with the introduction of capital controls, so this case is excluded from the analysis).

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

Table 4
Event Studies - Crises

This table presents the results of the event study tests for crisis events. The event studies examine whether the post-event mean is significantly different from the pre-event mean. The cross-market premium is measured as the percentage difference between the price in the domestic market and the price in New York. The event date is marked as the date the crisis starts. The post-event period used to calculate the mean equals the crisis period and the pre-event period is of equal length (the length of the window varies for each country). Event studies are computed at the stock level and are displayed in this table at the country level, averaging across stocks. The upper panel displays the event study results when the crisis dates are based on the exchange market pressure (EMP) criteria. The lower panel shows the event study results based on the stock market criteria. See description of Table 3 and main text for explanation of the different crisis definitions. Mean and variance significance tests are done at a ten percent significance level.

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

Figure 1

Event Studies - Capital Controls on Outflows

The figure displays, per country, the behavior of the cross-market premium before and after the introduction and lifting of capital controls on outflows. The event date, 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. 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 cross-market premium is measured as the percentage difference between the price in the domestic market and the price in New York. The horizontal axis represents the number of days prior to or elapsed from the event. We use a 130-day window.

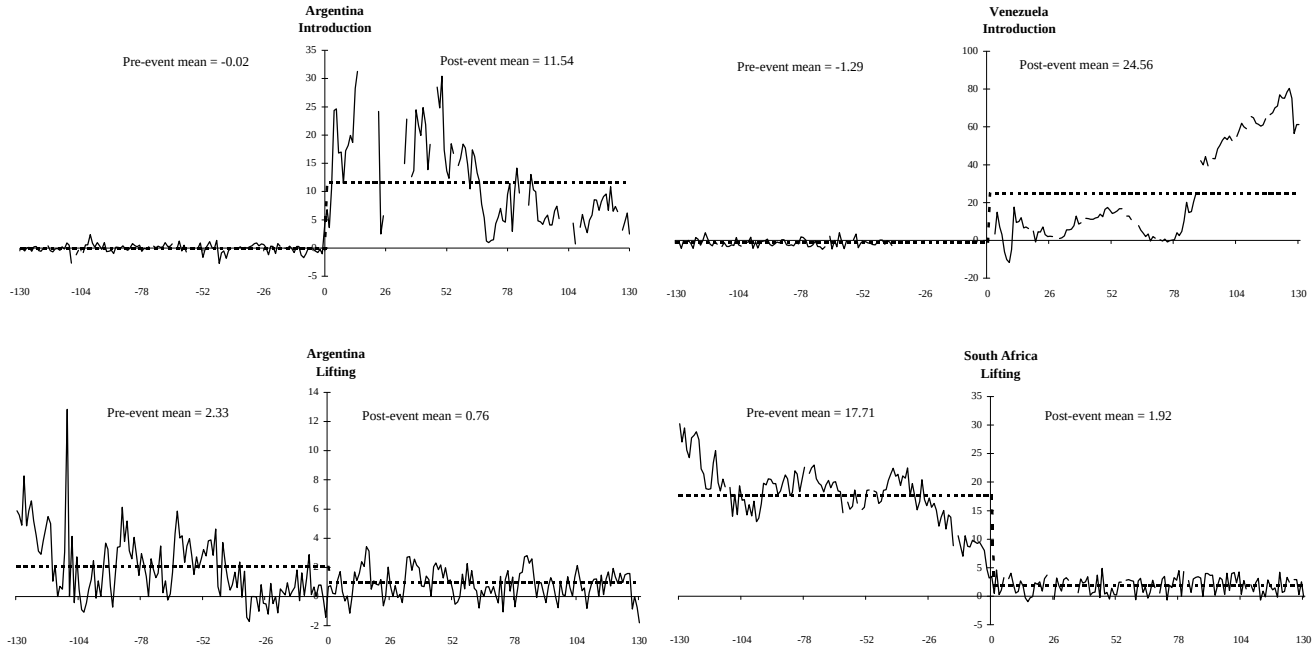

Figure 2

Event Studies - Capital Controls on Inflows

The figure displays, per country, the behavior of the cross-market premium before and after the introduction and lifting of capital controls on inflows. The event date, marked as time zero, is defined as the day controls are introduced in the two upper panels, the day controls are lifted in the two middle panels, and the day the controls change in strength in the two bottom panels. 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 cross-market premium is measured as the percentage difference between the price in the domestic market and the price in New York. The horizontal axis represents the number of days prior to or elapsed from the event. We use a 130-day window.

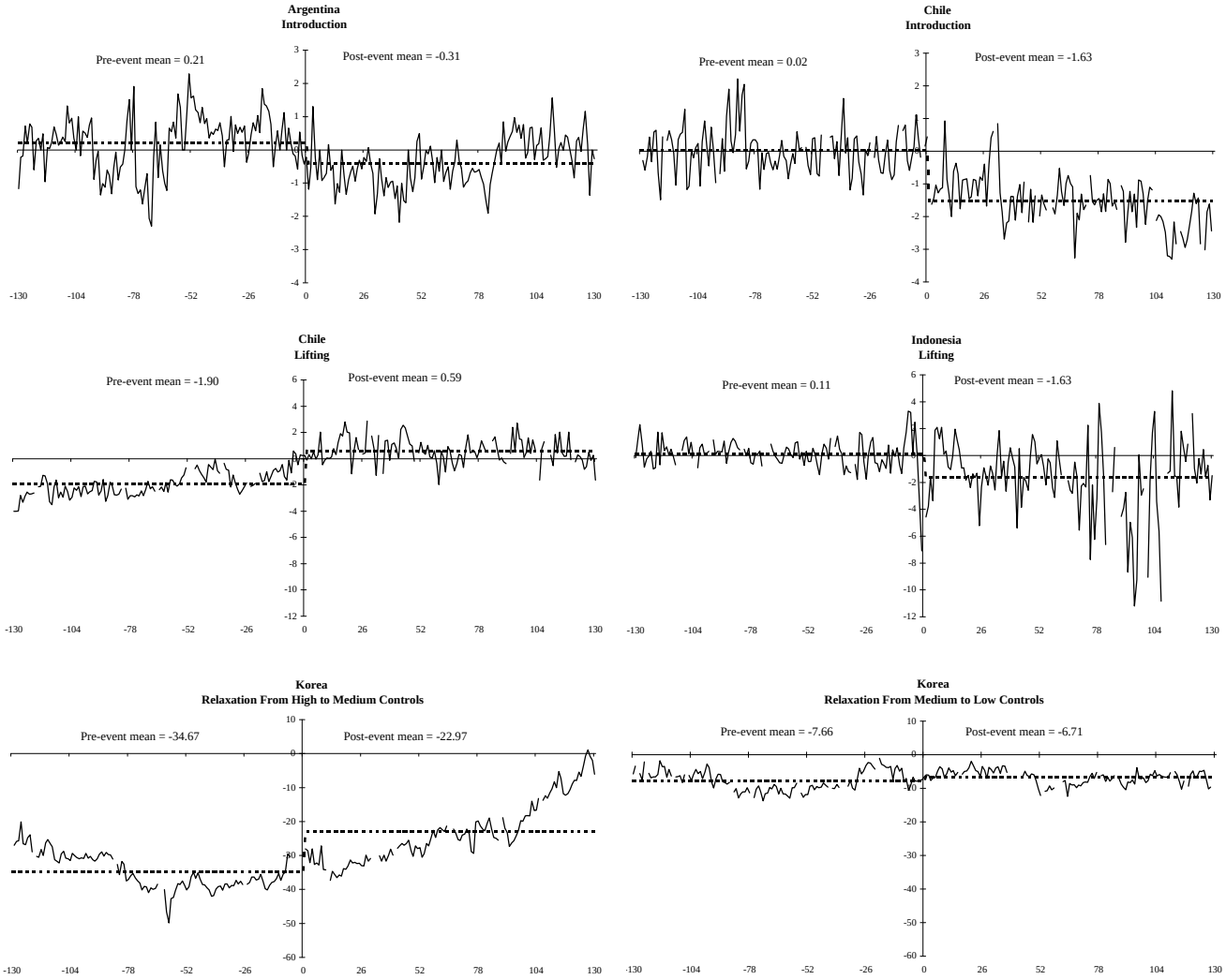

Figure 3

Event Studies - EMP Crises

The figure displays, per country, the behavior of the cross-market premium before and during crisis periods. The event date, marked as time zero, is defined as the day the crisis starts based on the exchange market pressure (EMP) criteria (see description of Table 3 and main text for an explanation of the crisis definition). 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 cross-market premium is measured as the percentage difference between the price in the domestic market and the price in New York. The horizontal axis represents the number of days prior to or elapsed from the event. The length of the window varies per country (pre-event and post-event periods are equal for each country).

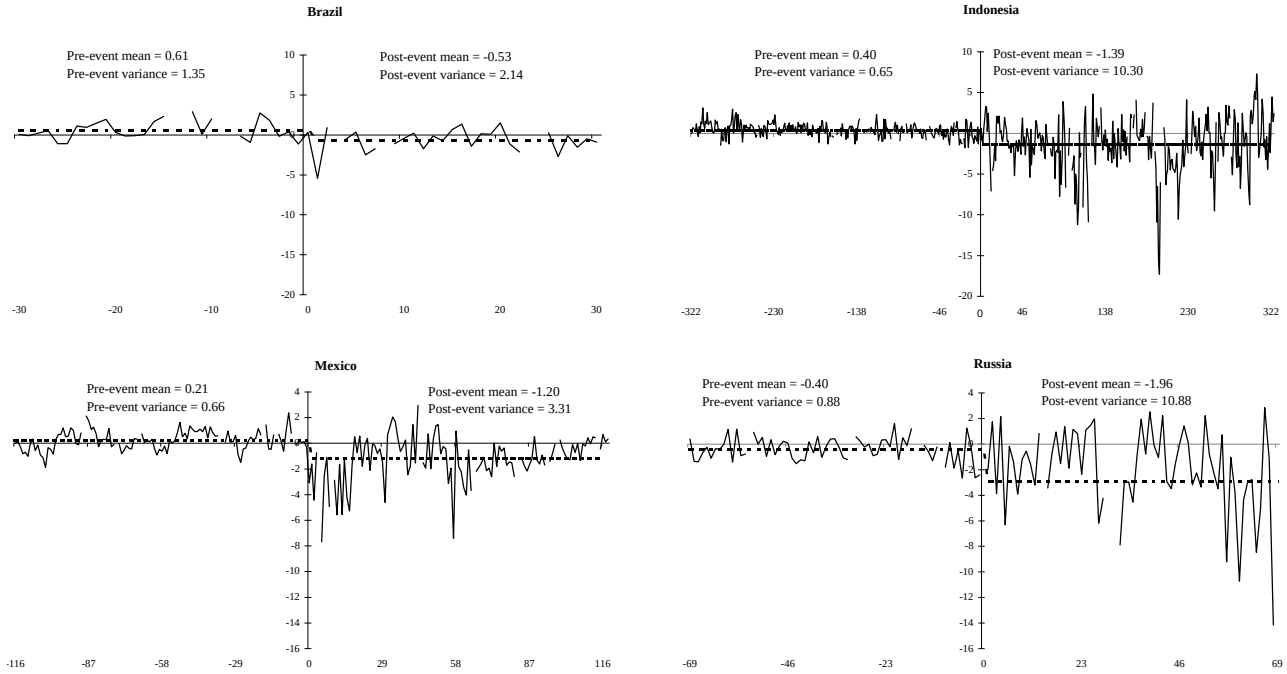

Figure 4.A

Event Studies - Stock Market Crises

Figures 4.A and 4.B display, per country, the behavior of the cross-market premium before and during crisis periods. The event date, marked as time zero, is defined as the day the crisis starts based on the stock market criteria (see description of Table 3 and main text for an explanation of the crisis definition). 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 cross-market premium is measured as the percentage difference between the price in the domestic market and the price in New York. The horizontal axis represents the number of days prior to or elapsed from the event. The length of the window varies per country (pre-event and post-event periods are equal in length for each country).

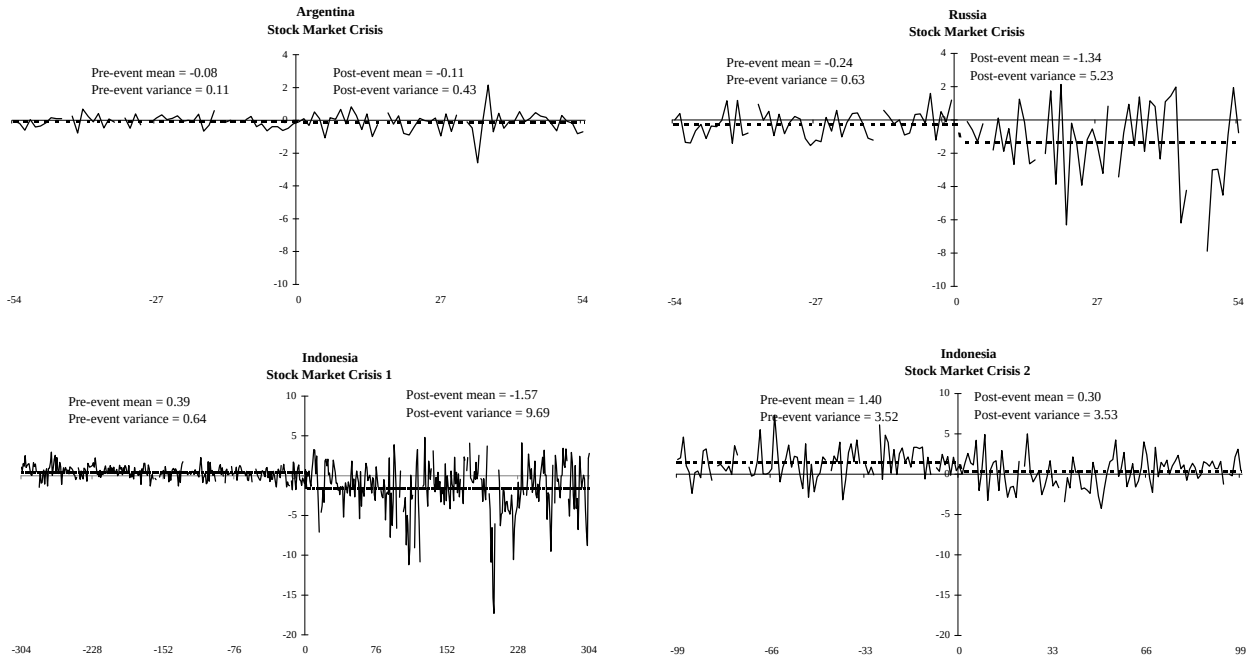

Figure 4.B

Event Studies - Stock Market Crises

Figures 4.A and 4.B display, per country, the behavior of the cross-market premium before and during crisis periods. The event date, marked as time zero, is defined as the day the crisis starts based on the stock market criteria (see description of Table 3 and main text for an explanation of the crisis definition). 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 cross-market premium is measured as the percentage difference between the price in the domestic market and the price in New York. The horizontal axis represents the number of days prior to or elapsed from the event. The length of the window varies per country (pre-event and post-event periods are equal in length for each country).