ISSN 1936-5330

kcFED Research Working Papers

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September 2021; updated December 2021
RWP 21-08
http://doi.org/10.18651/RWP2021-08

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Capital Controls and the Global Financial Cycle*

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Working Paper

December 6, 2021

Abstract

Capital flows into emerging markets are volatile and associated with risks, which renewed interest in capital controls as a policy tool. This paper documents that emerging markets increase capital inflow restrictions during episodes of major international financial distress, like the Global Financial Crisis or the Dot-Com Bubble. We develop a model in which this behavior arises from a desire to manipulate the risk premium. When investors are more risk-averse or markets are volatile, investors require a high marginal compensation to hold risky emerging market debt, thus incentivizing regulators to limit capital inflows. However, these interventions are only optimal from the perspective of the individual emerging market and reduce global welfare, adding a cautious note on the desirability of capital controls.

Keywords: Capital Controls; Risk Aversion; Volatility; Risk Premium

JEL: F36, F38, F41

*We thank Paul Bergin, Huixin Bi, Brent Bundick, Nicolas Caramp, Andrés Carvajal, Catherine Co, Athanasios Geromichalos, Karel Mertens, José Mustré-del-Río, Jun Nie, Pablo Ottonello, Sanjay R. Singh, Alan M. Taylor and participants at several seminars for valuable comments on the paper. The views expressed in this paper are those of the authors and do not necessarily represent those of the Federal Reserve Bank of Kansas City or the Federal Reserve System. Declarations of interest: none.

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1. Introduction

The financial integration of emerging markets (EMs) has rekindled a debate on the advantages and disadvantages of international financial flows. Despite widely recognized benefits of foreign capital, sudden stops may have sustained negative effects on macroeconomic and financial stability (Reinhart and Rogoff, 2011; Forbes and Warnock, 2012). The IMF shares this view and advocates capital controls under certain circumstances to address international capital surges (Ostry et al., 2010; Ostry et al., 2011). This policy proposal is supported by a new theoretical literature, which stresses that emerging markets may borrow excessively on international markets due to externalities that private agents do not internalize (see, for example, Bianchi, 2011). Though the specific externality varies, the common policy prescription is to impose macroprudential capital controls, that is, to tighten restrictions during economic booms associated with high external credit growth. However, recent applied work (Eichengreen and Rose, 2014; Fernández et al., 2015) has struggled to identify such "optimal" use in practice with the exception of Brazil (Chamon and Garcia, 2016).[1]

The purpose of this paper is to provide a novel rationale for capital controls that is consistent with their usage in emerging markets. We first document a new stylized fact: Emerging markets tend to tighten capital inflow restrictions during periods of major financial distress. We identify three episodes: The Global Financial Crisis, the Dot-Com Bubble and to a lesser extent the Asian Financial Crisis. We then propose a theoretical framework that is able to rationalize this finding. We model a standard small open economy, but augment the canonical framework with two features, risk-averse international investors and risky emerging market debt. Both ingredients help explain why sovereign bond spreads and capital inflows respond to characteristics unrelated to the domestic economy like investor sentiments or the riskiness of international financial markets (see, for example, Gonzalez-Rozada and Levy Yeyati, 2008; Longstaff et al., 2011; Lizarazo, 2013). An important implication of these features is that emerging markets must pay a higher risk premium when investors are more sensitive to risk or when international markets are volatile. Higher borrowing costs in turn incentivize regulators to reduce the amount of debt via capital inflow controls, similar to Aguiar and Gopinath (2006), who argue that governments would not borrow a lot when the bond price function is extremely steep.

Our emphasis on the incentives of regulators to manipulate borrowing costs are complementary to the existing capital controls literature based on externalities. Capital

[1] A complementary literature studies the effectiveness of capital controls. Rebucci and Ma (2019) and Erten et al. (2021) provide an extensive review of this literature.

controls in these models address an underlying inefficiency and therefore improve welfare on aggregate.[2] In contrast, intervention in our model is due to regulators that are able to influence borrowing costs. Thus, capital controls are only desirable from the perspective of the emerging market, but decrease global welfare.

In the first part of the paper, we empirically assess how regulators adjust capital controls in response to global financial conditions. Our sample covers three periods of global financial distress: the Asian Financial Crisis in 1997, the Dot-Com Bubble in the early 2000s and the Global Financial Crisis of 2007-2008. We show that particularly during the latter two episodes, a significant share of countries imposed additional capital inflow restrictions, which were subsequently reversed. These associations prevail even after we control for various factors that should influence regulators to implement or discontinue capital controls. Furthermore, we decompose financial distress, as proxied by the Chicago Board Options Exchange Volatility Index (VIX), into volatility and risk aversion following Bekaert and Hoerova (2014), and establish a positive link between capital controls and the two aforementioned structural factors.

In the second part of the paper, we formally analyze these empirical facts. We build a stylized two-period open economy model with two agents: international investors and borrowers from an emerging market. To smooth consumption, borrowers issue international debt, which international investors purchase. Our model has three crucial features: First, international investors are risk-averse. Consequently, they require compensation in the form of a risk premium that is increasing in the share of risky assets in the total portfolio. Second, following empirical evidence, we allow for default in emerging market debt. This feature implies that borrowers are required to pay a risk premium that endogenously depends on the aggregate amount of debt issued by the emerging market. Third, and once again driven by data, we impose a positive correlation between the risk profile of international financial markets and the emerging market. International investors, therefore, avoid emerging market bonds as a hedge against volatile international financial markets.

We then contrast the unregulated equilibrium with a national planner (regulator), who maximizes welfare on behalf of all households in the emerging market. The planner controls aggregate debt and therefore internalizes the positive relationship between aggregate debt and the country-specific risk premium required by investors. This increases the perceived cost of debt and, as a consequence, a planner issues less international debt than households. The planner equilibrium is subsequently

[2] Papers with pecuniary externalities include Bianchi (2011), Benigno et al. (2013, 2016), Korinek and Sandri (2016), Korinek (2018) or Ma (2020). Aggregate demand externalities are featured in Farhi and Werning (2016), Korinek and Simsek (2016) or Schmitt-Grohe and Uribe (2016).

decentralized with a tax that is akin to price-based capital inflow controls. The basic concept hence resembles the optimal tariff argument in Obstfeld and Rogoff (1996), who advocate imposing tariffs when households borrow and import to decrease the price of debt.

Importantly, intervention via capital controls in our framework increases with the risk aversion of investors and volatility in international financial markets. The intuition is as follows: If investors are more risk-averse, they require a higher marginal compensation for holding emerging market debt. Because a monopolistic planner internalizes this heightened sensitivity, debt becomes more expensive from the planner's perspective. The planner ceteris paribus issues less debt, which is decentralized with tighter capital inflow controls. The relationship between capital controls and international financial volatility is more nuanced. If international markets are more volatile, investors will attempt to hedge against this additional risk. However, emerging market bonds perform poorly when international markets are risky and are hence not a good hedge; as a result, volatility in international markets decreases the relative demand for emerging market bonds. Investors will thus require a higher marginal compensation to hold these bonds, which ceteris paribus increases intervention via capital controls similar to the argument on risk-aversion.

The justification for capital control relates to the assumption that a regulator is able to influence the country-specific risk premium, even though we do not require any impact on world interest rates. An emerging market has a natural monopoly on its own debt. However, most emerging markets are small and compete for funds with other countries, which may limit their influence on the risk premium. To shed light on these issues, we first vary the size of the emerging market. We find that intervention increases with country size, both in the model and in the data. Intuitively, investors are less sensitive to a smaller emerging market, because its debt constitutes a smaller fraction of the overall portfolio. As a second experiment, we add another emerging market that competes for funds from international investors. We analyze unilateral capital controls and a Nash equilibrium where both countries are allowed to impose capital controls taking the action of the other regulator as given. The main insight from this experiment is that intervention also depends on the business cycle comovement between two emerging countries. If business cycles in the two economies are synchronous, bonds have a similar risk profile and are therefore jointly riskier. As a result, investors demand additional compensation, which ceteris paribus increases regulatory intervention.

At the core of our results is the desire of emerging markets to lower the risk premium via capital inflow controls. Both theoretical and empirical evidence suggest that risk premiums are central to emerging market policymakers, making this channel plausible. From a theoretical perspective, the idea that countries have monopoly power and might wish to alter relative prices via capital controls is related to De Paoli and Lipinska (2012) and Costinot et al. (2014). In De Paoli and Lipinska (2012), a regulator has an incentive to manipulate the intratemporal terms of trade. In our framework, a regulator finds it optimal to alter the risk premium and hence intertemporal prices. This is similar to Costinot et al. (2014), where capital inflow controls are imposed to manipulate the world interest rate. Our paper differs in two ways: first, we only require an influence on the domestic risk premium rather than world interest rates. Second, capital controls in our framework are driven by the risk aversion of investors and uncertainty in international financial markets, features that are not discussed in Costinot et al. (2014). Our work is also related to Bocola and Lorenzoni (2020), where governments intervene to improve domestic financial stability. These policies lower the risk-premium and allow borrowers to borrow more in domestic rather than foreign currency. On the empirical side, Uribe and Yue (2006), Akinci (2013), and Bhattarai et al. (2020) among others emphasize the importance of emerging market spreads in determining business cycle fluctuations and that spreads transmit global financial shocks to the domestic economy. Country spreads and hence risk premiums are therefore a primary concern for policymakers in emerging markets.

2. Stylized Facts

This section provides two new insights: First, we suggest a simple algorithm to identify emerging markets that actively evaluate their capital control policies. Second, we show that these "active" emerging markets respond to global financial conditions, particularly to investors' risk aversion and volatility in international financial markets.

2.1. Active Capital Control Management

Though capital controls are common among emerging markets, they tend to be persistent (Klein, 2012), which poses a challenge in detecting any regularities. We, therefore, first identify "active" countries that frequently adjust their capital controls.

We resort to Fernández et al. (2016) for annual data on capital controls. The authors manually interpret and code inflow and outflow restrictions for up to ten categories provided by the Annual Report on Exchange Arrangements and Exchange Restrictions

(AREAER) since 1995. The distinction between inflow and outflow restrictions is both policy-relevant and theoretically appealing. Much of the recent policy debate centers around managing capital inflows from international investors (see, for example, Ostry et al., 2010; Ostry et al., 2011; Forbes et al., 2015). Further, from a theoretical perspective, capital controls are meant to curb current account reversals for indebted countries, which subsequently justifies inflow restrictions (see, for example, Bianchi, 2011; Schmitt-Grohe and Uribe, 2016; Korinek, 2018). The model we propose in the next section also advocates inflow controls. We consider inflow restrictions from all categories but exclude foreign direct investment (FDI), since FDI investments are long-term and politically motivated. We aggregate restrictions and normalize this index between $[0,1]$ ("Inflow Restriction Index"), where 1 refers to inflow restrictions in all asset classes excluding FDI. Data is available for 68 EMs over 23 years.

The major disadvantage with the Fernández et al. (2016) capital control measure relates to its extensive margin. Restrictions on each asset category are binary. We therefore cannot capture the intensity of capital controls (see, for example, Forbes et al., 2015; Ghosh et al., 2017; Acosta-Henao et al., 2020). However, as Acosta-Henao et al. (2020) show, the persistence of capital controls is "quite robust", regardless whether capital control indices are constructed based on the extensive or intensive margin. This notion is also supported by Fernández et al. (2015) who showcase that the "aggregation of binary indices across a number of finely defined asset categories [...] effectively captures the use of controls along the more direct intensive margin." Further, the intensive margin measures cover a shorter time period, fewer countries and are only available for a narrow set of assets.

There is no established procedure to identify countries with active capital controls. Hence, we focus on a plausible condition and refer the reader to the appendix for a host of robustness checks. As a baseline, we identify a country as active if its inflow restrictions are more volatile than the sample average across all countries. We proceed in two steps. We first compute the standard deviation of changes in the Inflow Restriction Index across all countries and years. We then compare this number to the standard deviation of each country and classify a country as active if its standard deviation is higher than the sample average. We prefer a threshold based on the standard deviation over a threshold based on the number of years in which a country changed its capital controls. The latter only captures the frequency of adjustments, but not the number of adjustments during a year.

Table 1 lists the 22 EMs that satisfy our criterion ranked by the country-specific standard deviation (column 1). In column 2, we report the relative frequency at which countries adjust their capital controls. All countries except Uganda change their capital inflow controls at least every five years (Change > 0.2). Some countries like Brazil, Columbia, Kazakhstan, or Russia adjust their controls at least every second year on average (Change > 0.5). Columns 3 and 4 split changes in capital inflow restrictions into increases or decreases. As apparent, most countries tend to balance their adjustments.[3]

Table 1: *Active Countries: Descriptive Statistics*

Country	Std. Dev.	Change	Increase	Decrease
Algeria	.294	.5	.318	.182
Moldova	.244	.478	.304	.174
Brazil	.23	.609	.348	.261
Argentina	.213	.522	.391	.13
Nigeria	.18	.391	.174	.217
Hungary	.172	.261	.174	.087
Kazakhstan	.169	.739	.261	.478
Bahrain	.165	.522	.261	.261
Venezuela	.152	.391	.304	.087
Chile	.147	.348	.087	.261
Ethiopia	.134	.391	.217	.174
Poland	.134	.478	.174	.304
Bulgaria	.132	.217	.087	.13
Vietnam	.122	.391	.217	.174
Colombia	.119	.609	.391	.217
Russian Federation	.118	.565	.217	.348
Ecuador	.113	.304	.13	.174
Uganda	.11	.087	.043	.043
Ghana	.109	.391	.174	.217
Tanzania	.109	.391	.174	.217
Lebanon	.105	.435	.261	.174
Mexico	.103	.435	.217	.217

Notes*: Column 1 displays the standard deviation of capital inflow control adjustments for each country. Columns 2-4 portray the relative frequency that a country changes/increases/decreases its capital inflow controls. The statistics are computed as the number of years with changes/increases/decreases divided by the number of years with available data. Sample: 1995-2017.*

2.2. Capital Controls during Global Financial Distress

The new empirical insight from this paper is that active emerging markets temporarily adjust their capital inflow restrictions in response to elevated international financial distress. In particular, we identify three episodes: the Global Financial Crisis, the Dot-Com Bubble, and the Asian Financial Crisis. During all three periods we observe

[3]We provide a comparison between active and inactive countries along various dimensions in Table B7. A few differences are noticeable. Active countries have a larger current account deficit, a lower credit to GDP ratio, higher GDP, a more volatile exchange rate, and are more likely to face banking crises.

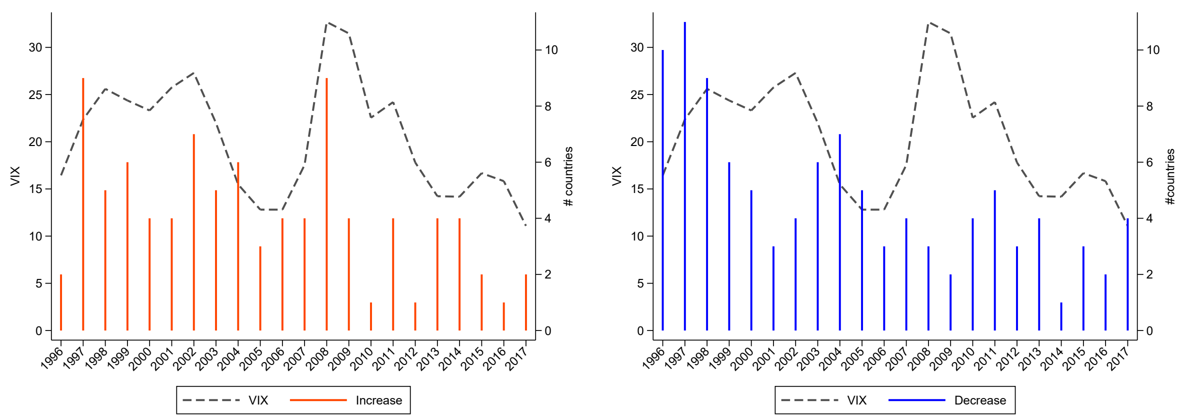
a sizable increase in the number of countries imposing capital inflow controls. A decomposition of financial distress into risk aversion and volatility reveals that both factors contribute to this finding.

We proxy international financial conditions by the VIX. This index measures the volatility of the U.S. stock market (S&P 500) and is based on option prices (so-called "implied volatility"). As high values of the VIX are associated with plummeting asset prices around the world, it has been widely used in the literature to proxy for global financial conditions (Bekaert et al., 2013; Bruno and Shin, 2014; Ghosh et al., 2014; Miranda-Agrippino and Rey, 2020).

Figure 1 provides descriptive statistics on the comovement of capital inflow restrictions and global financial distress. Both panels plot the VIX against the number of active countries that increased (Panel (a)) or decreased (Panel (b)) inflow restrictions in any asset category (excluding FDI) relative to the previous year. Based on Panel (a), active emerging markets tend to increase capital inflow controls during periods of elevated global financial distress. At the height of the 2008 Financial Crisis, for example, nine countries (41% of all active countries) imposed additional restrictions. We see similar spikes around the Dot-Com Bubble and the Asian Financial Crisis. In contrast, only few countries increase restrictions during financially stable periods, specifically, between the years 2005 and 2007 or post 2008.

Figure 1: *Capital Inflow Controls and the Global Financial Cycle*

(a) *Increase* ***(b)*** *Decrease*



Notes*: The orange (blue) bars represent the number of active emerging markets (counted on the right y-axis) that increased (decreased) their capital inflow controls during a given year. The dashed grey line displays the VIX (level displayed on the left y-axis).*

We make the following observations in Panel (b): The late 1990s were generally associated with capital market liberalizations across emerging markets. Thus, despite the hike in countries increasing restrictions during the Asian Financial Crisis, overall more countries decreased restrictions. This is not the case during the Dot-Com Bubble and the Global Financial Crisis, where only very few countries decreased restrictions.

We subsequently zoom in on countries that increased capital inflow restrictions during the Dot-Com Bubble and/or the Global Financial Crisis. Table 2 lists all countries that increased capital inflow restrictions during either or both (asterisk *) events. We count 15 countries out of which 7 countries raised restrictions during both episodes.

Table 2: *Countries Responding to Global Financial Distress*

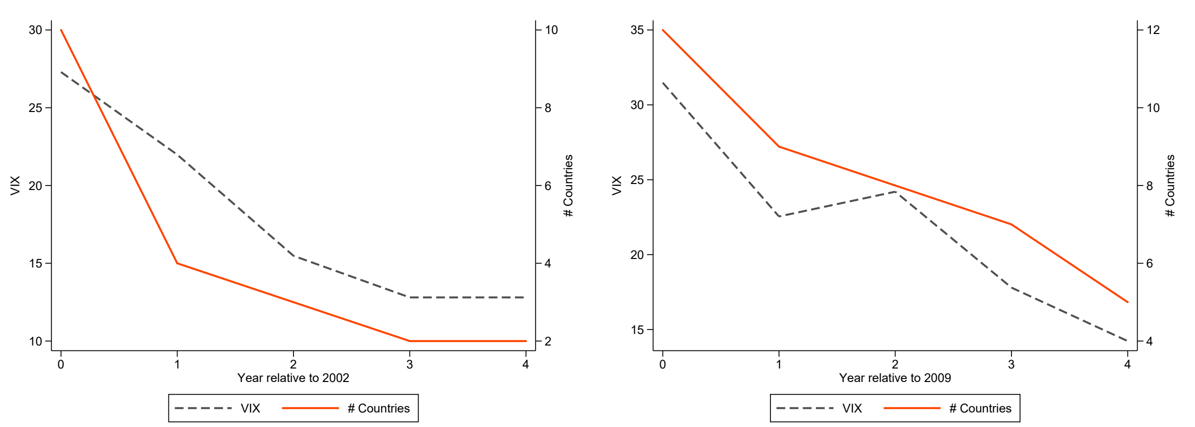
Algeria*	Chile	Lebanon*	Tanzania
Argentina*	Colombia*	Moldova*	Venezuela*
Bahrain	Ethiopia*	Nigeria	Vietnam
Brazil	Kazakhstan	Russia	.

Notes: *This list shows all countries that increased their capital inflow restrictions during the Dot-Com Bubble or the Global Financial Crisis. Countries marked with an asterisk (*) enhanced their inflow restrictions during both episodes.*

In Figure 2, we show that the majority of these 15 countries only temporarily increased capital inflow controls during the Dot-Com Bubble (Panel (a)) or the Global Financial Crisis (Panel (b)). In more detail, each plot portrays the number of countries (solid red line) that increased their restriction during the crisis, but subsequently did not reverse their decision once global financial markets stabilized.

Figure 2: *Persistence of Capital Inflow Restrictions*

(a) *Dot-Com Bubble* ***(b)*** *Global Financial Crisis*



Notes: *The solid red lines depict the number of countries (counted on the right y-axis) that increased capital inflow restrictions during the Dot-Com Bubble (Panel (a)) or the Global Financial Crisis (Panel (b)), but did not decrease restrictions h years after the last crisis. The dashed grey line displays the VIX (level displayed on the left y-axis).*

Focusing on Panel (a), we see that 8 of 10 countries reduced their capital inflow controls within 3 years after the Dot-Com Bubble. Similarly, 7 out of the 12 countries lowered capital inflow controls within 4 years after the Global Financial Crisis. It thus appears that many of these restrictions were temporary and imposed to deal with extraordinary financial turmoil.

Regression analysis

We next provide more nuanced results based on a formal regression analysis. First, we regress the two indicators (Increase, Decrease) on a cubic ln(VIX) polynomial:

$$Prob(y_{i,t} = 1) = F\left(\beta_0 + \beta_1 ln(VIX)_t + \beta_2 ln(VIX)_t^2 + \beta_3 ln(VIX)_t^3\right) \qquad (1)$$

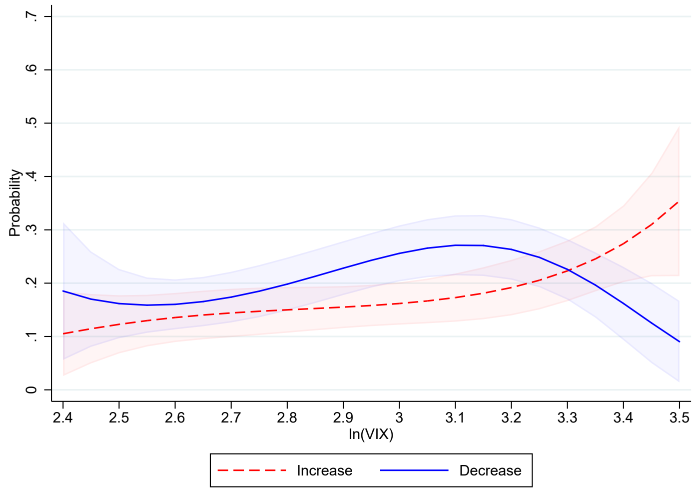
where $y_{i,t} \in \{\text{Increase}_{i,t}, \text{Decrease}_{i,t}\}$. The term $F(\cdot)$ refers to the logistic function. We choose a third-order polynomial to capture the non-linear relationship between the decision to increase/decrease capital flow restrictions and global financial conditions. As evident from Figure 3 and consistent with the previous descriptive analysis, countries are significantly more likely to increase restrictions once international financial markets are in distress (dashed red line). On the contrary, countries are most likely to decrease restrictions during moderate levels of financial distress (solid blue line). The difference between the two regression lines is significant, primarily for high levels of the VIX. This is in line with the previous descriptive evidence: episodes of elevated international financial distress are driving our results.

Decomposing the VIX

The VIX proxies for international financial distress and is derived from option prices. As is well known in the literature (see, for example, Bliss and Panigirtzoglou, 2004; Jackwerth, 2015) option prices contain information about risk aversion and volatility. Intuitively, if markets are volatile, it is more likely that options will be in the money at the expiration date, which increases the value of an option. Similarly, if investors are more risk-averse, demand for, and ultimately the price of, options increases. Because the VIX is a function of underlying option prices it is therefore possible to reverse engineer measures for risk aversion and uncertainty. We follow Bekaert and Hoerova (2014) and work with their decomposition of the VIX. Figure 4 displays the corresponding risk aversion and volatility series.[4] Both series exhibit similar patterns and are highly correlated with the VIX: they spike during the Global

[4] The volatility series depicts the conditional volatility of the S&P 500 index. Risk aversion is referred to as variance premium in Bekaert and Hoerova (2014). The variance premium is a widely accepted proxy for market-implied risk aversion (Bollerslev et al., 2009; Bekaert and Hoerova, 2014).

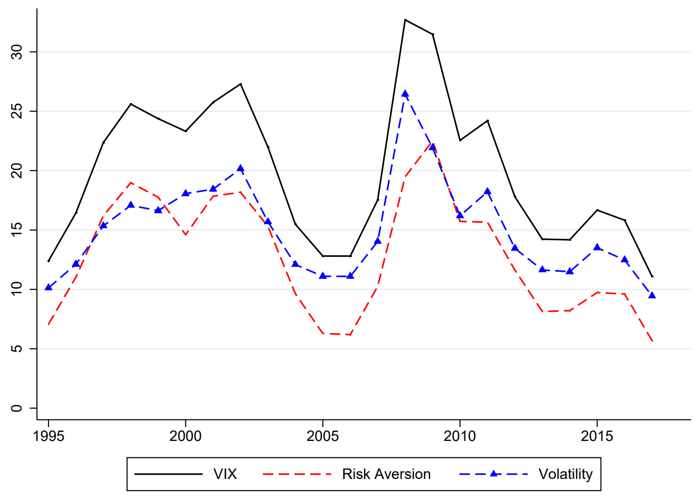
Figure 3: Capital Controls and the VIX



Notes: The dashed red (solid blue) line displays the probability of increasing (decreasing) capital inflow controls (y-axis) as a function of ln(VIX) (x-axis). Shaded areas indicate 90% predictive margins. The underlying regression model is a logit model with a cubic polynomial and no control variables as portrayed in Equation (1). Active emerging markets only. Sample: 1995-2017.

Financial Crisis and reach elevated levels during the Asian Financial Crisis and the Dot-Com Bubble.

Figure 4: Decomposing the VIX: Risk Aversion and Volatility

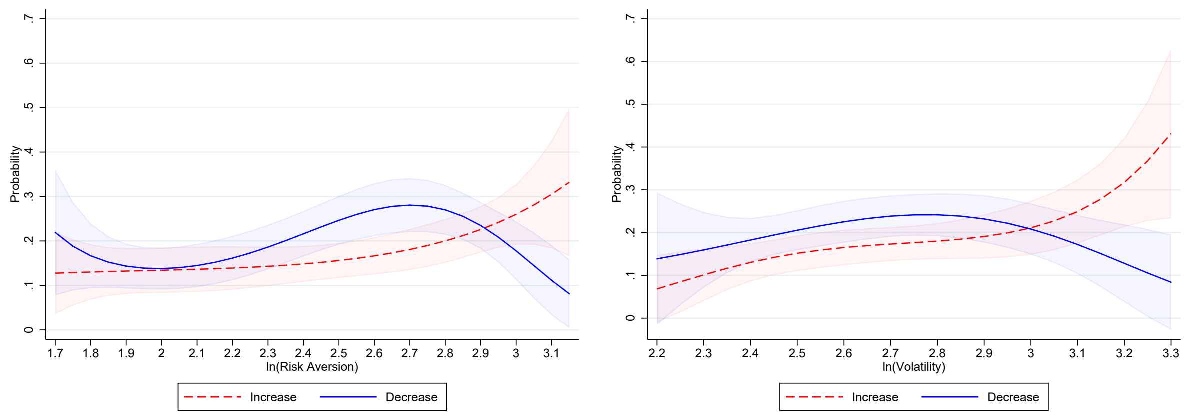


Notes: Time series of VIX (solid line), risk aversion (dashed red line) and volatility (dashed blue line with triangle markers) from 1995 until 2017.

Because risk aversion and volatility closely track the VIX, it is not surprising that we obtain similar regression results when we replace the VIX with its subcomponents in Equation (1). We visualize the regression output in Figure 5. As evident, countries are more likely to increase restrictions (dashed red line) if investors are more risk-averse or if markets are more volatile. In contrast, capital controls tend to decrease (solid blue line) once risk aversion or financial market volatility moderates. Similar to our previous results, tail events in risk aversion or volatility drive the significant difference between the likelihood to increase versus decreases capital inflow controls.

Figure 5: *Capital Controls, Risk Aversion and Volatility*

(a) *Risk Aversion* ***(b)*** *Volatility*



Notes: *The dashed red (solid blue) line displays the probability of increasing (decreasing) capital inflow controls (y-axis) as a function of risk aversion (Panel (a)) or volatility (Panel (b)) (x-axis). Shaded areas indicate 90% predictive margins. The underlying regression model is a logit model with a cubic polynomial and no control variables as portrayed in Equation (1), where we replaced ln(VIX) with the logarithmic volatility or risk aversion measure. Active emerging markets only. Sample: 1995-2017.*

2.3. Robustness Checks

This section serves two purposes: First, we argue that global financial conditions influence capital inflow restrictions even when we control for various explanatory variables as suggested by the theoretical and empirical literature. Second, we verify that our results continue to hold if we resort to different (reasonable) classifications for active countries or alternative data for capital controls.

The theoretical literature on capital controls suggests that capital controls should be tightened if economies take on too much external debt. Crucially, these restrictions should be imposed during domestic booms, and not during a recession (see, for example, Bianchi, 2011). We account for these arguments by adding real GDP per capita growth, the change in the current account to GDP ratio, and credit to GDP growth (subsample only) to the regression. We also include a banking crisis indicator to explore if countries loosen their controls in response to severe domestic financial distress. The literature also motivates capital control restrictions due to nominal rigidities related to wage or price stickiness in combination with the zero lower bound or fixed exchange rates (see, for example, Farhi and Werning, 2016; Schmitt-Grohe and Uribe, 2016). Because data on wage growth is limited, we focus on inflation (subsample only) in our regression analysis. With downward wage or price stickiness, capital controls should increase when inflation is high to avoid price levels that are too high in future downturns.

From a policy perspective, capital controls are frequently motivated as a means to limit exchange rate overshooting and asset price bubbles (Ostry et al., 2010; Magud et al., 2018). We consequently control for exchange rate movements and stock markets (subsample only). Countries also require a proper institutional framework to implement capital controls in a meaningful way (Eichengreen and Rose, 2014). We, therefore, incorporate an institutional quality index. All variables with limited data are explored in the appendix.

To summarize this discussion, we estimate the following logit regression:

$$Prob(y_{i,t} = 1) = F\left(\beta_0 + X_t^G \beta_G + X_{i,t-1}^D \beta_D + \alpha_i\right) \tag{2}$$

The dependent variable $y_{i,t}$ is binary and measures increases or decreases in capital inflow restrictions. Relative to Equation (1) and as explained above, we consider a variety of domestic variables in the vector $X_{i,t-1}^D$. We lag domestic variables to mitigate reverse causality concerns. The vector X_t^G refers to global financial conditions (VIX, risk aversion or volatility, each separately considered). We also include country-fixed effects, denoted as α_i, in a subset of regressions.

Table 3 reports the regression results. As apparent, countries are more likely to increase inflow restrictions when financial distress is elevated (column 1 and 2). This observation simply mirrors Figure 3. The VIX coefficients in column 1 and 2 are highly significant with p-values of 0.009 and 0.023 respectively. We add domestic control variables in column 3. None of these variables explain the decision to increase capital controls. Further, financial distress remains a significant variable (p-value: 0.042), which suggests a direct effect on the decision to add restrictions. Countries tend to decrease inflow restrictions during somewhat moderate levels of financial distress (columns 4-6), though these findings are less striking than when we focus on the decision to increase restrictions. This links the regression results to the descriptive evidence in Figure 1. The domestic control variables in column 6 are insignificant (p-value: 0.503).

Table 3: *Results Logit Model*

	Increase in Inflow Restrictions			Decrease in Inflow Restrictions		
	(1)	(2)	(3)	(4)	(5)	(6)
$ln(VIX)$	0.35***	22.84	16.77	0.07	-56.94	-51.29
	(0.14)	(33.20)	(33.66)	(0.11)	(35.38)	(35.57)
$ln(VIX) \times ln(VIX)$		-2.52	-1.85		6.37*	5.75
		(3.54)	(3.59)		(3.80)	(3.82)
$ln(VIX) \times ln(VIX) \times ln(VIX)$		0.09	0.07		-0.24*	-0.21
		(0.13)	(0.13)		(0.14)	(0.14)
$\Delta CA/GDP_{-1}$			-0.02			-0.03
			(0.03)			(0.03)
$\Delta log(GDP/CAP)_{-1}$			0.03			-0.04
			(0.04)			(0.03)
$\Delta log(ExchangeRate)_{-1}$			0.00			0.00
			(0.00)			(0.00)
$Inst.Quality_{-1}$			-0.04			0.18
			(0.12)			(0.11)
$BankingCrisis_{-1}$			-0.27			0.11
			(0.81)			(0.76)
p-value: Domestic = 0			0.734			0.503
p-value: VIX = 0	0.009	0.023	0.042	0.519	0.093	0.186
Pseudo R^2	0.018	0.021	0.026	0.001	0.016	0.025
Observations	449	449	449	449	449	449

Notes*: Institutional quality and ln(VIX) are standardized. Banking crisis is a binary indicator equal to 1 if a crisis occurs. The remaining variables are expressed in %. A constant is estimated, but not displayed. Active emerging markets only. Sample: 1995-2017. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

Additional Checks

We perform various additional robustness checks. We delegate related regression tables to the appendix. Specifically, we obtain very similar results when we replace the VIX with its subcomponents, risk aversion and volatility (Table B1). We also consider country-fixed effects and additional control variables for which we have only limited data coverage (Table B2, B3). Country-fixed effects do not change our results. Though some of the additional control variables are statistically significant, the domestic variables remain jointly insignificant, and our results in Table 3 remain valid. We also consider the Chinn-Ito Index (Chinn and Ito, 2006) as a measure for capital controls (Table B6, Figure C1). The results are qualitatively similar, but the significant difference between the likelihood to increase or decrease restrictions vanishes. We attribute this to the nature of the index. The Chinn-Ito Index aggregates over inflow and outflow restrictions. These restrictions have opposite effects on net flows and may hence offset each other. Last but not least, we vary the threshold for the definition of active countries (Tables B4, B5). We find that the significance of our results improves with the tightness of the classification. We conclude that global financial conditions are a significant factor in the decision to adjust capital inflow restrictions.

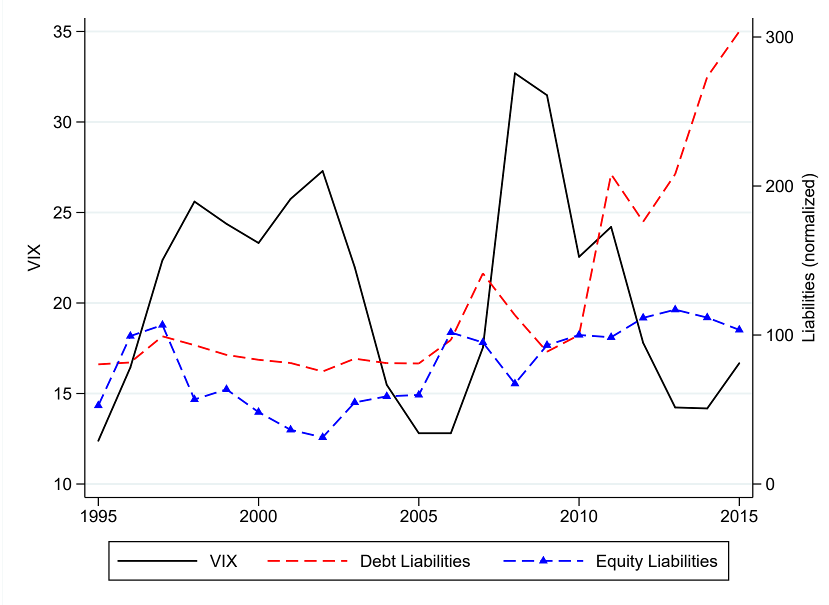
2.4. Comparison with Externality Literature

In the previous sections we documented that emerging markets, which actively evaluate their capital control policies, tend to increase inflow restrictions during periods of high international financial distress. Before we provide a theoretical perspective, we review this observation in light of recent proposed theories for the usage of capital inflow controls.

Following the aftermath of the Global Financial Crisis, a new literature emerged that justifies capital controls due to the occurrence of externalities. Specifically, emerging markets overborrow during economic booms, which could magnify future recessions. This literature stresses two externalities: pecuniary externalities and demand externalities. The former work trough prices in combination with binding collateral constraints (see, for example, Bianchi, 2011; Korinek, 2018) , while demand externalities are associated with the zero lower bound (Farhi and Werning, 2016; Korinek and Simsek, 2016) or international constraints on monetary policy due to a fixed exchange rate combined with downward nominal wage rigidity (Schmitt-Grohe and Uribe, 2016). Though these motivations differ considerably, they lead to the same conclusion: It is optimal to avoid excessive capital inflows during domestic booms. These recommendations would limit the external exposure during sudden stops in international capital and could limit the severity of recessions in emerging markets.

In Figure 6, we portray the exposure of emerging markets to foreign financing (equity, debt). In more detail, the dashed red and dashed blue line with triangle markers highlight the average foreign debt and equity position across active emerging markets. We see that foreign debt exposure decreased during the Global Financial Crisis, but steadily increased since then. Foreign equity exposure is more stable, but dips around the Global Financial Crisis and the Dot-Com Bubble. Thus, if anything, external financing and the VIX are negatively correlated, which is consistent with the notion of a ”flight to safety” during international financial distress. Following the normative capital control theories based on the externality view, countries should not increase their capital inflow restrictions during ”flight to safety” episodes, which are also frequently associated with emerging market crises. However, many countries do not follow this advice as we highlighted in previous sections.

Figure 6: *Foreign Equity/Debt Exposure and the VIX*



Notes*: The dashed red (dashed blue line with triangle markers) line portrays the average debt (portfolio equity) liability position (counted on the right y-axis) for active emerging markets. Each country specific series is normalized to 100 in 2010. The solid black line displays the VIX (levels displayed on the left y-axis). Ethiopia is excluded due to missing data. Sample: 1995-2015. Source: Lane and Milesi-Ferretti (2018).*

3. Analytical Framework

This section provides a stylized model in which national regulators manipulate the country risk premium and lower the external debt burden via capital inflow controls. Three elements are crucial: First, we explicitly model risk-averse international investors who allocate their funds between safe and risky assets. Second, emerging market debt is subject to default. Third, emerging markets are more likely to default when international markets are riskier. Consequently, investors are more sensitive to emerging market debt if (i) their risk aversion increases or if (ii) their international portfolio becomes riskier. As we show in Section 4.1, a domestic regulator, who exerts influence on the emerging market risk premium, exploits this heightened sensitivity and rationally increases inflow controls when international investors are more responsive to emerging market debt. All proofs are delegated to Appendix D.

3.1. Environment

The economy consists of two periods $\{t, t+1\}$ and features two agents, borrowers (B) in an emerging market of size χ and international investors (I) with measure one. Both agents are risk-averse and derive utility from consumption $(c_{i,t})$ with $i \in \{B, I\}$.

To intertemporally allocate funds, investors choose between two assets. Risk-free one-period bonds (l_{t+1}) with inelastic supply that one can think of as a safe investment opportunity in advanced economies and risky one-period bonds ($b_{I,t+1}$) which are traded with borrowers from the emerging market. Investors also hold a risky exogenous portfolio (a_{t+1}) that represents international financial markets. Borrowers in the emerging market are required to issue debt to finance consumption in period t. With probability p, borrowers will simultaneously default on their debt. We can therefore define two states: If $s = 1$, the emerging market defaults. If $s = 0$, the emerging market repays its debt. There is no production, and endowments for both agents are exogenous. We subsequently characterize the environment in more detail.

International Investors: International investors are risk-averse and only consume in the second period ($c_{I,t+1}$). They maximize expected utility by choosing a portfolio of risk-free (l_{t+1}) and risky emerging market bonds ($b_{I,t+1}$). Because emerging market bonds are subject to default with probability p, investors require a risk premium RP_t beyond the normalized gross return of one on the safe asset. Investors also hold an exogenous risky asset (a_{t+1}). It is best to think about this risky asset as a "rest of the world" portfolio that has been selected before period t. We do not endogenize this object to gain analytical tractability. The objective function is characterized as

$$\max_{c_{I,t+1},b_{I,t+1},l_{t+1}} \left\{E_t[v_{t+1}(c_{I,t+1})]\right\}. \tag{Po:I}$$

The assumption that investors do not consume in period t is without loss of generality. We impose exponential utility, $v_{t+1}(c_{I,t+1}) = -exp(-\lambda c_{I,t+1})$. The parameter λ represents the level of risk aversion. If $\lambda > 0$, investors are risk-averse.[5] $E_t[\cdot]$ is the expectations operator with respect to time t.

Investors receive an initial endowment ($e_{I,t}$), but no endowment in $t + 1$. With the previous information, the budget constraints of investors are

$$b_{I,t+1} + l_{t+1} = e_{I,t} \tag{3}$$

$$c_{I,t+1} = (1 + RP_t)\overline{b_{I,t+1}} + l_{t+1} + a_{t+1}. \tag{4}$$

The process for $\overline{b_{I,t+1}}$ is described as:

$$\overline{b_{I,t+1}} = \begin{cases} b_{I,t+1} & \text{with probability } 1-p, \\ 0 & \text{with probability } p. \end{cases} \tag{5}$$

[5]This specific functional form simplifies the analysis. We numerically verify the robustness of this choice with more standard CRRA preferences for investors and borrowers in the appendix.

We do not take a stance on why emerging market bonds are risky. Instead, we simply model the observation that international debt financing in emerging markets is risky and frequently associated with sovereign default. We provide empirical support for this notion in Figure C2.[6]

International financial markets and hence the payoff from a_{t+1} are uncertain and follow a normal distribution with mean μ and standard deviation σ. The parameter σ characterizes international financial volatility and hence resembles the volatility component of the VIX. We make one crucial assumption regarding the risk profile of emerging market debt and the international financial market:

Assumption 1 *Global Financial Cycle*

$$p(\sigma) \text{ and } \frac{\partial p(\sigma)}{\partial \sigma} > 0.$$

We hence assume that the emerging market is more likely to default when international financial markets are riskier. This notion captures the idea of a global financial cycle which manifests in the comovement of financial assets. The implication of this dependency is that investors do not wish to purchase emerging market bonds as a hedge against risk from international markets. This assumption is based on empirical grounds. In Table B8, we show that emerging markets are more likely to experience an external debt crisis if international markets are volatile.

Emerging Market: The emerging market is populated by households who wish to consume during both periods ($c_{B,t}, c_{B,t+1}$). Unlike investors, households receive their endowment ($e_{B,t+1}$) in period $t+1$ and are therefore required to issue international debt ($b_{B,t+1}$) to finance consumption in the first period. Bonds are purchased by international investors and risky, as described previously. Throughout the paper, we maintain the assumption that investors are more wealthy than households from emerging markets, that is, $e_{I,t} > e_{B,t+1}$. This assumption ensures an interior solution in which investors purchase both assets. Domestic borrowers maximize utility

$$\max_{c_{B,t}, c_{B,t+1}, b_{B,t+1}} \left\{ u_t(c_{B,t}) + E_t[u_{t+1}(c_{B,t+1})] \right\}. \tag{Po:EM}$$

We adopt a log-quasilinear utility function with $t+1$ consumption as the numéraire to gain analytical tractability. Therefore, $u_t(c_{B,t}) = ln(c_{B,t})$ and $u_{t+1}(c_{B,t+1}) = c_{B,t+1}$. Log-utility during period t ensures that households always borrow internationally.

[6] A variety of studies on emerging markets motivate default as a consequence of political instability (see, for example, Citron and Nickelsburg, 1987; Cuadra and Sapriza, 2008). A complementary literature argues that default depends on income fluctuations and hence the stance of the business cycle (see, for example, Arellano, 2008). In these papers, default is more likely in recessions when it is more costly for a risk-averse borrower to repay noncontingent debt.

We assume that $e_{B,t+1}$ is large enough such that households are able to smooth their marginal utilities across both periods.

The budget constraints in both periods correspond to

$$c_{B,t} = b_{B,t+1} \tag{6}$$
$$c_{B,t+1} = e_{B,t+1} - (1 + RP_t)\overline{b_{B,t+1}}. \tag{7}$$

The term $\overline{b_{B,t+1}}$ captures the amount of debt that households repay to international investors (see Equation (5)). Since households simultaneously do not repay their debt with probability $p(\sigma)$, they are required to pay a risk premium (RP_t). This piece completes the description of the model.

3.2. Unregulated Equilibrium

We start by defining the unregulated equilibrium. Following the convention in the literature, we use aggregate letters to denote aggregate quantities. For example, $C_{B,t}=\int_0^{\chi} c_{B,t} dj = \chi c_{B,t}$.

Definition 1 (Unregulated Equilibrium): *The unregulated equilibrium is characterized by the risk premium RP_t and endogenous quantities $\{c_{B,t}, c_{B,t+1}, c_{I,t+1}, b_{B,t+1}, b_{I,t+1}, l_{t+1}\}$ such that*

1. *international investors maximize utility* (Po:I) *subject to the constraints* (3) *and* (4) *taking the risk premium as given;*
2. *borrowers in the emerging market maximize utility* (Po:EM) *subject to the constraints* (6) *and* (7) *taking the risk premium as given;*
3. *the market for emerging market bonds clears, that is $B_{I,t+1} = B_{B,t+1}$.*

Analysis

International Investors: The first-order condition balances the marginal utilities from safe assets and risky emerging market bonds. Combined with the budget constraints, Equations (3) and (4), the first-order condition gives rise to a demand function for emerging market bonds. This investor-specific demand can be aggregated over all investors, which determines the required risk premium as a function of total bond purchases. Dropping the arguments in the marginal utility v'_{t+1}, we obtain

$$RP_t = \frac{p(\sigma)}{1 - p(\sigma)} \frac{E_t[v'_{t+1}|s = 1]}{E_t[v'_{t+1}|s = 0]}. \tag{AD}$$

The required risk premium is a probability-weighted ratio of marginal utilities. A high marginal utility during default or a high likelihood of default make safe assets more desirable, which must be offset by a higher risk premium.

The following assumption guarantees the existence of the aggregate demand curve.

Assumption 2 *Existence*

$$1 + \frac{p(\sigma)}{1-p(\sigma)} \frac{E_t[v'_{t+1}|s=1] E_t[v''_{t+1}|s=0] B_{I,t+1}}{E_t[v'_{t+1}|s=0]^2} > 0.$$

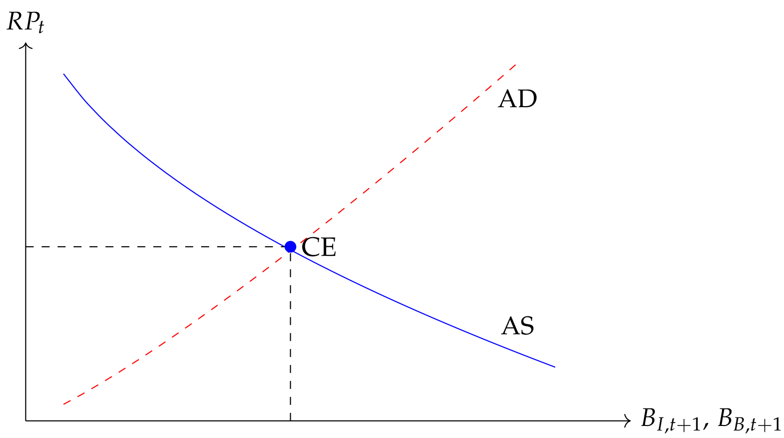
The assumption appears technical, but it ensures that (aggregate) demand has a fixed point in RP_t. In other words, with Assumption 2 the right hand side of Equation (AD) grows by less than one for a marginal change in the risk premium. This requirement is satisfied as long as p is not too high.

Emerging Market: Optimization by borrowers leads to a standard Euler equation augmented for potential default. Similar to the demand equation for emerging market bonds, we can aggregate over all borrowers and plug in constraints (6) and (7). The equation links the aggregate supply of emerging market bonds to the prevailing risk premium. Dropping arguments in u'_t and u'_{t+1}, the aggregate supply curve reads

$$u'_t = (1 - p(\sigma)) \left(u'_{t+1}|s = 0\right) (1 + RP_t). \tag{AS}$$

The left hand side of the equation denotes the marginal utility from borrowing. The right hand side reflects the expected utility costs associated with borrowing. In case of default, households keep their borrowed funds.

Figure 7: *Bond Market Equilibrium*



Notes*: The solid blue line characterizes the aggregate supply and the dashed red line the aggregate demand of emerging market bonds. The unregulated equilibrium is marked (CE).*

The Bond Market Equilibrium: The equilibrium is derived by setting aggregate demand equal to aggregate supply as illustrated in Figure 7. As apparent, aggregate demand for emerging market bonds is increasing in the risk premium. More emerging market debt increases the wedge between the marginal utilities in the default/no default state and mandates a higher risk premium. Aggregate supply is downward sloping. The risk premium decreases available consumption in period $t+1$ if borrowers do not default. A higher risk premium, therefore, reduces the willingness to issue debt.

We formally prove the existence of a unique equilibrium in the appendix and state this observation in Lemma 1.

Lemma 1: *The bond market equilibrium exists and is unique.*

4. Capital Controls and the Risk Premium

Can a regulator from an emerging market increase domestic welfare relative to the unregulated equilibrium? In other words, is it optimal to distort the supply of emerging market debt? The answer to these questions is affirmative. We model the regulator as a monopolist on the supply of bonds who internalizes the positive relationship between debt absorption and the risk premium as postulated by the aggregate demand curve. More intuitively, a regulator understands that more debt leads to a higher risk premium, which incentivizes a reduction in debt via capital inflow controls. Because intervention is tied to the monopoly power, this practice extracts rent from international investors. As such, a regulator improves welfare in the emerging market at the expense of international investors and reduces global welfare. The justification for intervention in this model is hence fundamentally different from the literature on aggregate demand or pecuniary externalities where competitive allocations are inefficient.

We follow the dynamic public finance literature and use the primal approach (Lucas and Stokey, 1983). That is, a national planner directly chooses the consumption path of domestic households and the supply of emerging market bonds (Section 4.1). Subsequently, we decentralize the allocation via capital inflow controls (Section 4.2). Afterward, we discuss how capital controls respond to volatility in international financial markets and investor risk aversion (Section 4.3). We conclude this chapter with numerical illustrations where we vary the size of the emerging market and include a second (foreign) emerging market (Section 4.4). Throughout the analysis, we assume that international investors continue to act competitively and demand risky bonds according to Equation (AD).

4.1. National Planner Equilibrium

The national planner maximizes utility on behalf of all households in the emerging market

$$\max_{C_{B,t},C_{B,t+1},B_{B,t+1}} \int_0^{\chi} \left\{ u_t\left(\frac{C_{B,t}}{\chi}\right) + E_t\left[u_{t+1}\left(\frac{C_{B,t+1}}{\chi}\right)\right]\right\} dj, \tag{Po:NP}$$

subject to the budget constraints and an implementability constraint

$$C_{B,t} = B_{B,t+1} \tag{8}$$

$$C_{B,t+1} = E_{B,t+1} - (1+RP_t)\overline{B_{B,t+1}} \tag{9}$$

$$RP_t = \frac{p(\sigma)}{1-p(\sigma)} \frac{E_t[v'_{t+1}|s=1]}{E_t[v'_{t+1}|s=0]}. \tag{10}$$

There are two differences relative to the unregulated optimization problem: First, the national planner chooses aggregate quantities as represented by capital letters. Second, the planner internalizes the dependency between the risk premium and the aggregate demand of bonds, which in equilibrium must equal supply. The planner hence de-facto chooses the supply of bonds on the aggregate demand curve that maximizes domestic welfare. Equation (10) reflects this notion and consequently serves as an implementability constraint.

Definition 2 (National Planner Equilibrium): *The planner equilibrium is characterized by the risk premium RP_t and endogenous quantities $\{c_{B,t}, c_{B,t+1}, c_{I,t+1}, b_{B,t+1}, b_{I,t+1}, l_{t+1}\}$ such that*

1. *international investors maximize utility (Po:I) subject to the constraints (3) and (4) taking the risk premium as given;*
2. *a national planner maximizes utility (Po:NP) subject to the constraints (8), (9) and (10);*
3. *the market for emerging market bonds clears that is $B_{I,t+1} = B_{B,t+1}$;*
4. *aggregate quantities are proportionally distributed, e.g., $c_{B,t} = \frac{C_{B,t}}{\chi}$.*

Analysis

We focus on the emerging market, since international investors do not change their behaviour. The Euler equation for the national planner is summarized as

$$u'_t = (1-p(\sigma))(u'_{t+1}|s=0)\left((1+RP_t) + \frac{\partial RP_t}{\partial B_{I,t+1}} B_{B,t+1}\right). \tag{AS:NP}$$

Relative to households, a national planner internalizes that international investors demand a higher compensation for purchasing additional bonds ($\frac{\partial RP_t}{\partial B_{I,t+1}} > 0$). The national planner therefore issues strictly less debt than households in the unregulated equilibrium. We summarize this finding in the first proposition.

Proposition 1 (Overborrowing): *The national planner internalizes the positive link between the issuance of risky bonds and the required risk premium as postulated by the aggregate demand curve* (AD). *As a consequence, it is optimal to issue fewer bonds than individual households in the unregulated equilibrium.*

4.2. Implementation

The national planner solution can be decentralized by a period t tax (τ) on emerging market debt akin to price-based capital inflow controls. The budget constraint for borrowers becomes

$$c_{B,t} = (1-\tau)b_{B,t+1} + T.$$

The term $T = \tau b_{B,t+1}$ represents lump sum transfers from tax revenues to avoid wealth effects. A positive value of τ induces households to borrow less. With this adjustment, the Euler equation in the regulated equilibrium becomes

$$u'_t(1-\tau) = (1-p(\sigma))(u'_{t+1}|s=0)(1+RP_t). \tag{AS:CC}$$

Optimization with the tax leads to a modified aggregate supply curve that resembles the unregulated supply curve apart from the additional term $1-\tau$. The optimal level of capital controls is then chosen to close the wedge between the regulated aggregate supply curve and the national planner's first-order condition.

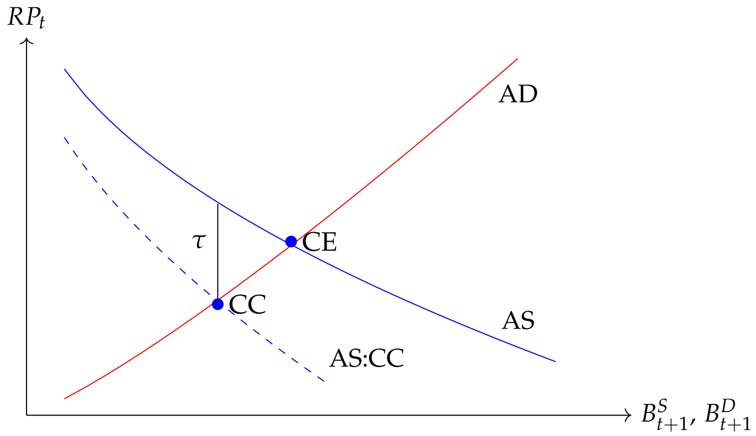
Proposition 2 (Optimal Capital Controls): *Capital controls on inflows maximize domestic welfare by implementing the national planner allocation. The optimal level of capital controls (τ) is characterized as*:

$$\tau = (1-p(\sigma))\frac{(u'_{t+1}|s=0)}{u'_t}\frac{\partial RP_t}{\partial B_{I,t+1}}B_{B,t+1} > 0.$$

The second proposition characterizes the optimal level of capital controls. It can be decomposed into two parts. The first component reflects the relative costs in terms of probability weighted marginal utilities. If consumption is scarce in period t, u'_t is large and it is not optimal to tax period t consumption/borrowings heavily. On the other hand, if consumption in case of no default is small and repayment likely, a high tax is optimal to shift consumption towards period $t+1$. The second term of the optimal tax formula reflects the monopoly power of the national planner. The derivative $\frac{\partial RP_t}{\partial B_{I,t+1}}$ determines the extent to which a national planner is able to manipulate the risk premium. The term is multiplied by $B_{B,t+1}$, which essentially reweighs the monopoly power by its relevance akin to the actual bond supply.

We illustrate the regulated equilibrium in Figure 8. The regulated aggregated supply curve (AS:CC) is below the aggregate supply curve of the unregulated equilibrium. The wedge between both curves equals τ and hence the level of capital controls.

Figure 8: *Regulated versus Unregulated Solution*



Notes*: The solid blue line characterizes the aggregate supply of emerging market bonds in the unregulated equilibrium and the dashed blue line the aggregate supply in the regulated equilibrium with capital controls (τ). The solid red line represents aggregate demand by international investors. The two equilibria are marked.*

4.3. Volatility and Investor Risk Aversion

How should regulators adjust capital controls in response to elevated volatility and risk aversion? With the previous analysis in mind, we are now able to characterize this link theoretically, which is the central contribution of this model.

The main takeaway from this section is that increasing capital inflow controls during periods of high volatility and risk aversion, as observed in the data, is consistent with a rational, domestic welfare-maximizing regulator in an emerging market. To justify this observation within our framework, we require that $\frac{\partial \tau}{\partial \lambda} > 0$ and $\frac{\partial \tau}{\partial \sigma} > 0$. As a reminder, the parameter λ captures international investors' risk aversion. The parameter σ characterizes the standard deviation of the international portfolio and hence reflects global financial volatility.

Risk Aversion

Proposition 3: *A national regulator optimally raises the level of capital inflow controls in response to elevated international risk aversion and vice versa,*

$$\frac{\partial \tau}{\partial \lambda} > 0.$$

This proposition provides a normative justification for the empirical regularities uncovered earlier. The intuition for this result is as follows: As investors become more risk-averse, their sensitivity to risky asset holdings increases. This manifests in a steeper aggregate demand curve ($\frac{\partial^2 RP_t}{\partial B_{I,t+1} \partial \lambda} > 0$), which increases the national planner's costs of issuing debt. Because households do not internalize this effect, the wedge between the planner and the unregulated allocation widens. To close this wedge, capital controls must increase.

We illustrate the proposition in Figure 9 (solid blue line). Clearly, as the risk aversion of investors rises (x-axis), the optimal level of capital controls (y-axis) increases. Notice that optimal capital controls are zero if investors are risk neutral. In this case, investors require a fixed risk premium equal to $\frac{p}{1-p}$ and the aggregate demand curve is flat.

Financial Volatility

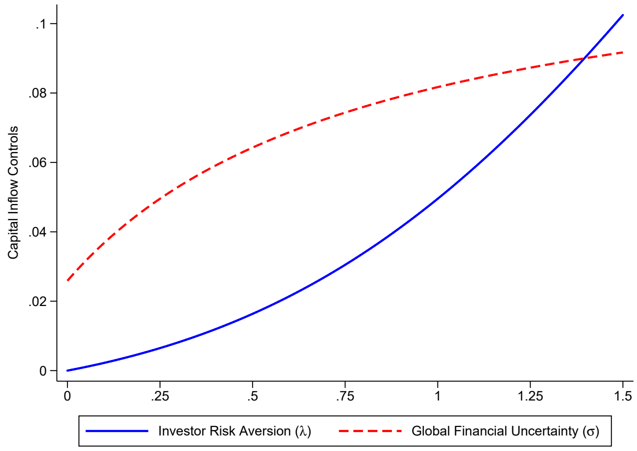
Proposition 4: *A national regulator optimally raises the level of capital inflow controls in response to global financial volatility and vice versa,*

$$\frac{\partial \tau}{\partial \sigma} > 0.$$

The proposition justifies the behavior of various emerging markets in our empirical exercise. But what drives this result? First, international investors dislike risk, hence investors prefer to hedge against a riskier international portfolio. Second, because risky emerging market bonds are more likely to default during periods of global financial distress, investors increase their relative demand for safe assets. Similar to our previous exposition on risk aversion, investors consequently require a higher marginal compensation for risky emerging market debt. As a result, the aggregate demand curve becomes steeper, which increases intervention via capital controls.

The positive relationship between capital controls and volatility is displayed in Figure 9 (dashed red line). As markets are generally more uncertain (x-axis), optimal capital controls (y-axis) increase.

Figure 9: Capital Controls, Risk Aversion and Volatility



***Notes**: The plot displays the optimal level of capital controls τ (y-axis) as a function of the risk aversion of international investors (λ, solid blue line) or volatility in international financial markets (σ, dashed red line). Calibration: χ=1, p=0.02 (solid blue line), p=$0.05\frac{\sigma}{1+\sigma}$+0.01 (dashed red line), λ=1 (dashed red line).*

4.4. Monopoly Power Revisited

The previous narrative provides a clear justification for regulatory intervention via capital inflow controls from the perspective of an emerging market: Intervention in international capital markets reduces the amount of international debt and lowers the required risk premium. The incentives to reduce the cost of debt are tied to the monopoly power of the emerging market. An emerging market has a natural monopoly on its own debt, but how relevant is this characteristic in practice? To shed light on this issue, we examine two experiments. We vary the size of the emerging market and add a second emerging market that competes with the other emerging market for funds from international investors.

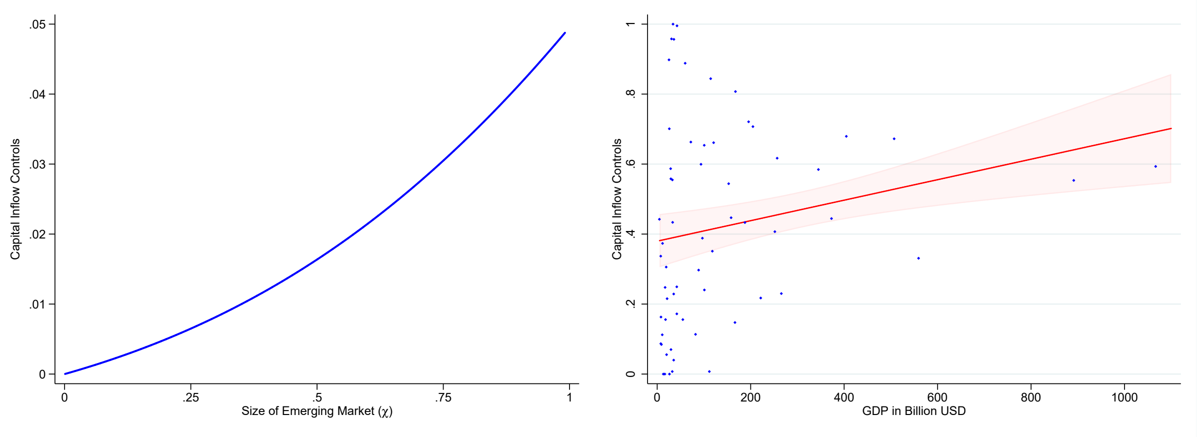
Country Size

Small emerging markets naturally issue less debt and are hence quantitatively less relevant in international portfolios. As such, a regulator may have limited ability to manipulate the risk premium simply because investors are less sensitive to debt from the specific emerging market. As a consequence, intervention via capital controls would be muted. Indeed, this is what we observe both in our model and the data, as Figure 10 emphasizes.

Concerning the model, we capture the size of an emerging market with the parameter χ, which determines the size of the country relative to the size of international investors. If χ is small, aggregate debt becomes negligible from the perspective of investors, which diminishes the responsiveness to changes in emerging

Figure 10: *Country Size and Capital Controls*

(a) *Model* ***(b)*** *Data*



Notes: *Panel (a): The plot displays the optimal level of capital controls τ (y-axis) as a function of the size of the emerging market (χ). Calibration: p=0.02, λ=1. Panel (b): The panel presents results from a bivariate OLS regression. Dependent variable (y-axis): Inflow Restriction Index. Independent variable: Domestic GDP in Billion USD (x-axis). Both variables are country-specific sample averages. 90% predictive margins and observations are added. Outliers in GDP are trimmed (top and bottom 5%). Active and inactive emerging markets. Sample: 1995-2017.*

market debt. Optimal capital controls are therefore small as we illustrate in Panel (a).

It is reassuring that we observe a similar pattern in the data. In Panel (b) of Figure 10, we provide results from a bivariate OLS regression where we regress the Inflow Restriction Index (Section 2.1) on the size of the domestic economy as measured by GDP in USD. As apparent from the plot, the relationship between capital inflow controls and GDP is positive and significant. Countries with a higher GDP tend to have more controls.

Two Competing Emerging Markets

We consider two emerging markets ("domestic" and "foreign") that compete for funds from international investors and address the following two questions: How do capital controls depend on the joint risk profile of emerging markets? Are capital controls tighter or looser when multiple countries resort to capital flow restrictions?

We model both emerging markets equivalently, that is, both emerging markets follow the same setup as described in Section 3.1. We denote the default probability of the second (foreign) emerging market as $q(\sigma)$ with $\frac{\partial q(\sigma)}{\partial \sigma} > 0$. The most notable difference between the basic setup and this extended framework pertains to the default structure among both emerging markets. To be more precise, we define the probability that both emerging markets default on their debt as d, where d is necessarily smaller than p or q, that is, $d \leq min\{p, q\}$. Consequently, we can determine four regimes. We display these regimes and their associated probabilities in Figure 11.

Figure 11: *Payoff Structure*

Domestic EM \ Foreign EM	Default	Payment
Default	d	$p-d$
Payment	$q-d$	$1-p-q+d$

In this extended framework, international investors can choose between three assets, the riskless asset and two risky emerging market bonds. Their optimization problem is therefore summarized as

$$\max_{c_{I,t+1},b_{I,t+1},b^*_{I,t+1}l_{t+1}} \left\{E_t[v_{t+1}(c_{I,t+1})]\right\}, \tag{Po:I}$$

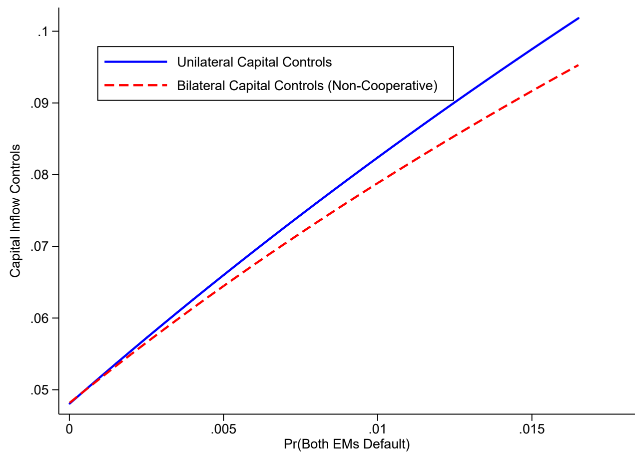
where we characterize foreign variables with an asterix (*). The augmented budget constraints are

$$b_{I,t+1} + b^*_{I,t+1} + l_{t+1} = e_{I,t} \tag{11}$$

$$c_{I,t+1} = (1+RP_t)\overline{b_{I,t+1}} + (1+RP^*_t)\overline{b^*_{I,t+1}} + l_{t+1} + a_{t+1}. \tag{12}$$

We first focus on a scenario with unilateral capital controls where the domestic regulator takes the actions of the foreign emerging market as given. Figure 12 portrays the optimal level of capital controls as a function of the probability that both emerging markets default (d). Because default is Bernoulli distributed, d also captures the correlation in the risk profile among both emerging markets. Specifically, if $d > pq$, default among the two emerging markets is positively correlated and vice versa. On an abstract level, we can interpret d as the comovement of business cycles given that default is more likely during recessions. Based on the solid blue line, which captures unilateral capital controls, it becomes apparent that capital inflow restrictions increase with a more similar risk structure. Intuitively, as debt from both emerging markets becomes more similar (substitutes), international investors have fewer options to hedge one risky asset with the other. On the contrary, if default probabilities are negatively correlated, investors can purchase both bonds in equal amounts (complements) and thus mitigate the aggregate risk from emerging market bonds. Consequently, they do not require a high marginal compensation for additional emerging market debt, which decreases the scope of the domestic emerging market to manipulate the risk premium. In reality, many emerging markets face similar business cycle dynamics, especially countries that are geographically close. Hence, the fact that countries compete for funds does not necessarily imply that countries should impose fewer capital controls, even when the sole motivation for capital controls relates to monopolistic risk premium manipulations.

Figure 12: *Two Emerging Markets: The Correlation Structure and Capital Controls*



Notes: *The plot displays the optimal level of capital inflow controls* τ *(y-axis) as a function of the probability that both emerging markets default simultaneously (d). The solid blue line considers a scenario where only one emerging market imposes capital controls. The dashed red line displays the level of capital controls if both emerging markets implement capital controls non-cooperatively. Calibration:* χ=1, p=q=0.02, λ=1.

In the second experiment, we analyze capital controls in a Nash equilibrium where both emerging markets resort to capital controls in a non-cooperative manner. This scenario emerges when both regulators maximize domestic welfare without taking general equilibrium effects on the second emerging market into account. The dashed red line in Figure 12 displays this experiment. As evident, capital controls are generally lower, specifically when bonds from the emerging markets are substitutes rather than complements. In either case, emerging markets on aggregate issue less debt than with unilateral controls. When emerging market debt from both countries are substitutes (large d), the required marginal compensation for debt from one emerging market is closely tied to the level of aggregate debt. With less aggregate debt, emerging market bonds become less important as part of the overall portfolio, and investors are less responsive. On the contrary, if bonds are complements (small d), a reduction in foreign emerging market debt makes domestic debt riskier from the perspective of investors, as they have fewer foreign bonds to hedge the risk associated with the domestic bond. This in turn requires a higher marginal compensation and can offset the implications from a general decline in emerging market debt.

5. Conclusion

Capital controls receive significant attention from international policymakers as a tool to mitigate boom-bust cycles in international financial flows and to limit external overborrowing. However, though emerging markets make heavy use of capital controls, several questions remain open (Rebucci and Ma, 2019).

In this paper, we focus on the link between the theoretical and applied literature. For example, while the theoretical literature advocates macroprudential capital inflow controls during economic booms associated with high credit growth, the applied literature has not been able to observe such patterns except for a few case studies like Brazil (Chamon and Garcia, 2016). We wonder why countries have not implemented capital controls accordingly. Hopefully they will over time, but maybe there is an alternative justification for capital controls. We explore one such explanation, global financial conditions paired with risk aversion and domestic default, in this paper.

We empirically show that countries that actively re-evaluate their capital inflow controls respond to global financial conditions, in particular volatility and risk aversion by tightening restrictions. We then propose a simple model and argue that the empirical regularities may be rational. Because debt is risky and investors are risk-averse, investors are sensitive to emerging market debt and require a risk premium. Regulators can exploit this relationship. A regulator, who acts as a monopolist on domestic debt, reduces emerging market debt and lowers the risk premium. This choice is subsequently implemented via capital inflow controls. Since investors are particularly sensitive when they are very risk-averse or when international financial markets are volatile, it is optimal to increase restrictions during periods of global financial distress. However capital controls as a result of monopolistic intervention only improve welfare in the emerging market at the expense of international investors. Thus, capital controls are not socially desirable in our framework.

A. Appendix: Data

***Table A1:** Country List - Active and Inactive*

Algeria	Egypt	Mexico	South Africa
Angola	El Salvador	Moldova	Sri Lanka
Argentina	Ethiopia	Morocco	Swaziland
Bahrain	Georgia	Myanmar	Tanzania
Bangladesh	Ghana	Nicaragua	Thailand
Bolivia	Guatemala	Nigeria	Togo
Brazil	Hungary	Oman	Tunisia
Brunei Darussalam	India	Pakistan	Turkey
Bulgaria	Indonesia	Panama	Uganda
Burkina Faso	Jamaica	Paraguay	Ukraine
Chile	Kazakhstan	Peru	United Arab Emirates
China	Kenya	Philippines	Uruguay
Colombia	Kuwait	Poland	Uzbekistan
Costa Rica	Kyrgyz Republic	Qatar	Venezuela
Côte d'Ivoire	Lebanon	Romania	Vietnam
Dominican Republic	Malaysia	Russia	Yemen
Ecuador	Mauritius	Saudi Arabia	Zambia

Variables and Data Sources

Banking Crises: Indicator for systemic banking crises (Source: Laeven and Valencia, 2018).

Capital Controls: The baseline measure is from Fernández et al. (2016). We consider inflow restrictions and exclude FDI. We also analyze the Chinn-Ito Index (Chinn and Ito, 2006) as a robustness check.

CA/GDP: Current account balance (% of GDP) (Source: IMF).

Credit/GDP: Domestic credit to the private sector (% of GDP) (Source: World Bank).

CPI: Consumer price index. We construct inflation as the log difference and trim data above 10% inflation (Source: IMF).

Exchange Rates: Nominal exchange rates vis-a-vis the US dollar. Daily quotes are averaged over each year (Source: Bloomberg).

External Debt Crises: Indicator from Reinhart and Rogoff (2009).

External Liabilities: Portfolio equity and debt liabilities (portfolio debt + other debt investment excluding FDI) from Lane and Milesi-Ferretti (2018).

Gross Domestic Product: (i) GDP per capita in constant local currency (Source: World Bank) and (ii) GDP in US dollar (Source: IMF).

Institutional Quality: Index constructed as the sum over all 12 political risk categories from the International Country Risk Guide (Source: Political Risk Group).

Risk Aversion/Volatility: Series from Bekaert and Hoerova (2014). The daily values are averaged over each year.

Stock Market Indices: The daily quotes are averaged over each year (Source: Bloomberg).

VIX: Chicago Board Options Exchange Volatility Index. The daily quotes are averaged over each year (Source: Bloomberg).

B. Appendix: Tables

Table B1: *Comparison: VIX, Risk Aversion and Volatility*

	Increase in Inflow Restrictions			Decrease in Inflow Restrictions		
	(1)	(2)	(3)	(4)	(5)	(6)
$ln(VIX)$	22.84			-56.94		
	(33.20)			(35.38)		
$ln(VIX) \times ln(VIX)$	-2.52			6.37*		
	(3.54)			(3.80)		
$ln(VIX) \times ln(VIX) \times ln(VIX)$	0.09			-0.24*		
	(0.13)			(0.14)		
$ln(RA)$		2.75			-33.06**	
		(14.89)			(15.99)	
$ln(RA) \times ln(RA)$		-0.57			6.01**	
		(2.59)			(2.81)	
$ln(RA) \times ln(RA) \times ln(RA)$		0.04			-0.36**	
		(0.15)			(0.16)	
$ln(VOL)$			32.42			-8.93
			(30.94)			(35.93)
$ln(VOL) \times ln(VOL)$			-3.11			1.08
			(2.94)			(3.45)
$ln(VOL) \times ln(VOL) \times ln(VOL)$			0.10			-0.04
			(0.09)			(0.11)
p-value: VIX RA/VOL = 0	0.023	0.064	0.017	0.093	0.064	0.434
Pseudo R^2	0.021	0.016	0.023	0.016	0.016	0.008
Observations	449	449	449	449	449	449

Notes*: Robustness checks based on the VIX decomposition into risk aversion (RA) and volatility (VOL). ln(VIX), ln(RA) and ln(VOL) are standardized. A constant is estimated, but not displayed. Active emerging markets only. Sample: 1995-2017. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

Table B2: *Additional Domestic Variables: Increase in Inflow Restrictions*

	Increase in Inflow Restrictions				
	(1)	(2)	(3)	(4)	(5)
$ln(VIX)$	16.77	21.43	18.96	39.10	14.85
	(33.66)	(42.87)	(38.32)	(47.74)	(35.63)
$ln(VIX) \times ln(VIX)$	-1.85	-2.26	-2.00	-4.30	-1.64
	(3.59)	(4.61)	(4.08)	(5.11)	(3.81)
$ln(VIX) \times ln(VIX) \times ln(VIX)$	0.07	0.08	0.07	0.16	0.06
	(0.13)	(0.16)	(0.14)	(0.18)	(0.13)
$\Delta CA/GDP_{-1}$	-0.02	-0.06	-0.01	0.00	-0.02
	(0.03)	(0.05)	(0.04)	(0.05)	(0.03)
$\Delta log(GDP/CAP)_{-1}$	0.03	0.02	0.03	0.04	0.07*
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)
$\Delta log(ExchangeRate)_{-1}$	0.00	-0.00	0.01	-0.03*	0.01
	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)
$Inst.Quality_{-1}$	-0.04	-0.01	-0.14	-0.28*	0.11
	(0.12)	(0.15)	(0.13)	(0.16)	(0.32)
$BankingCrisis_{-1}$	-0.27	0.69	-1.02		-0.40
	(0.81)	(1.40)	(0.88)		(0.92)
$\Delta log(StockIndex)_{-1}$		0.01**			
		(0.01)			
$\Delta(Credit/GDP)_{-1}$			0.03		
			(0.03)		
π_{-1}				-0.01	
				(0.07)	
Fixed Effects	No	No	No	No	Yes
p-value: Domestic=0	0.734	0.199	0.447	0.248	0.398
p-value: VIX=0	0.042	0.105	0.043	0.333	0.052
Pseudo R^2	0.026	0.066	0.036	0.043	0.110
Observations	449	271	368	293	449

***Notes**: Institutional quality and ln(VIX) are standardized. Banking crisis is a binary indicator equal to 1 if a crisis occurs. The remaining variables are expressed in %. A constant is estimated, but not displayed. Active emerging markets only. The test on the significance of domestic variables does not include fixed effects. The banking crisis indicator perfectly predicts the dependent variable in column 4 and is hence omitted. Sample: 1995-2017. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

Table B3: *Additional Domestic Variables: Decrease in Inflow Restrictions*

	Decrease in Inflow Restrictions				
	(1)	(2)	(3)	(4)	(5)
$ln(VIX)$	-51.29	-66.43	-69.99*	-62.88	-48.64
	(35.57)	(43.29)	(38.57)	(42.31)	(36.03)
$ln(VIX) \times ln(VIX)$	5.75	7.12	7.67*	7.05	5.47
	(3.82)	(4.67)	(4.16)	(4.57)	(3.87)
$ln(VIX) \times ln(VIX) \times ln(VIX)$	-0.21	-0.25	-0.28*	-0.26	-0.20
	(0.14)	(0.17)	(0.15)	(0.16)	(0.14)
$\Delta CA/GDP_{-1}$	-0.03	-0.07	-0.04	-0.06	-0.02
	(0.03)	(0.05)	(0.04)	(0.04)	(0.03)
$\Delta log(GDP/CAP)_{-1}$	-0.04	-0.06	-0.04	-0.05	-0.06
	(0.03)	(0.05)	(0.04)	(0.05)	(0.04)
$\Delta log(ExchangeRate)_{-1}$	0.00	0.01	-0.01	-0.01	0.00
	(0.00)	(0.01)	(0.01)	(0.02)	(0.00)
$Inst.Quality_{-1}$	0.18	0.27*	0.17	0.17	0.32
	(0.11)	(0.16)	(0.13)	(0.16)	(0.31)
$BankingCrisis_{-1}$	0.11	0.62	0.87	0.85	0.04
	(0.76)	(1.34)	(0.79)	(1.18)	(0.81)
$\Delta log(StockIndex)_{-1}$		0.01**			
		(0.01)			
$\Delta(Credit/GDP)_{-1}$			-0.03		
			(0.03)		
π_{-1}				0.01	
				(0.06)	
Fixed Effects	No	No	No	No	Yes
p-value: Domestic=0	0.503	0.193	0.414	0.555	0.539
p-value: VIX=0	0.186	0.454	0.282	0.129	0.194
Pseudo R^2	0.025	0.048	0.029	0.037	0.078
Observations	449	271	368	293	449

Notes*: Institutional quality and ln(VIX) are standardized. Banking crisis is a binary indicator equal to 1 if a crisis occurs. The remaining variables are expressed in %. A constant is estimated, but not displayed. Active emerging markets only. The test on the significance of domestic variables does not include fixed effects. Sample: 1995-2017. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

Table B4: *Robustness: Lenient Threshold Classification*

	Increase in Inflow Restrictions			Decrease in Inflow Restrictions		
	(1)	(2)	(3)	(4)	(5)	(6)
$ln(VIX)$	0.22*	5.73	5.81	0.09	-48.00	-45.49
	(0.12)	(29.85)	(30.39)	(0.10)	(31.72)	(32.33)
$ln(VIX) \times ln(VIX)$		-0.72	-0.73		5.48	5.20
		(3.18)	(3.24)		(3.40)	(3.47)
$ln(VIX) \times ln(VIX) \times ln(VIX)$		0.03	0.03		-0.21*	-0.20
		(0.11)	(0.11)		(0.12)	(0.12)
$\Delta CA/GDP_{-1}$			-0.02			-0.03
			(0.03)			(0.03)
$\Delta log(GDP/CAP)_{-1}$			-0.00			0.00
			(0.03)			(0.03)
$\Delta log(ExchangeRate)_{-1}$			0.00			0.01
			(0.00)			(0.01)
$Inst.Quality_{-1}$			0.03			0.15
			(0.11)			(0.11)
$BankingCrisis_{-1}$			0.08			-0.02
			(0.60)			(0.63)
p-value: Domestic = 0			0.956			0.706
p-value: VIX = 0	0.062	0.146	0.200	0.381	0.025	0.061
Pseudo R^2	0.007	0.009	0.011	0.001	0.018	0.024
Observations	578	578	578	578	578	578

Notes*: This table provides result from a more lenient classification requirement (domestic std. dev. above 0.8 of avg. std. dev.). This lower threshold classifies six more countries as active: Bolivia (std. dev. 0.101), Saudi Arabia (0.100), Romania (0.95), Ukraine (0.094), Dominican Republic (0.89) and Jamaica (0.85). Institutional quality and ln(VIX) are standardized. Banking crisis is a binary indicator equal to 1 if a crisis occurs. The remaining variables are expressed in %. A constant is estimated, but not displayed. Active emerging markets only. Sample: 1995-2017. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

Table B5: *Robustness: Strict Threshold Classification*

	Increase in Inflow Restrictions			Decrease in Inflow Restrictions		
	(1)	(2)	(3)	(4)	(5)	(6)
$ln(VIX)$	0.48***	15.21	7.83	0.07	-94.89**	-94.06**
	(0.18)	(41.07)	(43.66)	(0.14)	(44.14)	(45.41)
$ln(VIX) \times ln(VIX)$		-1.83	-1.01		10.43**	10.33**
		(4.38)	(4.65)		(4.76)	(4.91)
$ln(VIX) \times ln(VIX) \times ln(VIX)$		0.07	0.04		-0.38**	-0.38**
		(0.15)	(0.16)		(0.17)	(0.18)
$\Delta CA/GDP_{-1}$			-0.01			-0.06
			(0.04)			(0.04)
$\Delta log(GDP/CAP)_{-1}$			0.07*			-0.04
			(0.04)			(0.04)
$\Delta log(ExchangeRate)_{-1}$			0.01			-0.00
			(0.01)			(0.01)
$Inst.Quality_{-1}$			-0.10			0.14
			(0.13)			(0.14)
$BankingCrisis_{-1}$			-0.72			-0.64
			(1.12)			(1.13)
p-value: Domestic = 0			0.300			0.514
p-value: VIX = 0	0.007	0.007	0.008	0.644	0.097	0.159
Pseudo R^2	0.032	0.042	0.058	0.001	0.026	0.040
Observations	281	281	281	281	281	281

***Notes**: This table provides result from a more strict classification requirement (domestic std. dev. above 1.2 of avg. std. dev.). With this tighter threshold only 14 countries are classified as active with Vietnam as the last country included (see Table 1). Institutional quality and ln(VIX) are standardized. Banking crisis is a binary indicator equal to 1 if a crisis occurs. The remaining variables are expressed in %. A constant is estimated, but not displayed. Active emerging markets only. Sample: 1995-2017. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

Table B6: *Robustness: Chinn-Ito Index*

	Increase in Restrictions			Decrease in Restrictions		
	(1)	(2)	(3)	(4)	(5)	(6)
$ln(VIX)$	0.32**	24.73	35.12	0.15	-37.93	-38.02
	(0.16)	(61.01)	(60.46)	(0.14)	(35.78)	(36.61)
$ln(VIX) \times ln(VIX)$		-2.37	-3.53		4.21	4.22
		(6.36)	(6.32)		(3.83)	(3.92)
$ln(VIX) \times ln(VIX) \times ln(VIX)$		0.08	0.12		-0.15	-0.15
		(0.22)	(0.22)		(0.14)	(0.14)
$\Delta CA/GDP_{-1}$			-0.00			0.01
			(0.04)			(0.03)
$\Delta log(GDP/CAP)_{-1}$			-0.05			0.02
			(0.05)			(0.04)
$\Delta log(ExchangeRate)_{-1}$			0.00			0.00
			(0.01)			(0.00)
$Inst.Quality_{-1}$			0.08			0.13
			(0.16)			(0.15)
$BankingCrisis_{-1}$			0.26			-0.66
			(0.79)			(1.07)
p-value: Domestic = 0			0.805			0.836
p-value: VIX = 0	0.040	0.292	0.381	0.272	0.431	0.458
Pseudo R^2	0.013	0.017	0.026	0.003	0.008	0.014
Observations	448	448	448	448	448	448

Notes: *We classify countries into active and inactive using our baseline metric, but use the Chinn-Ito Index to construct the Increase and Decrease indicators. Institutional quality and ln(VIX) are standardized. Banking crisis is a binary indicator equal to 1 if a crisis occurs. The remaining variables are expressed in %. A constant is estimated, but not displayed. Active emerging markets only. Sample: 1995-2017. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

Table B7: *Active versus Inactive Countries*

	Active	Inactive
Inflow Restrictions	0.483	0.423
CA/GDP (in %)	-2.2166	-0.342
Credit/GDP (in %)	34.024	44.618
Inst. Quality	63.146	63.724
GDP, Billions USD	251.775	217.588
Exchange Rate (CV)	0.475	0.347
Banking Crisis (in %)	2.372	1.796

Notes*: Comparison between EMs which actively adjust their capital inflow restrictions and the remaining (inactive) countries. Inflow restrictions are measured on an interval between $[0,1]$ where 1 refers to inflow restrictions in all asset categories excluding FDI. Institutional Quality is the sum over 12 different political risk categories. The exchange rate statistic displays the coefficient of variation (standard deviation/mean).*

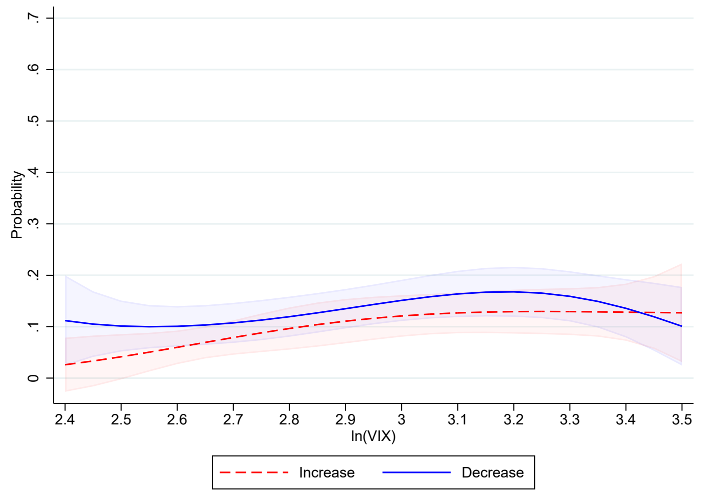
Table B8: *Calibration: Default in Emerging Markets and Financial Distress*

	External Debt Crisis					
	Active Countries			All Countries		
	(1)	(2)	(3)	(4)	(5)	(6)
$ln(VIX)$	0.12			0.24		
	(0.41)			(0.27)		
$ln(VIX)_{-1}$		0.35*			0.44***	
		(0.19)			(0.16)	
$ln(VOL)_{-1}$			0.29*			0.35***
			(0.15)			(0.14)
Pseudo R^2	0.002	0.012	0.009	0.005	0.017	0.013
Observations	208	195	195	672	630	630

Notes*: The table presents result from bivariate logit models. Dependent variable: Start of external debt crisis (Reinhart and Rogoff, 2009). Independent Variables: logarithm of VIX or volatility (VOL) (Bekaert and Hoerova, 2014). ln(VIX) and ln(VOL) are standardized. A constant is estimated, but not displayed. Sample: 1995-2010. Huber-White robust standard errors in parentheses. Stars indicate significance levels (*10%, **5%, ***1%).*

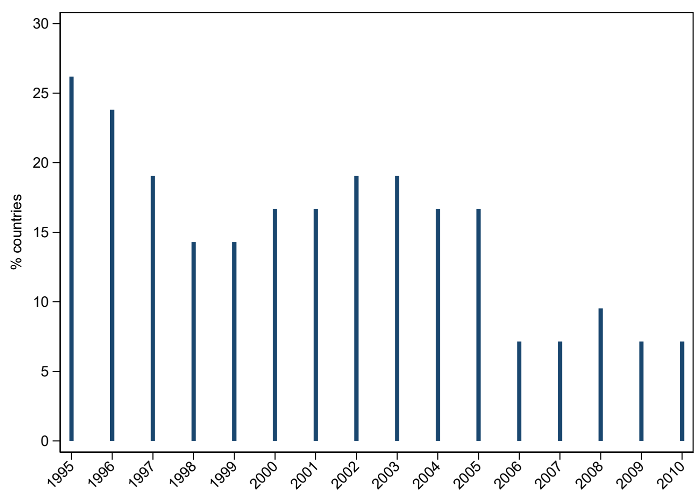
C. Appendix: Figures

Figure C1: *The Chinn-Ito Index and the VIX*



Notes: *We classify countries into active and inactive using our baseline metric, but use the Chinn-Ito Index to construct the Increase and Decrease indicators. The dashed red (solid blue) line displays the probability of increasing (decreasing) capital inflow controls (y-axis) as a function of ln(VIX) (x-axis). Shaded areas indicate 90% predictive margins. The underlying regression model is a logit model with a cubic polynomial and no control variables as portrayed in Equation (1). Active emerging markets only. Sample: 1995-2017.*

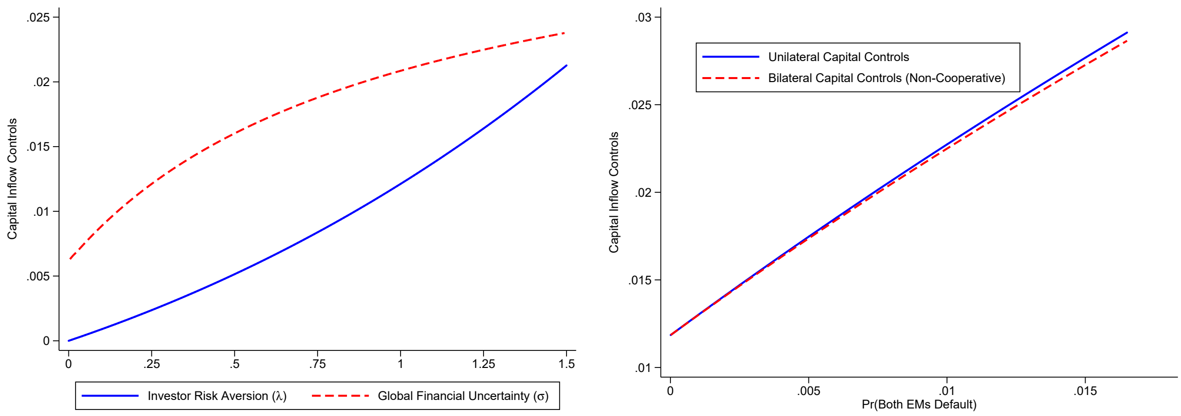
Figure C2: *External Debt Crises: Emerging Markets*



Notes: *The graph depicts the share (%) of EMs in an ongoing external debt crisis (y-axis) as defined in Reinhart and Rogoff (2009) between 1995 and 2010 (x-axis). We include all active and inactive EMs for which data is available. Advanced economies, as defined by the World Economic Outlook (IMF), did not experience a debt crisis during this period.*

Figure C3: *Capital Controls with CRRA Preferences*

(a) *Risk Aversion and Volatility* ***(b)*** *Two Emerging Markets: The Correlation Structure*



Notes: *Panel (a): The plot displays the optimal level of capital controls τ (y-axis) as a function of the risk aversion of international investors (λ, solid blue line) or volatility in financial markets (σ, dashed red line). Calibration: $E_{B,t+1}$=20, $E_{I,t}$=30, μ=3, θ=1 (risk aversion borrowers), χ=1, p=0.02 (solid blue line), σ=0.25 (solid blue line), p=0.05$\frac{\sigma}{1+\sigma}$+0.01 (dashed red line), λ=1 (dashed red line). Panel (b): The plot displays the optimal level of capital controls τ (y-axis) as a function of the probability that both emerging markets default simultaneously (d). The solid blue line considers a scenario where only one emerging market imposes capital controls. The dashed red line displays the level of capital controls if both emerging markets implement capital controls non-cooperatively. Calibration: $E_{B,t+1}$=$E^*_{B,t+1}$=20, $E_{I,t}$=30, μ=3, σ=0.25, χ=1, p=q=0.02, θ=λ=1.*

D. Appendix: Model

Proof of Lemma 1: We formally prove the uniqueness of the bond market equilibrium. Existence is trivial due to sufficient endowments as described in Section 3 and the Inada condition on borrowers' period t utility function, which ensures that borrowers issue debt at any finite risk premium. We first derive the slope of the aggregate demand curve. The aggregate demand equation can be rewritten as

$$RP_t - \frac{p(\sigma)}{1-p(\sigma)} \frac{E_t[v'_{t+1}(E_{I,t} - B_{I,t+1} + A_{t+1})]}{E_t[v'_{t+1}(E_{I,t} + RP_t B_{I,t+1} + A_{t+1})]} = 0.$$

We exploit the Implicit Function Theorem and obtain

$$\frac{\partial RP_t}{\partial B_{I,t+1}} = \frac{-\frac{p}{1-p}\left(E_t[v'_{t+1}|s=0]E_t[v''_{t+1}|s=1] + E_t[v'_{t+1}|s=1]E_t[v''_{t+1}|s=0]RP_t\right)}{E_t[v'_{t+1}|s=0]^2 + \frac{p}{1-p}E_t[v'_{t+1}|s=1]E_t[v''_{t+1}|s=0]B_{I,t+1}}.$$

Because v_{t+1} is strictly concave, the numerator is positive. The denominator is positive with Assumption 2. The derivative is therefore strictly positive. The procedure for the aggregate supply curve is similar. The aggregate supply curve corresponds to

$$u'_t\left(\frac{B_{B,t+1}}{\chi}\right) - (1-p(\sigma))u'_{t+1}\left(\frac{E_{B,t+1} - (1+RP_t)B_{B,t+1}}{\chi}\right)(1+RP_t) = 0.$$

Applying the Implicit Function Theorem yields

$$\frac{\partial RP_t}{\partial B_{B,t+1}} = \frac{-\left(u''_t + (1-p)(u''_{t+1}|s=0)(1+RP_t)^2\right)}{(1-p)\left((u''_{t+1}|s=0)(1+RP_t)B_{B,t+1}) - \chi(u'_{t+1}|s=0)\right)}.$$

The numerator is greater than zero since u_t is strictly and u_{t+1} weakly concave. The denominator is negative under the same condition. The supply curve is therefore strictly decreasing. As a consequence, aggregate demand and supply intersect exactly once. ■

Proof of Proposition 3: The aggregate demand and supply curves with exponential and log-quasilinear utility are:

$$RP_t = \frac{p(\sigma)}{1-p(\sigma)} exp\left(\lambda(1+RP_t)B_{I,t+1}\right) \tag{AD}$$

$$B_{B,t+1} = \frac{\chi}{(1-p(\sigma))(1+RP_t)} \tag{AS}$$

$$B_{B,t+1} = \frac{\chi}{(1-p(\sigma))(1+RP_t)+\chi\lambda RP_t}. \tag{AS:NP}$$

Capital controls are characterized as

$$\tau = \frac{\chi\lambda RP_t}{(1-p(\sigma))(1+RP_t)+\chi\lambda RP_t}.$$

The derivative $\frac{\partial\tau}{\partial\lambda}|_{\text{total}}$ is

$$\left.\frac{\partial\tau}{\partial\lambda}\right|_{\text{total}} = \frac{\partial\tau}{\partial\lambda} + \frac{\partial\tau}{\partial RP_t}\frac{\partial RP_t}{\partial\lambda}.$$

It is straight forward to verify that $\frac{\partial\tau}{\partial\lambda} > 0$ and $\frac{\partial\tau}{\partial RP_t} > 0$. With regard to $\frac{\partial RP_t}{\partial\lambda}$ we plug Equation (AS:NP) into Equation (AD):

$$RP_t - \frac{p(\sigma)}{1-p(\sigma)} exp\left(\frac{\lambda(1+RP_t)\chi}{(1-p(\sigma))(1+RP_t)+\chi\lambda RP_t}\right) = 0.$$

We apply the Implicit Function Theorem and obtain $\frac{\partial RP_t}{\partial\lambda} > 0$. Thus, $\frac{\partial\tau}{\partial\lambda}|_{\text{total}} > 0$. Capital controls are increasing in risk aversion. ■

Proof of Proposition 4: Building on the derivation for Proposition 3, $\frac{\partial\tau}{\partial\sigma}|_{\text{total}}$ equals

$$\left.\frac{\partial\tau}{\partial\sigma}\right|_{\text{total}} = \frac{\partial\tau}{\partial\sigma} + \frac{\partial\tau}{\partial RP_t}\frac{\partial RP_t}{\partial\sigma}.$$

We obtain $\frac{\partial\tau}{\partial\sigma} > 0$ as $p'(\sigma) > 0$ and $\frac{\partial\tau}{\partial RP_t} > 0$. Combining Equation (AS:NP) and Equation (AD) as before, one obtains $\frac{\partial RP_t}{\partial\sigma} > 0$. Therefore, $\frac{\partial\tau}{\partial\sigma}|_{\text{total}} > 0$. In other words capital controls increase in volatility. ■

Two Country Model: The extended model features two aggregate demand curves, one for each emerging market bond.

$$RP_t = exp\left(\lambda(1+RP_t)B_{I,t+1}\right)\frac{d\,exp(\lambda B^*_{I,t+1}) + (p-d)exp(-\lambda RP^*_t B^*_{I,t+1})}{(q-d)exp(\lambda B^*_{I,t+1}) + (1-p-q+d)exp(-\lambda RP^*_t B^*_{I,t+1})} \tag{AD}$$

$$RP^*_t = exp\left(\lambda(1+RP^*_t)B^*_{I,t+1}\right)\frac{d\,exp(\lambda B_{I,t+1}) + (q-d)exp(-\lambda RP_t B_{I,t+1})}{(p-d)exp(\lambda B_{I,t+1}) + (1-p-q+d)exp(-\lambda RP_t B_{I,t+1})} \tag{AD*}$$

Aggregate supply curves are isomorphic to the one country model with $p(\sigma)$ replaced by $q(\sigma)$ and asterisk (*) symbols for foreign supply.

The tax formulas for both countries are equivalent to the one country model, except for the relabeling of parameters/variables in case of foreign capital controls. This is a consequence of exponential utility and the observation that each planner treats foreign variables as given. The domestic regulator for example does not internalize the endogenous adjustments in RP_t^* or $B_{I,t+1}^*$ when calculating the response of the required domestic risk premium for a change in domestic bonds.

CRRA utility: We impose CRRA utility for borrowers (in both periods) and investors. The relative risk aversion parameter of investors (borrowers) is denoted as λ (θ). This gives rise to the following demand and supply schedules for the variant with one emerging market:

$$RP_t = \frac{p(\sigma)}{1-p(\sigma)} \frac{E_t\left[(E_{I,t} - B_{I,t+1} + A_{t+1})^{-\lambda}\right]}{E_t\left[(E_{I,t} + RP_t B_{I,t+1} + A_{t+1})^{-\lambda}\right]} \tag{AD}$$

$$\left(\frac{B_{B,t+1}}{\chi}\right)^{-\theta} = (1-p(\sigma))\left(\frac{E_{B,t+1}}{\chi} - (1+RP_t)\frac{B_{B,t+1}}{\chi}\right)^{-\theta}(1+RP_t) \tag{AS}$$

$$\left(\frac{B_{B,t+1}}{\chi}\right)^{-\theta} = (1-p(\sigma))\left(\frac{E_{B,t+1}}{\chi} - (1+RP_t)\frac{B_{B,t+1}}{\chi}\right)^{-\theta}\left(1+RP_t + \frac{\partial RP_t}{\partial B_{I,t+1}} B_{B,t+1}\right). \tag{AS:NP}$$

The derivative $\frac{\partial RP_t}{\partial B_{I,t+1}}$ is based of the aggregate demand curve and characterized as

$$\frac{\partial RP_t}{\partial B_{I,t+1}} = \frac{\lambda RP_t \left[\frac{E_t\left[C_{I,t+1}^{-\lambda-1}|s=1\right]}{E_t\left[C_{I,t+1}^{-\lambda}|s=1\right]} + \frac{RP_t E_t\left[C_{I,t+1}^{-\lambda-1}|s=0\right]}{E_t\left[C_{I,t+1}^{-\lambda}|s=0\right]}\right]}{1 - \lambda RP_t B_{I,t+1}\frac{E_t\left[C_{I,t+1}^{-\lambda-1}|s=0\right]}{E_t\left[C_{I,t+1}^{-\lambda}|s=0\right]}}.$$

Optimal capital inflow controls equal

$$\tau = (1-p(\sigma))\frac{(E_{B,t+1} - (1+RP_t)B_{B,t+1})^{-\theta}}{\left(B_{B,t+1}\right)^{-\theta}} \frac{\partial RP_t}{\partial B_{I,t+1}} B_{B,t+1}.$$

In the two country version, aggregate supply curves are isomorphic to the one country model with $p(\sigma)$ replaced by $q(\sigma)$ and asterisk (*) symbols for foreign emerging market variables. A similar argument holds for the tax formulas. We subsequently describe aggregate demand. To save space, we define a state vector $s = (d, f)$ with $d, f \in \{0, 1\}$ that characterizes four possible states. $s = (1, 0)$ for example corresponds to a state where the home country defaults, while the foreign emerging market does not default.

$$RP_t = \frac{dE_t\left[C_{I,t+1}^{-\lambda}|s=(1,1)\right] + (p-d)E_t\left[C_{I,t+1}^{-\lambda}|s=(1,0)\right]}{(q-d)E_t\left[C_{I,t+1}^{-\lambda}|s=(0,1)\right] + (1-p-q+d)E_t\left[C_{I,t+1}^{-\lambda}|s=(0,0))\right]} \tag{AD}$$

$$RP_t^* = \frac{dE_t\left[C_{I,t+1}^{-\lambda}|s=(1,1)\right] + (q-d)E_t\left[C_{I,t+1}^{-\lambda}|s=(0,1)\right]}{(p-d)E_t\left[C_{I,t+1}^{-\lambda}|s=(1,0)\right] + (1-p-q+d)E_t\left[C_{I,t+1}^{-\lambda}|s=(0,0)\right]} \tag{AD*}$$

Because consumption is a function of bond holdings and risk premiums according to Equations (11) and (12), we can rewrite the domestic aggregate demand curve as $h(RP_t, B_{I,t+1}, RP_t^*, B_{I,t+1}^*) = 0$. Domestic regulators treat foreign variables as given. The derivative $\frac{\partial RP_t}{\partial B_{I,t+1}}$ from the perspective of the domestic emerging market is therefore

$$\frac{\partial RP_t}{\partial B_{I,t+1}} = -\frac{\partial h/\partial B_{I,t+1}}{\partial h/\partial RP_t}$$

with

$$\begin{aligned}\frac{\partial h}{\partial B_{I,t+1}} =& -\lambda RP_t\Bigg[\frac{dE_t[C_{t+1}^{-\lambda-1}|s=(1,1)] + (p-d)E_t[C_{I,t+1}^{-\lambda-1}|s=(1,0)]}{dE_t[C_{I,t+1}^{-\lambda}|s=(1,1)] + (p-d)E_t[C_{I,t+1}^{-\lambda}|s=(1,0)]} \\ &+ RP_t\frac{(q-d)E_t[C_{t+1}^{-\lambda-1}|s=(0,1)] + (1-p-q+d)E_t[C_{I,t+1}^{-\lambda-1}|s=(0,0)]}{(q-d)E_t[C_{I,t+1}^{-\lambda}|s=(0,1)] + (1-p-q+d)E_t[C_{I,t+1}^{-\lambda}|s=(0,0)]}\Bigg]\end{aligned}$$

and

$$\frac{\partial h}{\partial RP_t} = 1 - \lambda RP_t B_{I,t+1}\left[\frac{(q-d)E_t[C_{I,t+1}^{-\lambda-1}|s=(0,1)] + (1-p-q+d)E_t[C_{I,t+1}^{-\lambda-1}|s=(0,0)]}{(q-d)E_t[C_{I,t+1}^{-\lambda}|s=(0,1)] + (1-p-q+d)E_t[C_{t+1}^{-\lambda}|s=(0,0)]}\right].$$

The derivation for $\frac{\partial RP_t^*}{\partial B_{I,t+1}^*}$ is isomorphic and hence omitted.

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