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Capital Markets Liberalization

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Navigating Capital Flows in Brazil and Chile

Working Paper

Brittany A. Baumann and Kevin P. Gallagher¹

Abstract

In the wake of the global financial crisis, many emerging market countries have been the recipients of unstable capital flows. Indeed, Brazilian President Dilma Rousseff has gone so far as to refer to post-crisis capital flows as a ‘tsunami’ that is a cause of great concern in the developing world. Different nations have responded to this challenge with different tools. Some nations have deployed capital account regulations, others have intervened in currency markets, and others have refrained from any activity at all. This paper analyzes the actions of Brazil and Chile between 2009 and the third quarter of 2011. During this period Brazil deployed capital account regulations and Chile intervened in its currency markets. We examine the effectiveness of each of these actions and the extent to which the actions of Brazil caused capital flow spillovers in the Chilean market. Consistent with the peer-reviewed literature on the subject, we find that capital account regulations had small but significant impacts on the shifting the composition of capital inflows toward longer-term investment, on the level and volatility of the exchange rate, on asset prices, and on the ability of Brazil to have independence in monetary policy. Brazil’s regulations did also temporarily cause an increase in capital flows into Chile. Chile’s interventions did not have a lasting impact on the Chilean exchange rate or on asset prices beyond the initial announcements of the policies. In Brazil’s case we thus conclude that Brazil’s regulations helped the nation ‘lean against the wind,’ but were not enough to tame the tsunami.

JEL CODES: E65, F32, F36, F41

1. Introduction

The regulation of cross-border capital flows was the norm during the Bretton Woods era. Beginning in the 1970s however, many developed countries significantly liberalized their capital markets and began encouraging their developing country counterparts to follow suit. The move to capital market liberalization has theoretical justification, but did not hold up to the empirical evidence, at least in the case of the liberalization of short-term capital flows in emerging market and developing countries. Indeed, the role that unstable capital flows played in the East Asian financial crisis in the late 1990s questioned the merits of capital account liberalization in developing countries for many economists and policy-makers alike. Leading up to the global financial crisis attention had thus shifted to identifying the ‘threshold’ level of

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income and institutional development whereby capital market liberalization could become associated with growth and financial stability in developing countries.

The global financial crisis has elevated this debate once again. Many economists have pointed out how unstable cross-border capital flows were at the root of the crisis—with the United States borrowing \$5 trillion from foreigners between 2001 and 2008 and one-third of the nation's housing debt owed to foreigners, and two-thirds of government debt by 2008 (Chinn and Frieden, 2011). What is more, a landmark International Monetary Fund (IMF) position paper found that those emerging market and developing nations that deployed capital controls (this term will be used interchangeably with “capital account regulations” and “capital flow measures” throughout the paper) were among the least hard hit during the crisis, leading the IMF to proclaim that capital account regulations are a legitimate part of the macroeconomic policy toolkit (Ostry et al., 2010).

In the wake of the financial crisis, low interest rates and slow growth in the industrialized countries has triggered mass inflows to emerging market and developing countries where interest rates and growth have been relatively higher. However, when global capital markets have felt chilled, such as with the emergence of the Eurozone crisis, there have been sudden stops of capital flows to developing countries and capital flight to ‘safety’ in industrialized country (chiefly US) markets. The IMF and others have expressed concern that such capital flow volatility is making it difficult for emerging market exchange rates, asset markets and beyond (IMF, 2011a).

Numerous countries have responded to this volatility either by deploying capital controls or by intervening in foreign exchange markets. In this comparative study we examine the financial interventions of two EMEs—Brazil and Chile—and the relative effectiveness of their respective policies. In late 2009 Brazil imposed a foreign exchange transactions (IOF) tax on foreign purchases of equities and bonds, i.e. a tax on capital inflows. On the other hand, the Chilean central bank pursued foreign exchange market intervention through daily dollar purchases beginning in January 2011. Both countries implemented such measures in response to steep appreciation in their exchange rates and heavy capital inflows that resulted in the aftermath of the 2008 global financial crisis. Hence, our time frame of analysis is the post-crisis period, beginning in early 2009 during which EMEs recovered substantially well and even experienced booms in their exchange rate and asset price markets. The analysis ends in late 2011 when there was a sudden stop in capital flows to developing nations due to the accentuation of the Eurozone crisis.

Table A: Summary of Measures to Manage Capital Flows in Brazil and Chile

Country	Total Inflows	Composition	Asset Prices	Exchange Rate	Monetary Autonomy
Brazil	Increased total inflows.	-Long-run impact: Decreased short-term, increased long-term flows. -Short-run: announcements were in reverse (increased short-term, decreased long).	-No long-run impacts -Short-run: Announcements reduced asset prices but the cumulative effect was offset by ADR announcement.	-Long-run impact: decreased level and volatility of Real. -Short-run impact: decreased level and volatility only in first announcement.	Increased monetary autonomy.
Chile	No effect.	No effect.	-No long-run impact -Short-run: Made domestic stock market more independent from the regional index. -Temporary spillover effects for IOF in Brazil.	-No long-run impact -Short-run: Decreased level of peso after the announcement. -Temporary IOF spillover effects.	No effect.

We investigate several macroeconomic outcomes in order to quantify the overall efficacy of these measures. We test the impact on three main variables: each country's equity market indices, the level and volatility of exchange rates, and the volume and composition of net capital inflows. Our findings are summarized in Table A. In Brazil, we find that the introduction of capital controls was associated with an increase in total inflows but that the composition was shifted from short to longer-term inflows. We also find that Brazil's measures had a lasting impact on the level and volatility of the exchange rate. In terms of asset prices, only announcements of controls were effective, and were offset by regulations on the ADR market that send investors back to Brazil. We also find that Brazil's measures modestly increased the ability of Brazil to pursue an independent monetary policy. Chile's currency interventions were less successful. The announcement of currency intervention reduced the level of the exchange rate, but not the volatility, and made the domestic stock market more independent from the region as a whole. Chile's interventions had no statistically significant impact on total inflows of

capital, the composition of inflows, or the ability of Chile to pursue an independent monetary policy.

The paper is divided into six parts. Section 2 very briefly reviews some of the literature on the theory and evidence pertaining to capital market liberalization and the use of capital account regulations in general. Section 3 presents the experience of Brazil and Chile with respect to capital flows in the period of study and discusses the use of data in the study as a whole. Section 4 outlines our modeling approach and methodology, while section 5 presents the results of our analysis. A final section summarizes our conclusions and suggests further work for research and policy.

2 Literature Review

The pendulum has swung back, forth, and now back again on the benefits of capital market liberalization. In the wake of the Great Depression and World War II, the architects of the Bretton Woods system were adamant that current transactions should be freely transferable, but that capital account transactions should not. Beginning in the late 1970s and 1980s that consensus began to change and capital market liberalization became a norm in theory and a policy goal in practice. The pendulum swung yet again in the aftermath of the East Asian financial crisis. Since then a large body of theory and evidence has arisen that justifies the regulation of cross-border finance.

Theoretical applications in the 1970s and 1980s point out that cross-border capital account liberalization would reap benefits because then capital would flow to areas that had a higher-return investment (i.e. EME and other countries in need of capital), and make markets more stable by incentivizing international risk sharing and diversification. It was further posited that capital market liberalization would enhance financial market development, and thus spur economic growth (Henry, 2007).

The empirical evidence, however, is more mixed. Numerous influential studies have concluded that (previous to the global financial crisis) that capital market liberalization was associated with economic growth in industrialized countries, but associated with a lack of growth and an increase in financial instability in developing countries (Stiglitz, et al., 2006). Recent studies have shown that the benefit of growth can only arise in economies that have reached a certain institutional threshold (Kose, Prasad, and Taylor 2009, Prasad et al. 2003). Henry (2007) provides a survey of the theory and evidence regarding capital market liberalization and growth, and two main conclusions are the following: institutional development is a key ingredient to reaping the benefits of capital openness, and empirical studies can be improved by employing a policy experiment approach. Such an approach is utilized in this study, by which we measure the impact of a policy before and after its onset.

Other studies have emphasized specific costs associated with capital openness, e.g. exchange rate appreciation, negative externalities such as over-borrowing, increased vulnerability to capital flight and crises. Hence, another subclass of this literature centers on the analysis of the cost of short-term capital flows—an important source of volatility, excessive risk-taking, and economic vulnerability. Short-term flows can be distortions to the competitive equilibrium since they are influenced heavily by private investor activity, e.g. in the form of noise trading, speculation bubbles, etc.

Theories examining the costs of capital market openness relate to the incidence of crises, sudden stops, and capital flight. A vast literature has emerged in defining the relationship

between capital market openness and bank and currency crises. The foundation of the recent literature has stemmed from the Mundell-Fleming model, an open economy framework addressing the effects on foreign exchange markets, monetary policy, and fiscal policy. A notable conclusion of this model influencing theory and policy is the so-called trilemma: perfect capital mobility, a fixed exchange rate regime, and independent monetary policy cannot all coexist; countries can maintain at most two of the three. The trilemma is one explanation for the eruption of currency crises in EMEs and the subsequent use of capital controls.

Stiglitz and Ocampo (2008) outline adverse consequences of capital market liberalization, with a focus on developing countries. First, open capital markets can create negative externalities, in form of currency appreciations, depreciations, or reductions in credit supply. Externalities arise because individual investors do not internalize the social impact of their borrowing and lending behavior. Second, open capital markets allow for coordination failures to more readily occur, due to heightened rollover risk which can lead to capital flight. Third, loss of monetary discretion may happen, particularly because interest rate fluctuations can cause large inflows or outflows. Fourth, imperfect information among investors results in herd behavior that propagates panics. Fifth, currency and maturity mismatches due to incomplete markets are prevalent and only heighten exchange rate and interest rate risk. Finally, incomplete equity markets and informational asymmetries make it difficult for countries to issue new equity in order to raise capital, thereby resorting more to self-financing so that the gains from globalization are not had. All in all, the consequences of open capital markets are costly, and raise the need for market interventions such as capital controls, which, according to Stiglitz et al. (2006), are the most effective policy instruments.

Theoretical studies have specifically modeled these costs in order to derive the optimal policy. In particular, Aizenman (2010), Jeanne and Korinek (2010), and Korinek (2011) are studies that have modeled capital flows as sources of negative externalities, showing how they create a wedge between private and social marginal benefits. These models then advocate capital controls as the optimal policy that corrects the wedge and restores efficiency.

Empirical studies on the effectiveness of capital flow management are usually country-specific and target specific capital control policies. The results then range across countries and across types of controls. However, Magud, Reinhart, and Rogoff (2011) offer a comprehensive assessment of the existing literature. Their review first acknowledges the lack of a unified theoretical framework, no common empirical methodology, and the heterogeneity of empirical findings across studies. They then address these drawbacks by summarizing studies of controls on inflows and outflows and of multi-country studies, and critiquing their methods and results.

The authors argue that capital controls are imposed by EMEs to combat four fears: fear of appreciation, fear of hot-money (short-term) flows, fear of large inflows, and fear of loss of monetary autonomy. Two additional fears, also addressed in our paper, are the fear of asset price bubbles and the fear of capital flight (Ocampo and Palma 2008; Grabel 2003; Epstein 2003). Ostry et al. (2010) found that those nations that deployed capital controls in the run up to the global financial crisis were among the least hard-hit during the crisis. Magud, Reinhart, and Rogoff (2011) find that controls on inflows increased monetary policy independence, altered the composition of capital flows, and reduced exchange rate volatility; controls did not reduce the volume of net flows in most studies. Nevertheless, the effects, though statistically significant, are temporary and small in magnitude. Finally, their review presents a theory to justify the impact on flow composition. Using a portfolio balance approach, their model shows how capital flow

restrictions can raise the share of short-term investments. This outcome will be tested in our study.

3 Background and Data

Brazil and Chile each intervened in the market to address the fears and concerns outlined in the last section. Brazil deployed capital account regulations, Chile intervened in its currency markets. Figure 1 depicts the rise in the Brazilian exchange rate, which appreciated over 40 percent between 2009 and 2011 before dropping during the worst of the Eurozone crisis in September of 2011. Figure 2 exhibits Brazil's potential stock market bubble that followed a similar trajectory during the same period. Figure 3 shows the corresponding rise in capital flows.

Figure 1. BRL

Figure 2. Bovespa

Figure 3. Brazil Net Inflows

In our regressions for Brazil, all data for the asset price and exchange rate regressions are daily frequency and are obtained from Bloomberg. For the Brazil regressions, our time period spans 1/5/2009 to 12/13/2011. For this time period, Figures 1 and 2, respectively, display the course of the Bovespa, Brazil's national stock exchange, and of the Brazilian nominal exchange rate (Real) in terms of U.S. dollars. The vertical line in each figure gives the date at which the IOF tax was first announced and imposed on October 19, 2009. The first announcement was followed by a string of tax hikes, modifications, as well as other types of capital flow management. As can be seen, the first announcement preceded a period of steep appreciation in both asset prices and the exchange rate.

The dates of the announcements of controls were specified from news articles and previous studies. Our event dates of interest are shown in Table B below. The dates are important since they help determine the time frame of analysis.

Table B. Capital Account Regulations in Brazil, 2009-2012

Announcement Date	Effective Date	Event
10/19/2009	10/20/2009	IOF tax of 2% on equities and bonds
11/19/2009	11/19/2009	ADR tax of 1.5%
10/4/2010	10/5/2010	IOF tax increases to 4% on bonds and equity funds
10/18/2010	10/19/2010	IOF tax increases to 6% on bonds and derivatives
12/15/2010	1/4/2011	Tax reductions for longer maturity bonds and private equity
1/6/2011	4/4/2011	Reserve requirement of 60% for USD positions
3/29/2011	3/29/2011	IOF tax increased to 6% on bonds with maturities up to 1 year
4/6/2011	4/7/2011	IOF tax modified to cover maturities up to 2 years
7/27/2011	7/27/2011	Tax of 1% to 25% on forex derivatives
12/1/2011	12/2/2011	Removal of 2% IOF tax on equities and certain debentures
3/1/2012	3/1/2012	IOF tax on bonds extended to cover maturities up to 3 years
3/12/2012	3/12/2012	IOF tax on bonds extended to cover maturities up to 5 years

Data on capital and current account flows and GDP are monthly frequency and available on the Central Bank of Brazil website. Additional variables in the capital flow regressions are taken from Bloomberg. These regressions cover November 2008 to November 2011. We begin our time frame at the end of 2008 in order to avoid the structural break caused by the 2008 financial crisis. Figure 3 below depicts this structural break in the capital flow data, in which substantial capital outflows resulted in the second half of 2008, but reversed their direction by the end of the year, resulting in positive net inflows by the start of 2009. Here, we define the capital account as the sum of the capital account and financial account, as given by the central bank data website. The financial account is composed of direct investment, portfolio investment, derivatives, and other investments, while the capital account is much smaller in size. Any feature to note is the relative volatility of FDI and non-FDI net inflows, as the latter includes more volatile, short-term investment and governs the overall trend in the capital account.

After a significant domestic debate regarding which measure to use in order to stem exchange rate appreciation and to prevent an asset bubble, Chile chose to conduct daily dollar purchases. For Chile, our time period spans slightly longer, from 1/5/2009 to 3/30/2012, in order to include a period after which the intervention ended. Even though Chilean interventions did not commence until the end of 2010, we use the early start date to incorporate spillover effects of the IOF in our analysis. For this time period, Figures 3 and 4, respectively, display the course of the Santiago Stock Exchange, Chile's national stock exchange, and of the Chilean nominal exchange rate (Peso) in terms of U.S. dollars. The vertical lines denote the announcement and the termination of the Chilean currency market intervention. Again, as in Brazil, we see that the intervention took place after a period of appreciation in both the asset price and exchange rate markets.

Chile pursued a different policy of currency market intervention. As seen in the table below, the Chilean Central Bank conducted daily purchases of \$50 million U.S. dollars, which lasted almost one year. A month prior to the intervention, the central bank also raised the limit on foreign investment in pension funds to 80% from 60%. The last increase occurred in October 2008. The dates and policies are given below in Table C.

Table C. Currency Market Intervention in Chile, 2010-2011

Announcement Date	Effective Date	Event
11/4/2010	12/2010	Increase in foreign investment limits on pension funds to 80% from 60%
1/3/2011	1/5/2011	Intervention program at a rate of \$50 million USD a day
2/8/2011	2/9/2011	Continuation of daily USD purchases
3/8/2011	3/9/2011	Continuation of daily USD purchases
4/8/2011	4/11/2011	Continuation of daily USD purchases
10/7/2011	10/8/2011	Continuation of daily USD purchases
11/8/2011	11/9/2011	Continuation of daily USD purchases
12/9/2011	12/16/2011	Termination of currency intervention program

To our knowledge, three studies have investigated the impact of the Brazilian IOF tax. Forbes et al. (2011) examines the IOF tax in Brazil, but tests only the impact on portfolio flows, using the Emerging Portfolio Fund Research database. Their novel dataset gives fund-level investments by country, but only accounts for 5% to 20% of total country market capitalization. They find evidence that controls reduce investor portfolio allocations to Brazil. They also find that spillovers occur due to Brazil's actions. Levy-Yeyati and Kiguel (2009) quantify the effectiveness of the IOF tax on the Brazilian exchange rate by running similar regression analyses to our own. The study, however, tests only the impact of the announcement of the tax, and not subsequent changes. Finally, IMF (2011b) tests for spillover impacts of Brazil's capital controls.

As the next sections show, we build on these studies by incorporating additional policy and modifications to the IOF tax through the end of 2011. We also examine a broader range of macroeconomic variables, e.g. equity prices, exchange rates, and disaggregated net inflows.

4 Methodology

In this study we examine the extent to which the interventions by Brazil and Chile had an independent impact on exchange rate levels and volatility, asset appreciation, as well as the scale, composition, and spillover impacts of capital inflows. The model specification for each is discussed in this section.

Exchange Rates

We assess the impact of the capital controls on changes in the Brazilian and Chilean nominal exchange rates by running a GARCH (1,1) regression. GARCH (1,1), or General Autoregressive Conditional Heteroskedasticity model with 1 lag in the error term and 1 lag in the variance term, allows us to not only study the impact on the level of the exchange rate, but also its volatility. Before running this regression, we must first test for heteroskedasticity, or ARCH effects, using Engle's Lagrange-multiplier (LM) test. Here we fit the model by OLS to test the null hypothesis of no ARCH effects. The LM test gives p-values well below 0.05; hence, we can reject the null of no heteroskedasticity.

The model testing the impact on the level and volatility of exchange rates is given below. The first equation gives the level regression, while the second gives the variance regression. For the Chilean peso regression, we do not include the lagged variance term in the second regression.

$$\Delta BRL_t = \beta_0 + \sum \beta_n \text{Announce}_{nt} + \beta_8 \Delta \text{Controls}_t + \beta_9 \Delta \text{Controls}_t * \Delta \text{Interest Rate}_t + \beta_{10} \Delta \text{Interest Rate}_t + \text{Other Covariates} + \varepsilon_t \quad (1)$$

$$\sigma_t^2 = \eta_0 + \eta_1 \varepsilon_{t-1} + \eta_2 \sigma_{t-1}^2 + \eta_3 \Delta \text{Controls}_t + \eta_4 \Delta \text{Controls}_t * \Delta \text{Interest Rate}_t + \eta_5 \Delta \text{Interest Rate}_t + \text{Other Covariates} + \varepsilon_t \quad (2)$$

$$\text{with } \varepsilon_t \sim N(0, \sigma_t^2)$$

Our variables of interest here are the dummy for the day of the first announcement, the dummy for the entire period for which the controls were in place, and the interaction variable—the dummy for the entire period times the change in the domestic interest rate. The coefficients on the dummies are the abnormal returns after controlling for the other covariates. Description and calculation of abnormal returns and cumulative abnormal returns are given in the next section. The interaction term measures the extent to which controls improved monetary autonomy: controls are successful in improving autonomy if changes in the domestic interest rate have smaller or negative effects on the exchange rate. The covariates are the regression are the change in the foreign interest rate (LIBOR) as well as log changes in the dollar exchange index (DXY), commodity price index (GSCI) and the JP Morgan Global Spread (EMBI).

Asset Prices

In order to assess the effectiveness of the controls on curbing asset price appreciation, we conduct an event study on the Brazilian national stock exchange (Bovespa) and the Chilean national stock exchange (Santiago). Controlling for changes in the regional stock market, proxied by the MSCI EM Latin America index, we compute the marginal and cumulative abnormal returns of capital control announcements. Abnormal returns capture whether the controls caused a significant reaction in the stock market, controlling for changes in the overall market. Hence they effectively measure the difference between the actual and expected return of the local stock market. We obtain cumulative abnormal returns by aggregating the marginal abnormal returns of each announcement, which are given by the coefficients of the event dummy variables.² Cumulative returns provide a better measure for the overall effect of the tax.

Similar to an event study, we run regression of the log change in the Bovespa on dummies for the announcement of the IOF tax and for subsequent policy modifications and on a dummy for the period during which the equity tax was in place. The model regression, along with the definition of abnormal returns, is shown below.

² In other words, cumulative abnormal returns, where n is the final period, are computed by the following approximation:

$$(p_{t+n} - p_t)/p_t = [(1 + ((p_{t+n} - p_{t+n-1})/p_{t+n-1})) * \dots * (1 + ((p_{t+1} - p_t)/p_t))] - 1.$$

$$\Delta Stock_t = \beta_0 + \beta_1 \Delta Market_t + \sum \beta_n Announce_t + \beta_9 Controls_t + \beta_{10} Controls_t * \Delta Market_t + \varepsilon_t \quad (3)$$

$$\Delta AbnormalRet_t = \Delta Stock_t - \Delta ExpectedRet_t$$

Announcement dummies are specified for the day after the announcement if announced after trading hours. Along with the dummy variables, we include an interaction variable—the regional market index times the overall control dummy—to capture the effect on local equity market independence.

Scale, Composition, and Spillover Effects of Capital Flows

Analysis of the impact on the capital account is four-fold. First, we conduct a cross-sectional regression of the Brazilian net capital inflows on capital control event dummies, interest rate differentials, and other covariates. Second, we study the impact on the composition of capital flows by studying the following capital flow outcomes: FDI less non-FDI flows and short-term versus long-term flows. Third, we run a panel regression of several Latin American economies in order to better explain the deviation of Brazilian net inflows from the regional trend in response to capital controls. Finally, we test for spillover effects by studying the impact on Chilean flows in response to the Brazilian capital controls. Here, we run a cross-sectional regression of Chilean flows. All flows are given as a percentage of GDP.

The model of the panel regressions is given by the general equation below. We use a two-month dummy for the announcement of the introduction of the IOF tax in order to obtain a better measure of the effect as well as more reliable standard errors. We use a multi-month dummy specified for all announcements (to measure a cumulative effect of all announcements) and another multi-month dummy specified for the entire period the tax is in place (to measure the overall effect of the IOF implementation period). We also include time (month-specific) effects to capture the overall trend of flows as well as any unobservable effects altering the level of flows. Additional country-specific covariates include the current account, as a percentage of country GDP, interbank domestic-US interest rate differential.

$$NetInflow_{it} = \beta_0 + \beta_1 CurAcc_{it} + \beta_2 C_i + \beta_3 Q_t + \beta_4 Announce_{it} + \beta_5 AllAnnounceDummy_{it} + \beta_5 Controls_{it} + \varepsilon_t \quad (4)$$

The cross-sectional regressions are similar and include more covariates. However, a substantial drawback is the low number of observations as well as the presence of endogeneity of the regressors. We address endogeneity by running IV regressions, using the lagged dependent variable as the instrument. We again use two-month dummies for each announcement in order to obtain valid standard errors, as well as dummy for the entire period when they are in place and a dummy for all announcements. Covariates are a lagged dependent variable, the current account, VIX Volatility index, EMBI Global Spread, a Bloomberg carry trade index, the FX premium, and interbank interest rates. The carry trade index measures the US short rate and the Brazilian long interest rate differential; thus, a positive coefficient is expected since a higher index should attract flows into Brazil. The model equation is given below.

$$\text{NetInflow}_t = \beta_0 + \beta_1 \text{CurAcc}_t + \sum \beta_j \text{Announce}_{jt} + \beta_7 \text{AllAnnounceDummy}_t + \beta_8 \text{Controls}_t + \sum \beta_j \text{Covariates}_{jt} + \varepsilon_t \quad (5)$$

We conduct analyses for total flows and disaggregated flows by decomposing net capital inflows into short-term and long-term measures. The short-term, long-term decomposition is similar to the FDI, non-FDI decomposition; non-FDI is composed largely of short-term investment while FDI can be regarded as long-term investments. We improve the FDI, non-FDI measure by stripping out long-term investment from portfolio investment and other investments. Long-term investment is thus measured by the sum of these long-term investments and FDI. Short-term investment is defined as short-term portfolio plus other investment (trade credits, currency and deposits, loans) plus derivatives.

5. Results and Analysis

Consistent with the literature reviewed above, we find that Brazil's capital account regulations had a significant but small impact on exchange rate levels and volatility, asset appreciation, on monetary policy independence, and on the scale, composition, and spillover effects of capital flows. In each of the other cases the impacts of the controls were temporary 'speed bumps' that allowed Brazil to lean against the wind but were far from enough to change the course of the monetary 'tsunami' that afflicted Brazil during the period. Chile's interventions were less successful.

Exchange Rates

In Table 1 both the mean and variance regressions of the Brazilian exchange rate are displayed. The first 8 variables listed are dummies of the day of each regulation announcement. The ninth variable, 'Controls Dummy' is a dummy for the entire period for which the controls were in place. As given by the coefficients of the daily announcement dummies, in the mean regression all announcements of controls have significant returns, with the largest return of -1.9 percent coming from the first announcement of the IOF. The cumulative returns of the announcements, however, amount to only -0.3 percent. The control dummy for the entire period is also significant and negative, yet at a very small magnitude of -0.1 percent. The control dummy also has a significant effect on exchange rate volatility, with a coefficient of -0.77: a negative coefficient implies that the controls decreased exchange rate volatility. All covariates—interest rate differential, DXY, GSCI, and EMBI—are significant in both regressions. The signs of the coefficients make economic sense as well: an increase in the foreign interest rate, dollar exchange index, and EMBI spread yields a lower nominal exchange rate, while an increase in the commodity price index appreciates the exchange rate. Given the structure of the regression equation, all coefficients in this regression are an approximate measure of the impact on the log variance of the exchange rate. Finally, we find evidence of increased monetary autonomy, given by the negative coefficient on the domestic interest rate interaction variable.

According to Table 2 currency market intervention also had significant effects on the Chilean peso. We also find evidence of spillover effects from the IOF. The first five variables listed are dummies for the day each policy was announced. The sixth variable, 'Intervention

Period Dummy', is the dummy for the entire period of the intervention. As captured by the intervention announcement dummies, the announcement first had a positive impact of 0.4% on the peso level, but then a negative and larger impact the following two days of -4.4% and -1.5%. The announcement of foreign investment limits also had a fairly large effect of 1.4%. Overall though, the intervention period did not have significant effects on either the level or volatility, as indicated by the intervention period dummy. Since the coefficient on the interaction variable is not significant, we find no evidence of improved monetary autonomy. The IOF announcement had a positive and significant impact on the peso level, and a negative and significant impact on the volatility. We conclude that the onset of Brazil capital controls influenced currency markets in Chile.

Asset Prices

The results are reported in Tables 3 and 4. In Table 3 of Brazil stock prices, the first nine variables listed apply to dummies of each announcement day, while the tenth variable, 'Controls Dummy' is a dummy for the entire period of equity tax. According to Table 3, the first announcement of the IOF tax induced a statistically significant, but small drop of -0.3 percent in the Bovespa. All subsequent tax hikes yielded significant (except the second increase), positive and small returns of less than one percent. The modification announcement, which extended the tax to bonds with maturities up to 720 days, from 360 days, had a significant and negative effect of almost -1 percent. The announcement of a 60 percent reserve requirement of US dollar positions for banks also had a significant and negative, but smaller effect of -0.4 percent. Surprisingly, cumulative abnormal returns, computed by aggregating the coefficients of all announcements, of the policy announcements amounted to almost -1 percent if we exclude the ADR announcement and equity removal announcement. Brazil noted that some investors were circumventing the 2 percent IOF tax by going through the ADR market and thus put in place an ADR tax, implemented about a month after the original IOF tax. As could be expected, the ADR coefficient is positive—taxes on ADRs closed the window on ADR purchases and thus re-triggered flows to Brazil. The coefficient is also approximately -1 percent and somewhat neutralizes the cumulative impact of the IOF measures. In summary, the IOF had a lasting impact on Brazilian asset prices as well, but one that was perhaps reversed given the tax on the ADR market.

The control dummy for the entire control period did not yield a significant return, as well as the return from the interaction variable, which measures stock market independence. Hence, we do not have evidence that changes in the Bovespa became more independent of the regional markets with the implementation of the controls. We can also not conclude that the controls cooled a supposed asset price bubble, as the control dummy can measure. The abnormal returns for days following each announcement are also not significant.

In Table 4, we run a similar analysis for the Chilean Santiago Stock Exchange. Not only do we test the effects of Chilean currency intervention, but also the presence of spillover effects from the Brazilian IOF tax. The first four variables are dummies for announcement days, while the fifth variable is the dummy for the entire period of intervention. The spillover effect can be quantified by the IOF Announcement dummy, which, according to the table below, is significant and positive. However, the magnitude of the effect is small and under 0.6 percent. The announcement of Chilean intervention had no significant effects. Interestingly, the announcement of the end of the daily dollar purchases had a significant and fairly large effect on

stock prices, over 1 percent. The announcement of increases in foreign investment limits also was significant, with a magnitude of almost -1 percent. In contrast to Brazilian stock regression, we find evidence of increased stock market independence, given by the coefficient of the interaction term of 0.29. Hence, during the period of intervention the Santiago exchange and the regional stock index were less correlated, but only by 0.01 percent. Nonetheless, we find no evidence that the period of intervention had any effect of domestic stock prices. The announcements of both foreign investment limits and the Brazilian IOF, however, did have significant effects. We conclude that our analysis gives evidence of spillover effects as well as significant but small effects of intervention on asset prices and stock market independence.

Scale, Composition, and Spillover Effects of Capital Flows

The impact of the IOF on the scale and composition of inflows is also fairly consistent with the literature. As in the other cases above we find small but temporary effects of capital account regulations. Tables 5 and 6 show the effects on composition of net capital inflows. Table 5 provides a more discerning decomposition of net inflows, and more interesting results. In this table, while the announcements are not significant in the OLS regressions, the first IOF announcement as well as the announcement of the reserve requirement becomes significant in the IV regressions. Surprisingly, the effect of these announcements is positive on short-term flows and negative on long-term flows—precisely the opposite intended effect of policymakers. However, according to the dummy on all announcements, the effect on short-term flows is negative, yet under 0.01%.

Contrastingly, Table 6 of total flows and flows decomposed into FDI and non-FDI flows do not yield significant effects from the first IOF announcement. The all-announcement dummy is positive and significant in the OLS regressions of total and FDI flows, yet loses its significance with the instrument. Yet, not only are most of the variables insignificant, but also very small in magnitude.

To complement the cross-sectional analysis, we create a panel of three Latin American countries in order to obtain a better measure of the effect of the IOF on Brazilian flows in relation to neighboring EMEs. The other countries are Chile and Colombia. Preferably, we would like to include a wider dataset; however, other Latin American EMEs have substantially less developed markets and also do not have monthly data for capital flows or GDP. Here, we do not include all other announcement dummies as they were not significant. In the panel regression, the covariates except the forward exchange rates are significant. The IOF announcement has positive and significant effects on total and non-FDI inflows of 0.014% and 0.033%, respectively. The all-announcement dummy, however, yields a positive, significant effect on FDI of 0.013%. Again, the findings are somewhat puzzling. However, both in Brazil and in the larger literature there is increasing concern that in the face of capital controls that investors ‘disguise’ short-term capital flows through financial FDI (Spiegel, 2012). The signs on these coefficients lend some credence to such claims, but cannot confirm them. The results are depicted in Table 7.

Table 8 gives the potential spillover effects of Brazil's controls on Chilean inflows. Here we run a cross-sectional regression of the Chilean capital account. Since the results did not report any significant coefficients beyond for the dummies of interest, we find no evidence of spillover effects.

7. Conclusion

In our paper we have examined the effects of attempts to navigate volatile capital in Brazil and Chile. We find statistically significant impact of Brazilian controls. However, we would characterize our findings as evidence of temporary ‘speed bumps’ that helped Brazil lean against the wind rather than reversing ‘tsunami’ of capital inflows that afflicted the country during this period.

In Brazil, we find that the introduction of capital controls was associated with an increase in total inflows but that the composition was shifted from short to longer-term inflows. We also find that Brazil’s measures had a lasting impact on the level and volatility of the exchange rate. In terms of asset prices, only announcements of controls were effective, and were offset by regulations on the ADR market that send investors back to Brazil. We also find that Brazil’s measures modestly increased the ability of Brazil to pursue an independent monetary policy. Chile’s currency interventions were less successful. The announcement of currency intervention reduced the level of the exchange rate, but not the volatility, and made the domestic stock market more independent from the region as a whole. Chile’s interventions had no statistically significant impact on total inflows of capital, the composition of inflows, or the ability of Chile to pursue an independent monetary policy.

More specifically, effects on the Brazilian exchange rate are similar: all announcements have a statistically significant impact, with the first IOF announcement have the largest negative effect, though small in magnitude. The overall effect of the controls is significant, but small. In regards to asset prices, we find that the announcements of the IOF and subsequent policy changes have statistically significant effects on the Bovespa. Particularly, the cumulative impact of all announcements is negative, yet small. However, the overall effect on the period during which the controls are in place is not significant.

In Brazil, controls did have significant impact on total inflows as well as the composition of flows, yet the effects are fairly small. The impact of announcements and overall impact are significant, but again small.

For Chile we find that Brazil’s cross-border financial regulations seemed to increase capital inflows to Chile for a short-period, but not a lasting one. Moreover, Chile’s reserve accumulation measures had only temporary effects in Chile and did not withstand the markets over time.

Our findings are consistent with the research on capital account regulations as reported by Magud et al. (2011) and Ostry et al. (2010). From a policy perspective we can further confirm that these measures can impact exchange rate appreciation and the development of asset bubbles. However, it is not clear from our analysis that such measures should be conduct alone but should rather be part of a wider package of macro-prudential policies. From our analysis, capital controls alone will not be sufficient to address the concerns about capital flow volatility unless they are much stronger and better enforced. Indeed, our finding that the controls were associated with a shift toward FDI may lend credence to claims that capital account regulations encourage some investors to circumvent regulation by disguising short-term capital flows as FDI. Finally, our parallel analysis of Chile finds that intervening in currency markets can have an even weaker effect than capital flow management measures and be costly in terms of their opportunity costs (Aizenman, 2010).

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Table 1: Brazilian Real

	BRL	
	Mean Equation	Variance Equation
IOF Announcement	-0.0186*** (0.000328)	
ADR Announcement	0.00303*** (0.000507)	
IOF Increase	0.0131*** (0.000537)	
IOF Increase	0.00711*** (0.000933)	
Reserve Requirement	0.00622*** (0.000519)	
IOF Increase	0.0105*** (0.000456)	
IOF Modified	-0.0160 (0.0107)	
Tax on Derivatives	-0.00508*** (0.000583)	
Controls Dummy	-0.00144** (0.000685)	-0.772*** (0.192)
Domestic Interest Rate * Controls	-0.232*** (0.0478)	13.06 (8.451)
Domestic-Foreign Interest Rate Diff.	-0.0589*** (0.0193)	4.557* (2.632)
DXY	-0.542*** (0.0584)	-35.63 (22.78)
GSCI	0.153*** (0.0236)	-24.65 (16.91)
EMBI	-0.0644*** (0.0125)	26.82*** (5.849)
Constant	0.00127** (0.000640)	-11.32*** (0.466)
Observations	762	
Wald	7.06e+10	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Chilean Peso

	CLP	
	Mean Equation	Variance Equation
IOF Announcement	0.00562*** (0.00147)	-1.281** (0.536)
Investment Limits Dummy	0.0137*** (0.000458)	
Intervention Announcement	0.00393*** (0.000402)	-217.2 (166.8)
Announcement Day+1	-0.0444*** (0.000616)	
Announcement Day+2	-0.0146*** (0.000725)	
Intervention Period Dummy	-0.000125 (0.000420)	-0.218 (0.161)
Domestic Interbank Interest Rate	0.000766 (0.000566)	-0.712 (0.545)
Interest Rate * Intervention Dummy	0.000554 (0.000621)	0.430 (1.866)
LIBOR	-0.0436 (0.0444)	-23.82 (17.67)
DXY	-0.328*** (0.0473)	-19.06 (14.01)
GSCI	0.0715*** (0.0176)	-3.953 (5.622)
EMBI	-0.0563*** (0.00897)	-1.330 (3.186)
Constant	0.000357 (0.000239)	-10.45*** (0.113)
Observations	844	
Wald	7.81e+08	

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Brazilian Stock Exchange

	Bovespa
IOF Announcement	-0.00321*** (0.000784)
ADR Announcement	0.0133*** (0.000535)
IOF Increase	0.00263*** (0.000421)
IOF Increase	0.000718 (0.000817)
Reserve Requirement	-0.00447*** (0.000287)
IOF Increase	0.00115*** (0.000291)
IOF Modified	-0.00903*** (0.000284)
Tax on Derivatives	0.00314*** (0.000656)
Equity Tax Removal	-0.00617*** (0.000288)
Controls Dummy	-0.000338 (0.000614)
MSCI EM Latin America	0.769*** (0.0238)
MSCI*Controls	0.0227 (0.0332)
Constant	0.000197 (0.000547)
Observations	728
R^2	0.828

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Chilean Stock Exchange

	Santiago
IOF Announcement	0.00553*** (0.000568)
Investment Limits Dummy	-0.00971*** (0.000486)
Intervention Announcement	-0.000336 (0.000953)
Intervention Ended	0.0122*** (0.000743)
Intervention Period Dummy	-0.00110 (0.000680)
MSCI EM Latin America	0.303*** (0.0156)
MSCI*Intervention	0.293*** (0.0505)
Constant	0.000968*** (0.000267)
Observations	816
R^2	0.495

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Brazil Long-Term and Short-Term Net Inflows

	Long-Term	Long-Term(IV)	Short-Term	Short-Term(IV)
IOF Announcement	-0.0415 (0.0245)	-0.0450* (0.0256)	0.0317 (0.0242)	0.0503* (0.0289)
IOF Increase	-0.0262 (0.0222)	-0.0304 (0.0248)	0.0232 (0.0195)	0.0305 (0.0289)
Reserve Requirement	-0.0144 (0.0162)	-0.0195 (0.0194)	0.0273* (0.0157)	0.0315** (0.0130)
IOF Increase	-0.0146 (0.0195)	-0.0181 (0.0191)	0.00620 (0.0198)	0.0115 (0.0155)
Tax on Derivatives	0.0181 (0.0141)	0.0151 (0.0186)	-0.00338 (0.0166)	-0.00634 (0.0179)
All Announcement Dummy	0.0250 (0.0187)	0.0290 (0.0192)	-0.00952 (0.0156)	-0.0170* (0.00870)
Controls Dummy	-0.000294 (0.00829)	0.00287 (0.0100)	-0.00355 (0.0123)	-0.00573 (0.0239)
Lagged Long-Term	-0.382* (0.190)	-0.213 (0.551)		
Current Account	0.357 (0.467)	0.647 (0.527)	-0.0937 (0.889)	-0.657 (1.223)
VIX	-0.286** (0.130)	-0.330** (0.126)	0.148 (0.180)	0.235* (0.120)
EMBI	0.0256 (0.0191)	0.0344 (0.0224)	-0.0262 (0.0279)	-0.0412** (0.0156)
Carry Trade Index	0.0542 (0.0378)	0.0726* (0.0418)	-0.0242 (0.0544)	-0.0651* (0.0336)
Forward Premium	0.0170 (2.094)	-1.331 (3.203)	2.169 (2.661)	4.614 (3.796)
Domestic Interest Rate	-0.203 (0.748)	-0.635 (0.855)	-0.438 (1.150)	0.466 (0.609)
US Interest Rate	4.298 (12.02)	8.763 (17.80)	6.474 (17.39)	7.351 (22.61)
Lagged Short-Term			-0.290 (0.269)	-0.434 (0.984)
Constant	-0.0779 (0.107)	-0.124 (0.149)	0.180 (0.117)	0.238* (0.129)
Observations	36	35	36	35
R^2	0.627	0.677	0.495	0.641

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Brazil Total, Non-FDI, and FDI Net Inflows

	Total	Total(IV)	Non-FDI	Non-FDI(IV)	FDI	FDI(IV)
IOF Announcement	-0.0191 (0.0237)	-0.0505 (0.230)	0.0200 (0.0229)	0.00360 (0.235)	-0.0262 (0.0188)	-0.0254 (0.0259)
IOF Increase	-0.0321 (0.0324)	-0.108 (0.465)	0.0239 (0.0192)	-0.00745 (0.285)	-0.0326 (0.0196)	-0.0339* (0.0193)
Reserve Requirement	0.00235 (0.0167)	-0.0226 (0.161)	0.0109 (0.0221)	0.0195 (0.0464)	-0.00558 (0.0180)	-0.0135 (0.0303)
IOF Increase	-0.0142 (0.0179)	-0.0287 (0.101)	0.0303 (0.0228)	0.0100 (0.207)	-0.0351* (0.0201)	-0.0297 (0.0295)
Tax on Derivatives	0.00770 (0.0157)	-0.00606 (0.0865)	0.0295* (0.0153)	0.0153 (0.110)	-0.0155 (0.0131)	-0.0124 (0.0149)
All Announcement Dummy	0.0198** (0.00907)	0.0313 (0.0937)	-0.00776 (0.0120)	-0.00490 (0.0757)	0.0233 (0.0156)	0.0242 (0.0164)
Controls Dummy	-0.0131 (0.0176)	-0.0391 (0.149)	0.000125 (0.0144)	-0.0166 (0.102)	-0.00464 (0.00825)	-0.00276 (0.00803)
Lagged Total Flows	0.324 (0.373)	2.004 (10.04)				
Current Account	-0.195 (0.605)	-1.353 (4.961)	0.109 (0.813)	-1.055 (5.042)	0.118 (0.423)	0.364 (0.447)
VIX	-0.131 (0.144)	-0.122 (0.276)	0.142 (0.221)	0.113 (0.945)	-0.250** (0.117)	-0.236 (0.190)
EMBI	0.0126 (0.0286)	0.0469 (0.237)	-0.0331 (0.0360)	-0.0213 (0.208)	0.0334* (0.0179)	0.0349 (0.0222)
Carry Trade Index	0.0444 (0.0504)	0.0875 (0.353)	-0.0354 (0.0631)	-0.0434 (0.224)	0.0672* (0.0327)	0.0779** (0.0344)
Forward Premium	-2.451 (3.396)	-14.64 (78.54)	1.618 (2.559)	0.267 (24.60)	-1.113 (1.663)	-2.773 (4.197)
Domestic Interest Rate	-0.748 (0.957)	-1.122 (4.551)	-0.575 (1.217)	0.299 (1.419)	-0.188 (0.653)	-0.595 (0.692)
US Interest Rate	13.02 (13.31)	14.14 (20.06)	0.791 (17.94)	-9.109 (67.81)	14.47 (10.11)	18.56 (15.03)
Lagged Non-FDI Flows			-0.204 (0.233)	0.567 (6.460)		
Lagged FDI Flows					0.0154 (0.199)	0.319 (1.078)
Constant	-0.0544 (0.161)	-0.452 (2.471)	0.269* (0.151)	0.142 (1.416)	-0.206** (0.0889)	-0.228** (0.0954)
Observations	36	35	36	35	36	35
R^2	0.652	.	0.586	0.259	0.558	0.588

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Total, Non-FDI, and FDI Net Inflows

	Total Flows	Non-FDI Flows	FDI Flows
IOF Announcement	0.0272* (0.00756)	0.0487** (0.0109)	-0.0215 (0.0185)
All Announcement Dummy	0.00935 (0.00671)	-0.00803* (0.00187)	0.0174* (0.00483)
Controls Dummy	0.0317 (0.0162)	0.0308 (0.0137)	0.000860 (0.00427)
Current Account	-1.251** (0.197)	-1.119** (0.232)	-0.132* (0.0358)
Domestic-US Interest Rate Diff.	-0.0855 (0.143)	-0.140 (0.387)	0.0542 (0.345)
Constant	0.0695 (0.0981)	0.0160 (0.0676)	0.0535 (0.0433)
Observations	111	111	111
R^2	0.458	0.405	0.346

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Chilean Net Inflows and Spillover Effects

	Total Flows	Non-FDI Flows	FDI Flows
IOF Announcement	0.0274 (0.181)	0.0234 (0.220)	0.00664 (0.0847)
BrazilControls	-0.0579 (0.0604)	-0.0629 (0.0890)	0.0118 (0.0535)
Chile Intervention Dummy	0.00719 (0.142)	-0.00673 (0.181)	0.00520 (0.0925)
L.Total Flows	-0.290*** (0.101)		
Current Account	-1.223* (0.704)	-1.333 (0.862)	0.117 (0.512)
VIX	0.515 (1.044)	-0.204 (1.362)	0.550 (0.598)
EMBI	0.0321 (0.0821)	0.0849 (0.0916)	-0.0629 (0.0470)
Carry Trade Index	-0.335 (7.893)	1.014 (9.149)	-0.810 (3.143)
Forward Exchange Rate	8.368 (49.37)	1.550 (57.58)	2.122 (20.06)
Domestic Interest Rate	-0.519 (2.239)	-1.703 (2.103)	1.355 (1.349)
US Interest Rate	36.44 (195.0)	121.2 (230.2)	-71.62 (70.51)
L.Non-FDI Flows		-0.171 (0.141)	
L.FDI Flows			-0.326 (0.198)
Constant	-1.432 (1.099)	-1.795 (1.263)	0.729 (0.668)
Observations	36	36	36
R^2	0.246	0.206	0.224

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$