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Capital Controls and the Global Financial Cycle*

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Abstract

Capital flows into emerging markets have become more volatile with increased risks, which renewed interest in active capital flow management. In this paper, we argue that heightened international financial volatility and investor risk aversion incentivizes emerging market regulators to reduce the amount of risky emerging market debt to cope with elevated risk premiums. In turn, this motive can be implemented via capital inflow restrictions during periods of major financial distress, which generates a trade-off with the familiar notion to implement capital controls counter-cyclically. We then revisit the usage of capital controls in practice. We find that emerging markets, which actively revaluate their capital flow restrictions, increase capital inflow controls during episodes of major international financial distress, which is consistent with the predictions of the model.

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

JEL: F36, F38, F41

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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 lasting 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).[1] These proposals are supported by a theoretical literature, which stresses that emerging markets may borrow excessively on international markets due to externalities leading to tight borrowing and collateral constraints during downturns (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; Acosta-Henao et al., 2020) has struggled to identify such 'optimal' counter-cyclical use in practice for a large sample of emerging markets.[2]

In this paper, we propose an alternative, complementary rationale for capital controls: Deteriorating global financial conditions increase the risk premium of emerging market debt and therefore raise the cost to issue bonds. Everything else equal, this creates an incentive for emerging markets to reduce their debt issuance, which can be accomplished via capital inflow controls. We then revisit the usage of capital controls and document a new stylized fact: Emerging markets increase capital inflow restrictions during episodes of major international financial distress, which is consistent with the implications from our model.

With regard to the empirical analysis, we show that emerging markets tend to tighten capital inflow, but not outflow restrictions during periods of major financial distress. We identify three episodes: The Global Financial Crisis, the Dot-Com Bubble and the Asian Financial Crisis. 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

[1]The IMF recently broadened its support for capital controls. See, `https://www.imf.org/en/Blogs/Articles/2022/03/30/blog033122-why-the-imf-is-updating-its-view-on-capital-flows`.

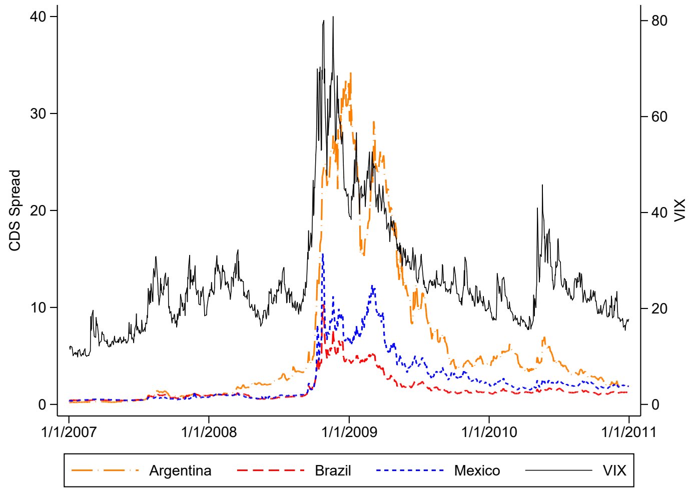
[2]There are of course exceptions like Brazil (Chamon and Garcia, 2016), or Peru (Keller, 2019). Further, there is a trend towards a counter-cyclical use since the Global Financial Crisis (Batini et al., 2020), though this has not yet affected aggregate data.

controls and the two aforementioned structural factors. These empirical findings are new and so is our approach: Rather than examining *all* emerging markets, we zoom in on countries that resort to capital controls as an *active* policy tool (22 out of 68 EMs). This sample selection makes it more likely to uncover empirical regularities and a priori does not discriminate among different motives. But because many emerging markets do not adjust their capital controls, this finding does not generalize.

In terms of the analytical framework, 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; Broner et al., 2013; Longstaff et al., 2011; Lizarazo, 2013; Gilchrist et al., 2022). 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. Indeed, this is what we observe in Figure 1. The chart plots normalized credit default spreads for 1 year government bonds for three emerging markets, Argentina, Brazil, and Mexico during the Global Financial Crisis. Reassuringly, as global financial conditions deteriorated (an increase in the VIX), spreads for all three countries rose. Higher borrowing costs in turn incentivize regulators, who internalize this price effect, to reduce the amount of debt, similar to Aguiar and Gopinath (2006): they argue that governments would not borrow a lot when the bond price function is extremely steep. The basic concept also 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.

An important question is whether our empirical findings are just consistent with the model, or if there is actual evidence supporting the notion that emerging markets purposely increased inflow restrictions around major financial crises to shield the domestic economy from external influences. To be upfront, narrative evidence is limited, but we do find that at least some evidence, particularly during the Asian Financial Crisis: As a case in point, in Colombia "measures where tightened [...] and only gradually eased over the subsequent two decades as external conditions improved" (Batini et al., 2020). This evidence also extends to several other emerging markets around that time, which "adopted new capital account restrictions to manage specific capital account shocks" during the crisis (Montiel, 2020). Further, during the early 2000s and hence the Dot-Com Bubble, many emerging markets were in distress (Reinhart and Rogoff, 2009) and experienced capital outflows. At the same time, restrictions for inflows increased, at least for countries that actively manage

Figure 1: Credit Default Spreads during the Global Financial Crisis



Notes*: The chart plots default risk on one year government bonds for three emerging markets, Argentina, Brazil, Mexico (dashed lines, displayed on left y-axis) during the Global Financial Crisis. Credit default spreads are normalized to 1 at the beginning of 2008. The solid line displays the VIX (displayed on right y-axis) Sample: Daily observations from January 2007 until January 2011.*

their capital flows. Evidence around the Global Financial Crisis is more scarce due to the timing of events. In particular, it is challenging to disentangle two effects that occurred in close succession: the Lehman collapse in September 2008, and the aggressive monetary policy response by advanced economies. As such, net capital flows towards emerging markets suddenly subsided, but quickly resurfaced due to search for yield behaviour by investors. However, many emerging markets were subject to additional controls by the end of 2008 just three months after the Lehman collapse, which at the very least suggests that they did not decrease restrictions once inflows subsided. After the Global Financial Crisis, and in line with the new stance towards capital controls, there is however more evidence that emerging markets implement capital controls counter-cyclically to deal with inflow surges (Batini et al., 2020).

Our emphasis on the incentives of regulators to reduce borrowings and lower the risk premium during global financial distress are complementary to the existing capital controls literature based on externalities. Capital controls in these models address an underlying inefficiency and therefore improve welfare on aggregate.[3] In contrast, intervention in our model extract rents from international investors. Capital controls in this environment are therefore inferior to macroprudential policies, yet as we argue consistent with empirical regularities. We thus do not advocate to use capital controls

[3]Papers with pecuniary externalities include Bianchi (2011), Benigno et al. (2013, 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).

as described in this paper. Indeed, macroprudential capital controls may limit the build-up of external debt ex-ante and therefore reduce borrowing costs during a crisis, without the disruptive effects of ex-post capital inflow restrictions, which trade lower risk premiums at the expense of larger current account reversals.

Our framework is closest to a small literature on the incentives of a monopolistic regulator to alter relative prices. In De Paoli and Lipinska (2012), a regulator wants 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) emphasize the importance of international risk premiums through which global financial shocks transmit to the business cycle of emerging markets.

2. Analytical Framework

This section provides the foundations for the subsequent structural and empirical analysis. We build a small open economy model with two distinct features: 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.

2.1. 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. The timing of the model is as follows: In the first period, agents observe global financial market uncertainty and investors' risk aversion. Both agents also make their investment decisions. During the second period, returns on investments are realized. The payoffs are tied to global financial conditions. Thus, we interpret both periods as roughly corresponding to one mayor financial crisis.

International Investors: International investors are risk-averse and for simplicity 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. Throughout the paper, we maintain the assumption that investors are more wealthy than households from emerging markets. This assumption guarantees an interior solution in which investors absorb all emerging market bonds and invest in the risk-free 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. Investors maximize expected utility

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

We impose exponential utility, $v_{t+1}(c_{I,t+1}) = -exp(-\lambda c_{I,t+1})$.[4] The parameter λ represents the level of risk aversion and is meant to capture international risk appetite. If $\lambda > 0$, investors are risk-averse.

Investors receive an initial endowment ($e_{I,t}$). With the previous information, the budget constraints of investors are

$$b_{I,t+1} + l_{t+1} = e_{I,t} + (1 + \overline{RP})\overline{b}_{I,0} \tag{1}$$
$$\overline{b}_{I,T} + c_{I,t+1} = (1 + RP_t)\tilde{b}_{I,t+1} + l_{t+1} + a_{t+1}. \tag{2}$$

The variables $\overline{b}_{I,0}$ ($\overline{b}_{I,T}$) refer to exogenous initial (final) bond holdings. We introduce these objects to provide realistic current account dynamics as explained in Section 3.4. The process for $\tilde{b}_{I,t+1}$ is described as:

$$\tilde{b}_{I,t+1} = \begin{cases} b_{I,t+1} & \text{with probability } 1 - p, \\ 0 & \text{with probability } p. \end{cases} \tag{3}$$

We do not take a stance on why emerging market bonds are risky. However, sovereign

[4] We numerically verify the robustness of this choice with more standard CRRA preferences for investors and borrowers in the appendix.

defaults among emerging markets are relatively common (Figure C3).[5]

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 is the second key parameter besides investor risk aversion λ. 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 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 consume $(c_{B,t}, c_{B,t+1})$ and issue bonds $(b_{B,t+1})$. Bonds are purchased by international investors and risky, as described previously. 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 combined with sufficient initial debt ensures that households always borrow internationally. 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 correspond to

$$c_{B,t} = b_{B,t+1} + e_{B,t} - (1 + \overline{RP})\bar{b}_{B,0} \tag{4}$$

$$c_{B,t+1} = \bar{b}_{B,T} + e_{B,t+1} - (1 + RP_t)\tilde{b}_{B,t+1}. \tag{5}$$

[5] 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.

The term $\tilde{b}_{B,t+1}$ captures the amount of debt that households repay to international investors (see Equation (3)). Since households do not repay their debt with probability $p(\sigma)$, they are required to pay a risk premium (RP_t). Last but not least, $\bar{b}_{B,0}$ ($\bar{b}_{B,T}$) refer to exogenous initial (final) debt holdings. This completes the description of the model.

2.2. Unregulated Equilibrium

We start by defining the unregulated equilibrium. Following the convention in the literature, we use aggregate letters to denote aggregate quantities.

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* (1) *and* (2) *taking the risk premium as given;*
2. *borrowers in the emerging market maximize utility* (Po:EM) *subject to the constraints* (4) *and* (5) *taking the risk premium as given;*
3. *the market for emerging market bonds clears, that is, $B_{I,t+1} = B_{B,t+1} = B_{t+1}$.*

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 (1) and (2), 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

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

where s=1 (s=0) refers to the sate in which the emerging market defaults (does not default). 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*

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

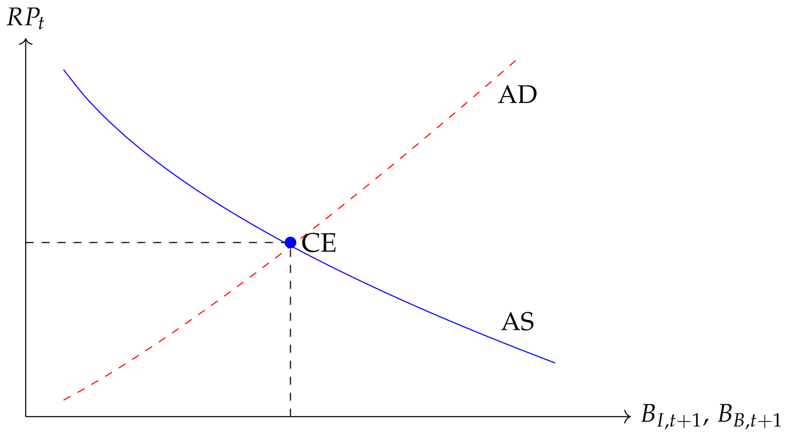
The assumption appears technical, but it ensures that (aggregate) demand has a fixed point in RP_t. In other words, with Assumption 2 the right hand side of Equation (AD) grows by less than one for a marginal change in the risk premium. This requirement is satisfied as long as $p(\sigma)$ is not too 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 (4) and (5). 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 2: *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).*

Bond Market Equilibrium: The equilibrium is derived by setting aggregate demand equal to aggregate supply as illustrated in Figure 2. 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.

3. 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. 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 (regulator) directly chooses the consumption path of domestic households and the supply of emerging market bonds (Section 3.1). Subsequently, we decentralize the allocation via capital inflow controls (Section 3.2). Afterward, we discuss how capital controls, and therefore the wedge between the planner and the unregulated equilibrium, respond to volatility in international financial markets and investor risk aversion (Section 3.3). We then explore the implications of such an intervention on the current account (Section 3.4). We conclude this chapter with numerical illustrations where we vary the size of the emerging market and include a second (foreign) emerging market (Section 3.5). Throughout the analysis, we assume that international investors continue to act competitively and demand risky bonds according to Equation (AD).

3.1. 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

$$C_{B,t} = B_{B,t+1} + E_{B,t} - (1 + \overline{RP})\overline{B}_{B,0} \tag{6}$$

$$C_{B,t+1} = \overline{B}_{B,T} + E_{B,t+1} - (1 + RP_t)\tilde{B}_{B,t+1} \tag{7}$$

$$RP_t = \frac{p(\sigma)}{1 - p(\sigma)} \frac{E_t[v'_{t+1}|s = 1]}{E_t[v'_{t+1}|s = 0]}. \tag{8}$$

The planner internalizes the dependency between the risk premium and debt absorption by international investors as postulated by the aggregate demand curve. The planner hence de-facto chooses the supply of bonds on the aggregate demand curve that maximizes domestic welfare. Equation (8) 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* (1) *and* (2) *taking the risk premium as given;*
2. *a national planner maximizes utility* (Po:NP) *subject to the constraints* (6), (7) *and* (8)*;*
3. *the market for emerging market bonds clears, that is, $B_{I,t+1} = B_{B,t+1} = B_{t+1}$.*

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. Though overborrowing also arises in the externality literature on capital controls, the reasoning is different. Here, a regulator understands that more debt increases the risk premium, hence it is desirable to reduce the amount of debt issuance relative to the unregulated equilibrium. The intervention is however beggar-thy-neighbor as it extracts a monopoly rent from international investors. In the externality literature, intervention is due to an inefficiency, for example, a borrowing constraint, and intervention can improve welfare on aggregate.

3.2. Implementation

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

$$c_{B,t} = (1-\tau)b_{B,t+1} + e_{B,t} - (1+\overline{RP})\bar{b}_{B,0} + T.$$

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 issue less debt. With this adjustment, the Euler equation in the regulated equilibrium becomes

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

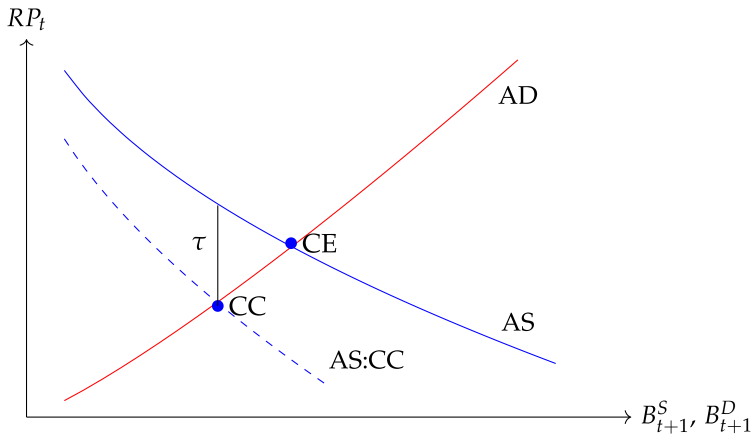
Optimization with the tax leads to a modified aggregate supply curve that resembles the unregulated supply curve apart from the additional term 1-τ. The level of capital controls is then chosen to close the wedge between the regulated aggregate supply curve and the national planner's first-order condition:

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

The formula 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 is limited in t+1, a high tax is optimal to encourage households to reallocate funds. The second term of the 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 pricing power by its relevance akin to the actual bond supply.

We illustrate the regulated equilibrium in Figure 3. The regulated aggregated supply curve (AS:CC) is below the aggregate supply curve of the unregulated equilibrium. The wedge between both curves is due to τ and hence the level of capital controls.

Figure 3: *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.*

3.3. Volatility and Investor Risk Aversion

How should regulators adjust capital inflow 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 is that increasing capital inflow controls during periods of high volatility and risk aversion 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 1: *A national regulator raises the level of capital inflow controls in response to elevated international risk aversion and vice versa,*

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

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 raises the national planner's cost to issue debt. Because households do not internalize this effect, the wedge between the planner and the unregulated allocation widens, and capital controls must increase to offset the wedge.

We illustrate the proposition in Figure 4 (solid blue line). Clearly, as the risk aversion of investors rises (x-axis), the level of capital controls (y-axis) increases. Notice that 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

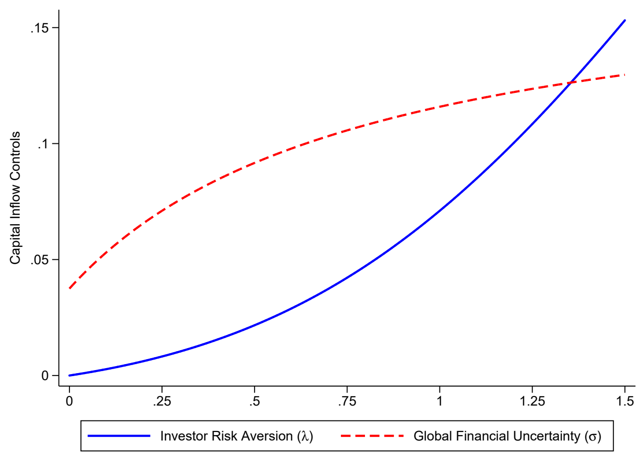
Proposition 2: *A national regulator raises the level of capital inflow controls in response to global financial volatility and vice versa,*

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

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 4 (dashed red line). As markets are generally more uncertain (x-axis), capital controls (y-axis) increase.

Figure 4: *Capital Controls, Risk Aversion and Volatility*



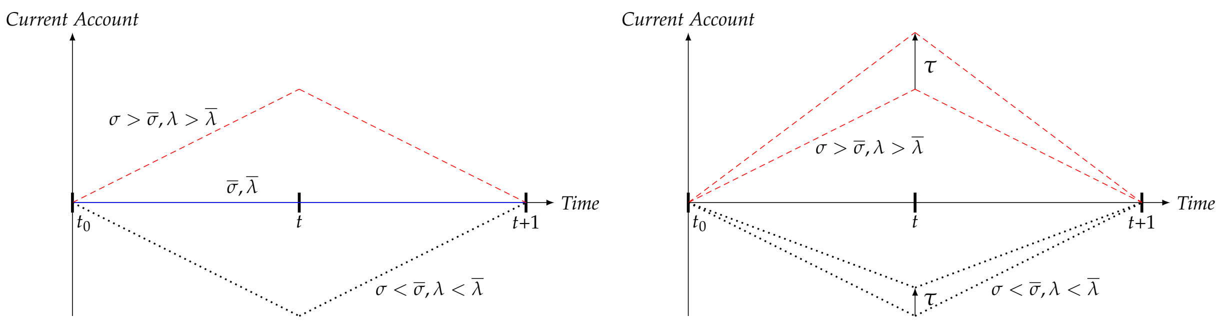
Notes: *The plot displays the level of capital controls τ (y-axis) as a function of the risk aversion of international investors (λ, solid blue line) or volatility in international financial markets (σ, dashed red line). Calibration: χ=1, $e_{B,t}$-$(1+\overline{RP})\bar{b}_{B,0}$=-0.2, p=0.02 (solid blue line), p=0.05$\frac{\sigma}{1+\sigma}$+0.01 (dashed red line), λ=1 (dashed red line).*

3.4. The Current Account

How do global financial conditions and capital inflow controls affect the current account? We first illustrate that our model is able to replicate current account reversals during periods of global financial distress as suggested by empirical evidence. Figure 5, Panel (a) portrays the current account during three periods t-1, t, and t+1. The current account in this model is defined as the difference between exports and imports plus net transfers in case of default which must be mirrored by a change in the international debt position. The current account in t-1 is not modeled and normalized to zero. Based on Equations (AD) and (AS), it is then possible to jointly determine a pair $\{\overline{\sigma}, \overline{\lambda}\}$ that is consistent with a zero current account in t and t+1 as represented by the solid blue line (see appendix for details). If financial market uncertainty increases or if investors are more risk averse than this benchmark ($\sigma > \overline{\sigma}, \lambda > \overline{\lambda}$), the emerging market issues less debt and runs a current account surplus, mirroring capital outflows from emerging markets during periods of financial distress (dashed red line). Intuitively, elevated risk aversion implies a higher risk premium and households in the emerging market issue consequently less debt. Further, with more uncertainty in international financial markets investors are less willing to hold emerging market debt as emerging market and global risk comove. All of these effects are reversed when volatility and/or risk aversion drops (dotted black line). Therefore, if international financial markets are calm, the model implies a current account deficit.

Figure 5: *Current Account*

(a) *Global Financial Conditions* ***(b)*** *Capital Inflow Controls*



Notes: *Panel (a): The chart illustrates the current account as a function of volatility (σ) and investor risk aversion (λ). $\overline{\sigma}, \overline{\lambda}$ (blue line) are consistent with a zero current account. More volatility or higher risk aversion imply less emerging market borrowing and hence a current account surplus and vice versa (dashed red and dotted black lines). Panel (b): The chart portrays the consequences of capital inflow controls on the current account when international financial volatility (σ) and investor risk aversion (λ) are either high (dashed red lines) or low (dotted black lines). Capital inflow controls (τ) reduce borrowings, however, the tax is larger when volatility or risk aversion is high, leading to a disproportionate effect on the current account during financial turmoil.*

Capital inflow controls as specified in the previous section limit the issuance of new debt in period t and thus either reduce the current account deficit when global financial conditions are calm, or increase the current account surplus during periods of financial turmoil and heightened uncertainty. Figure 5, Panel (b) illustrates these observations. The dashed red lines signal a current account surplus ($\sigma > \overline{\sigma}, \lambda > \overline{\lambda}$). The surplus increases with the capital control tax. Similarly, as indicated by the dotted black lines, the tax reduces the current account deficit during benign financial conditions.[6] The effects are however disproportionate: The increase in the current account surplus exceeds the reduction in the deficit, precisely because intervention increases with deteriorating financial markets as highlighted by Propositions 1 and 2.

Discussion

Current account reversals are generally perceived as detrimental to emerging markets. Hence, before we continue, we would like to emphasize why a tax on capital inflows that intensifies current account reversals is desirable in our framework. We differ from the macroprudential capital controls literature in two aspects (see, for example, Bianchi, 2011; Korinek, 2018): First, bonds are more costly to issue when financial conditions deteriorate. The regulator unlike households internalizes this price effect and therefore restricts capital inflows. Second, our model abstracts from a borrowing constraint that can generate vicious spirals of capital outflows, exchange rate depreciations and tighter borrowing limits. We hence model a crisis as being associated with higher borrowing costs, but not a binding borrowing constraint per se. Besides these two points, our model, just like most of the literature, abstracts from production (a noticeable exception is Ma, 2020). If production is realistically tied to foreign investments, net outflows are ceteris paribus less desirable. However despite these effects, the introduction of a time-varying risk premium makes inflow restrictions during global financial distress more desirable everything else equal.[7]

3.5. Monopoly Power Revisited

The previous narrative provides a clear justification for regulatory intervention via capital inflow controls from the perspective of an emerging market particularly during periods of international financial distress: Intervention in international capital markets

[6] The reduction in the current account deficit when market conditions are calm should not be mistaken for a prudential motive. First, restrictions are tighter during financial turmoil. Second, intervention is not due to vulnerabilities in the economy but rather because of monopolistic behavior.

[7] Capital controls may further detain investors to provide funds again in the future. However, this argument should primarily apply to outflow controls when investors cannot receive their funds rather than inflow controls, which discourage the issuance of new debt. We are not aware of empirical research concerning the long-run implications of periodic capital controls.

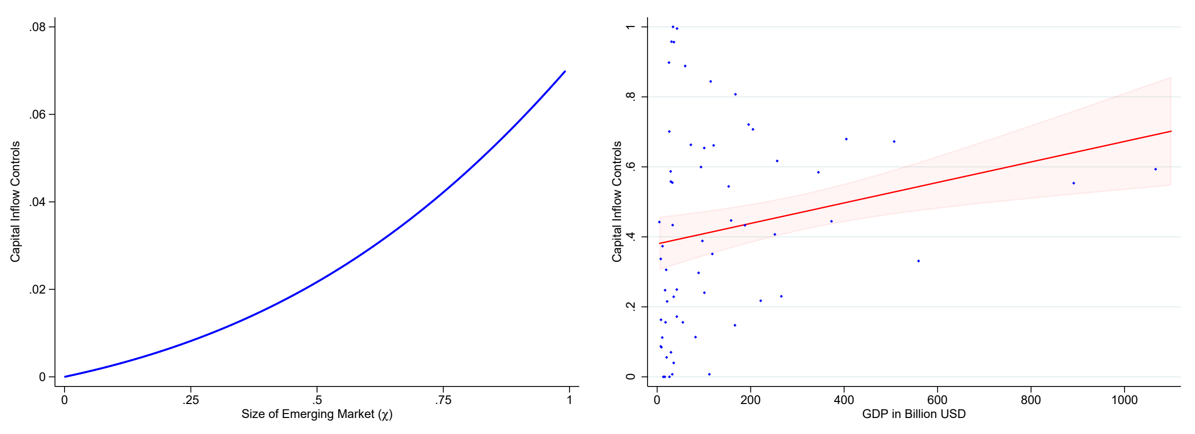
reduces the amount of international debt and lowers the required risk premium. The incentives to reduce the cost of debt are tied to the monopoly power of the emerging market. An emerging market has a natural monopoly on its own debt, but how relevant is this characteristic in practice? Before we test the implications in the data, we examine two extensions to assess the plausibility of our analytical results. 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, our model predicts that intervention via capital controls would be muted. Indeed, this is also what we observe in the data, as Figure 6 emphasizes.

Figure 6: *Country Size and Capital Controls*

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



Notes: *Panel (a): The plot displays the level of capital controls τ (y-axis) as a function of the size of the emerging market (χ). Calibration: $e_{B,t}$-$(1+\overline{RP})\bar{b}_{B,0}$=-0.2, 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. See Section 4.1 for more details on the data.*

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 market debt. 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 6, we provide results from a bivariate OLS regression where we regress the 'Inflow Restriction Index' (Section 4.1) 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.

We model both emerging markets equivalently, that is, both emerging markets follow the same setup as described in Section 2.1. 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 7.

Figure 7: *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

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

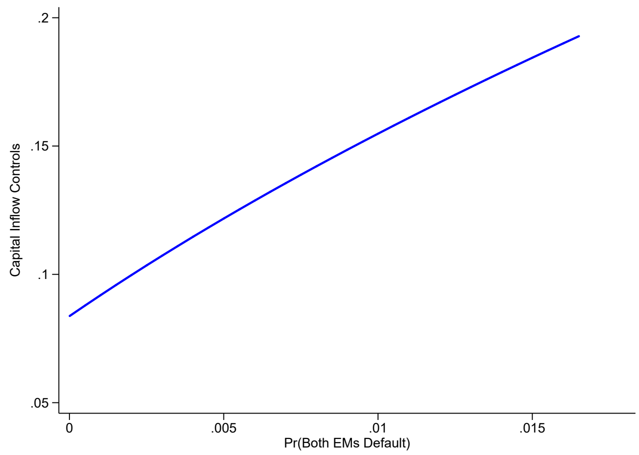
where we characterize foreign variables with an asterix (*). The augmented budget constraints are

$$b_{I,t+1} + b^*_{I,t+1} + l_{t+1} = e_{I,t} + (1 + \overline{RP})\overline{b}_{I,0} + (1 + \overline{RP}^*)\overline{b}^*_{I,0} \tag{9}$$

$$\overline{b}_{I,T} + \overline{b}^*_{I,T} + c_{I,t+1} = (1 + RP_t)\tilde{b}_{I,t+1} + (1 + RP^*_t)\tilde{b}^*_{I,t+1} + l_{t+1} + a_{t+1}. \tag{10}$$

We analyze capital controls in a Nash equilibrium where both emerging markets resort to capital controls in a non-cooperative manner. Figure 8 portrays the 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 it becomes apparent that capital inflow restrictions increase with a more similar risk structure. Intuitively, 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, the aggregate demand curve flattens and the wedge between the regulator and the unregulated equilibrium declines. 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 interventions to reduce the debt burden and risk premium.

Figure 8: *Two Emerging Markets: The Correlation Structure and Capital Controls*



Notes: *The plot displays the level of capital inflow controls τ (y-axis) as a function of the probability that both emerging markets default simultaneously (d). Calibration: χ=1, $e_{B,t}$-(1+$\overline{RP}$)$\overline{b}_{B,0}$=-0.2, p=q=0.02, λ=1.*

4. Stylized Facts

We now turn to our empirical analysis to examine if emerging markets indeed raised their capital inflow restrictions during periods of global financial distress as predicted by our analytical framework.

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 in Section 4.1 and subsequently zoom in on this group. This step makes it more likely to find *any* noteworthy patterns, but a priori does not discriminate among different motives. Our subsequent findings in Section 4.2 hence do not generalize to a sample including countries that do not adjust their capital controls. That said, we find that 'active' EMs disproportionately raised their capital inflow restrictions during the Asian Financial Crisis, around the Dot-Com Bubble, and the Global Financial Crisis. Section 4.3 provides several robustness checks. Section 4.4 compares our results with the prescriptions from the counter-cyclical externality literature on capital controls.

4.1. Active Capital Control Management

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. Each entry reflects restrictions at year end. Data is available for 68 EMs over 23 years. 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). The model we proposed in the previous sections 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 create an index, which we normalize between $[0, 1]$ ('Inflow Restriction Index', short IRI). A value of 1 refers to inflow restrictions in all asset classes excluding FDI. More formally, we construct

$$IRI_{i,t} = \frac{\sum_{j=1}^{M} CC_{i,j,t}}{M},$$

where $CC_{i,j,t}$ refers to a binary indicator reflecting restrictions in individual asset category j for country i in year t. M refers to the in total nine asset classes that we consider. The major disadvantage with the dataset 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, available intensive margin measures cover a shorter time period, fewer countries and are only available for a narrow set of assets.

We next split our sample of emerging markets into two groups: A group that 'actively' adjusts capital controls and a group that is 'passive'. The idea is somewhat related to Klein (2012), who distinguishes 'gates' and 'walls' depending on whether a country imposes capital controls temporarily or permanently. Our algorithm is as follows: First, we calculate the first difference in the 'Inflow Restriction Index'. Second, we compute the standard deviation of the first difference of the index separately for each country. Third, we categorize a country as active if its country specific standard deviation is greater or equal than the sample average across all EMs.[8] More formally, we generate our list of active countries as follows:

$$\begin{aligned} Active_i &= 1 \quad \text{if} \quad sd_i\left(\triangle_t IRI_{i,t}\right) \geq \frac{\sum_i^N sd_i\left(\triangle_t IRI_{i,t}\right)}{N} \\ Active_i &= 0 \quad \text{otherwise.} \end{aligned}$$

The threshold in the third step is of course somewhat arbitrary. However, as we detail in Table 1, the classification provides a list of countries that regularly adjust their capital inflow controls, just as intended. We refer the reader to the appendix for a host of robustness checks with regard to this threshold. We would also like to emphasize that we focus on the standard deviation of changes in the 'Inflow Restriction Index', rather than the standard deviation of the level. This is for two reasons: First, we prefer to categorize countries into active or inactive independent of the level of existing capital controls. This is particularly important due to the heterogeneous use of capital controls across EMs, particularly between more advanced emerging markets and developing economies (Fernández et al., 2015). Second, and more from a

[8]This approach accounts for the number of adjustments during a year, which we prefer over a metric that only considers the number of years in which a country changed its capital controls.

technical point, the 'Inflow Restriction Index' is non-stationary for some countries due to general trends (or random walk like behaviour) to either increase or decrease capital inflow restrictions during the sample period (see Table 1). The standard deviation of a non-stationary variable is possibly time-varying and hence not well defined.

Table 1 lists the 22 EMs (out of 68 EMs in total) 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).[9] Columns 3 and 4 split changes in capital inflow restrictions into increases or decreases. As apparent, the majority of countries tend to balance their adjustments, but some exceptions emerge, like for example Argentina, which primarily increased its restrictions during the sample period.[10]

4.2. 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 a sizable increase in the number of countries that impose additional capital inflow controls. A decomposition of financial distress into investor risk aversion (λ in our model) and volatility (σ) 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 (see, for example, Bekaert et al., 2013; Bruno and Shin, 2014; Ghosh et al., 2014; Miranda-Agrippino and Rey, 2020).

Figure 9 provides descriptive statistics on the comovement of capital inflow restrictions and global financial distress. Both panels plot the VIX against the number

[9]The data is annual, hence temporary changes within a year a not recorded. The reported frequency is hence a lower bound.

[10]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.

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.*

of active countries that increased (Panel (a)) or decreased (Panel (b)) inflow restrictions in any asset category (excluding FDI) relative to the previous year. In more detail, we define the two binary variables 'Increase' and 'Decrease' as follows:

$$\begin{aligned} Increase_{i,t} &= 1 \quad \text{if} \quad \triangle_t IRI_{i,t} > 0 \quad \& \quad Active_i = 1 \\ Increase_{i,t} &= 0 \quad \text{if} \quad \triangle_t IRI_{i,t} \leq 0 \quad \& \quad Active_i = 1. \end{aligned}$$

Similarly,

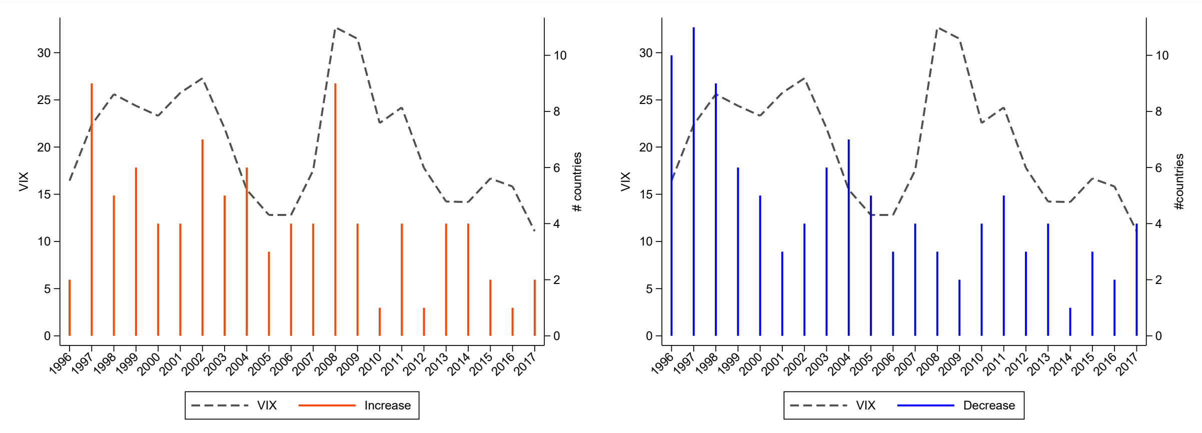
$$\begin{aligned} Decrease_{i,t} &= 1 \quad \text{if} \quad \triangle_t IRI_{i,t} < 0 \quad \& \quad Active_i = 1 \\ Decrease_{i,t} &= 0 \quad \text{if} \quad \triangle_t IRI_{i,t} \geq 0 \quad \& \quad Active_i = 1. \end{aligned}$$

Based on Figure 9, Panel (a), active emerging markets tend to increase capital inflow controls during periods of elevated global financial distress. At the height of the Global Financial Crisis (2008), for example, nine countries (41% of all active countries) imposed additional restrictions. We see similar spikes around the Dot-Com Bubble

(2002) and the Asian Financial Crisis (1997). In contrast, only few countries increase restrictions during financially stable periods, specifically, between the years 2005 and 2007 or post 2008.

Figure 9: 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 (displayed on the left y-axis).*

We make the following observations in Figure 9, 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 few countries decreased restrictions.

Table 2 lists all countries that increased capital inflow restrictions during any of the three episodes. Each country is marked by a letter, depending on whether it increased restrictions during the Asian Financial Crisis (1997, 'a'), the Dot-Com Bubble (2002, 'b'), or the Global Financial Crisis (2008, 'c'). We count 14 countries out of which 8 raised restrictions during at least two episodes. Of course, these countries could increase their inflow restrictions due to various reasons. As such we can only say that our empirical findings are consistent with the analytical framework. However, as mentioned in the Introduction, there is relatively broad based evidence that EMs increased their inflow restrictions during the Asian Financial Crisis to shield their economies from external factors. During the Dot-Com Bubble many emerging markets were subject to an external debt crises associated with high risk premiums, which also supports our analytical narrative. In contrast, the increase in restrictions during the Global Financial Crisis in 2008 could also relate to the aggressive easing of monetary policy in advanced economies, which led to substantial capital inflows towards EMs due to carry trade arguments unrelated to risk premium concerns. However, we notice tighter inflow restrictions just a few months after the Lehman collapse in September 2008 when capital inflows have not yet resumed.

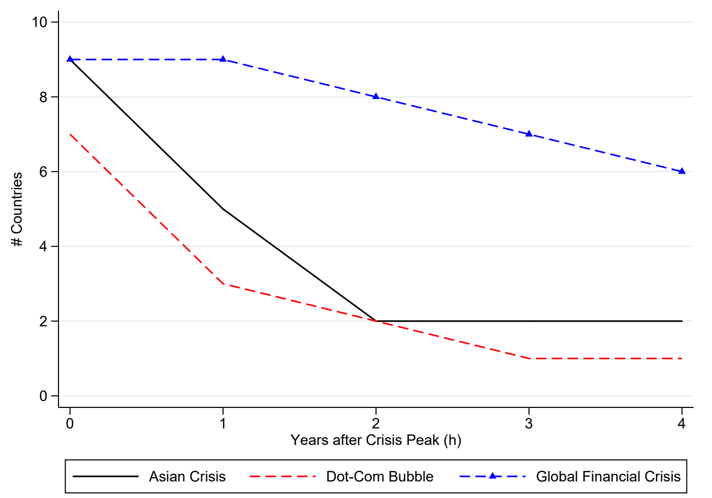
Table 2: *Countries Responding to Global Financial Distress*

Algeria (abc)	Bulgaria (a)	Lebanon (abc)	Venezuela (abc)
Argentina (c)	Chile (c)	Moldova (ab)	Vietnam (ac)
Bahrain (a)	Colombia (ab)	Nigeria (c)	.
Brazil (ac)	Ethiopia (bc)	Russia (b)	.

Notes*: This list shows all countries that increased their capital inflow restrictions during the Asian Financial Crisis (1997, 'a') Dot-Com Bubble (2002, 'b'), or the Global Financial Crisis (2008, 'c'). Restrictions are measured at year end and compared to the level of restrictions the year before.*

In Figure 10, we show that the majority of these 14 countries quickly eased their capital inflow restrictions after the Asian Financial Crisis or the Dot-Com Bubble, but less so after the Global Financial Crisis. In more detail, the plot portrays the number of countries that increased restriction during each crisis, but subsequently did not reverse their decision. The change over time thus resembles the number of countries that reduced capital inflow restrictions once market conditions stabilized.

Figure 10: *Persistence of Capital Inflow Restrictions*



Notes*: The chart depicts the number of countries that increased capital inflow restrictions during the Asian Financial Crisis (peak in 1997; solid black line), Dot-Com Bubble (peak in 2002; dashed red line), or the Global Financial Crisis (peak in 2008; dashed blue line with triangle markers), but did not lower restrictions during subsequent* $h = \{1, .., 4\}$ *years.*

In more detail, we see that 7 of 9 countries reduced their capital inflow controls by 1999, that is, two years after the Asian Financial Crisis. Similarly, 5 out of 7 countries lowered capital inflow controls within 2 years after the Dot-Com Bubble in 2002. It thus appears that restrictions were temporarily imposed during extraordinary financial turmoil, as suggested by our framework and in line with the narrative evidence presented earlier. The pattern after the Global Financial Crisis is somewhat different. Only 1 out of 9 EMs lowered restrictions by 2010 (2 years relative to crisis). This may reflect the new view by the IMF and the recent theoretical literature to manage capital inflow surges via capital inflow controls (Batini and Durand, 2020).

Discussion

We would like to emphasize that our previous finding on a systematic relationship between global financial conditions and the decision impose capital inflow controls does not contradict the existing literature (Eichengreen and Rose, 2014; Fernández et al., 2015; Acosta-Henao et al., 2020). In particular, Fernández et al. (2015), whose dataset we use, uncover the following robust stylized facts: First, *the unconditional variation in capital controls is small*. This is certainly true and motivates why we focus on a subsample of countries that do adjust their capital controls. Not surprisingly, there is no systematic pattern between the VIX and capital inflow controls considering the entire sample. Second, *capital inflow and outflow controls are positively correlated, both unconditionally and based on cyclical components around domestic business cycles*. Figure 11 shows that this correlation is less pronounced for active EMs during periods of high global financial distress. To provide details, the chart plots the number of countries that increased or decreased their outflow controls during a specific year, just as Figure 9 for inflow controls.[11] Thus, among countries that actively adjust inflow controls, we do not observe a noteworthy relationship between periods of major global financial distress and capital outflow controls. In other words, our stylized fact pertains to inflow, but not outflow controls. Third, *capital inflow and outflow controls do not respond to the domestic business cycle*. Our new stylized fact is about comovement with international financial conditions and not domestic boom bust episodes. Nevertheless, we confirm this result in Section 4.3. We show that the association between financial distress and capital inflow controls prevails even after controlling for domestic factors like changes in the current account, GDP, or the exchange rate amongst others.

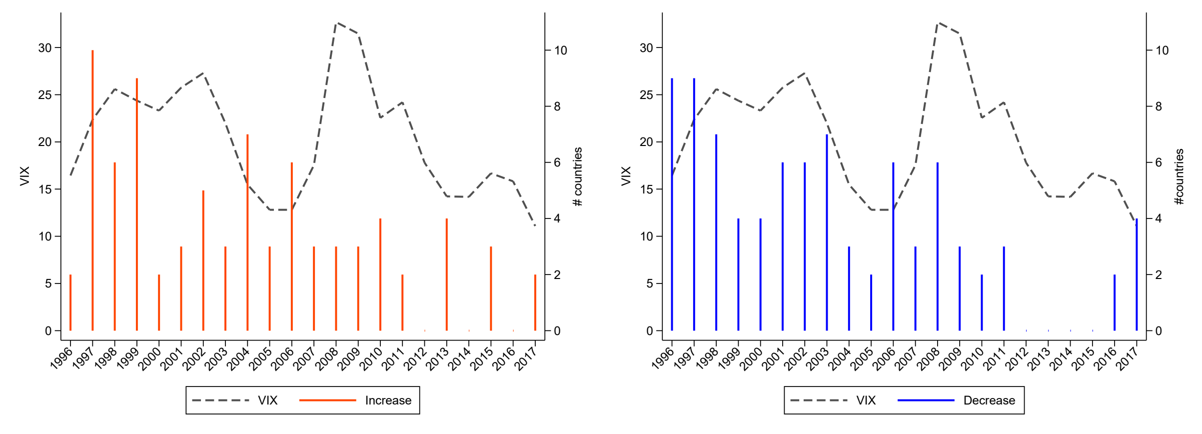
Regression analysis

We next provide more nuanced results based on a formal regression analysis. First,

[11]We define outflow controls in line with inflow controls. That is, we consider the same asset classes, compute a similar 'Outflow Restriction Index' (ORI) and create binary 'Increase' or 'Decrease' variables accordingly, focusing on the same subsample of countries that actively manage their inflow controls. We can alternatively define a new sample based on countries that actively adjusted their outflow rather than inflow controls and asses the relationship between outflow controls and global financial conditions. The results do not change and are available upon request.

Figure 11: *Capital Outflow 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; active with respect to inflow controls) that increased (decreased) their capital outflow controls during a given year. The dashed grey line displays the VIX (displayed on the left y-axis).*

we regress the two indicators ('Increase', 'Decrease') on a cubic ln(VIX) polynomial:

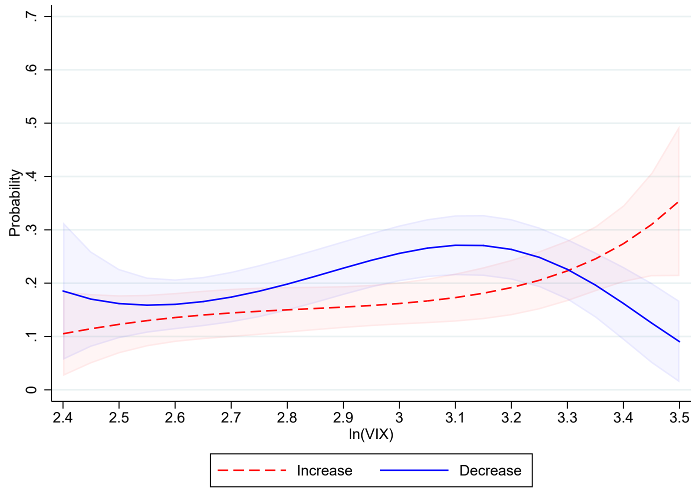
$$Prob(y_{i,t} = 1) = F\left(\beta_0 + \beta_1 ln(VIX)_t + \beta_2 ln(VIX)_t^2 + \beta_3 ln(VIX)_t^3\right) \qquad (11)$$

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 12, 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 aligns with the previous descriptive evidence: episodes of elevated international financial distress are driving our results. We repeat the same analysis analogously for increases or decreases in outflow controls. Figure C1 documents no noteworthy patterns in line with Figure 11.

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,

Figure 12: *Capital Inflow Controls and the VIX*



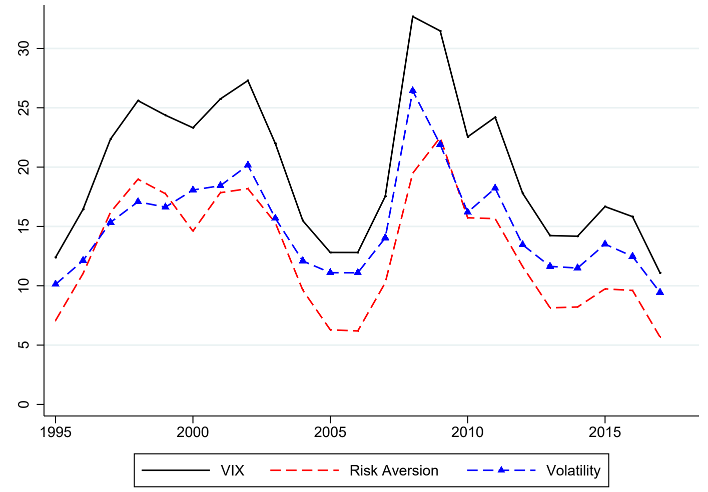
***Notes**: The dashed red (solid blue) line displays the probability of increasing (decreasing) capital inflow controls (y-axis) as a function of ln(VIX) (x-axis). Shaded areas indicate 90% predictive margins. The underlying regression model is a logit model with a cubic polynomial and no control variables as portrayed in Equation (*11*). Active emerging markets only. Sample: 1995-2017.*

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 13 displays the corresponding risk aversion and volatility series.[12] Both series exhibit similar patterns and are highly correlated with the VIX: they spike during the Global Financial Crisis and reach elevated levels during the Asian Financial Crisis and the Dot-Com Bubble.

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 (11). We visualize the regression output in Figure 14. 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 inflow 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. These results are noteworthy, as they provide a direct link with our analytical framework. In the model we showed that a regulator increases capital inflow controls to reduce the

[12] 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).

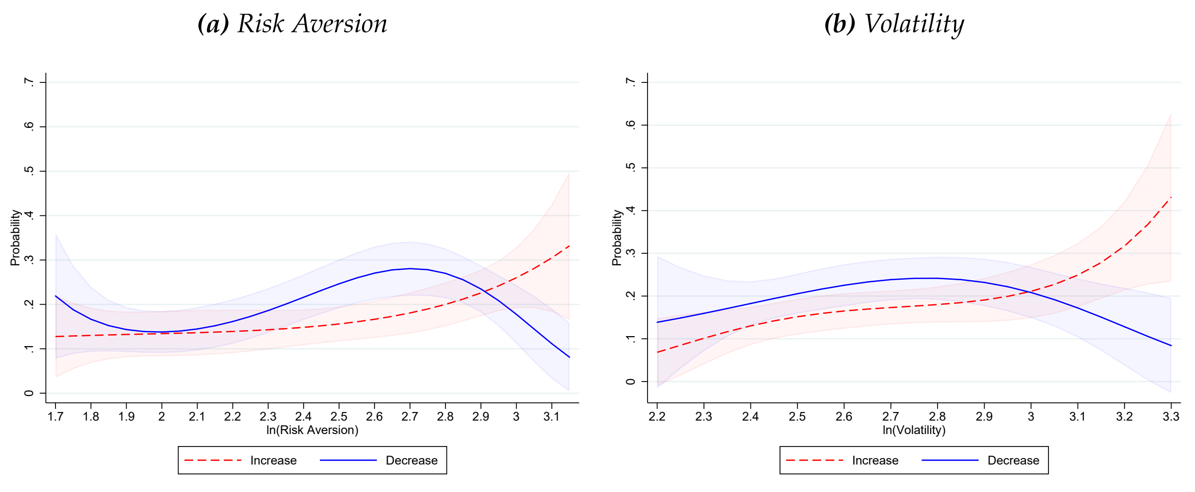
Figure 13: *Decomposing the VIX: Risk Aversion and Volatility*



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

debt burden and the risk premium. We also explained that the incentive to regulate is particularly strong when investors are very risk averse, or when global financial markets are more volatile.

Figure 14: *Capital Controls, Risk Aversion and 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 (11), where we replaced ln(VIX) with the logarithmic volatility or risk aversion measure. Active emerging markets only. Sample: 1995-2017.*

4.3. 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. We also consider 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:

$$Prob(y_{i,t} = 1) = F\left(\beta_0 + X_t^G \beta_G + X_{i,t-1}^D \beta_D + \alpha_i\right) \tag{12}$$

where $y_{i,t} \in \{\text{Increase}_{i,t}, \text{Decrease}_{i,t}\}$ just as in Equation (11). Relative to Equation (11) however, 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 12. 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 possibly 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 9. The domestic control variables in column 6 are insignificant.

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: 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

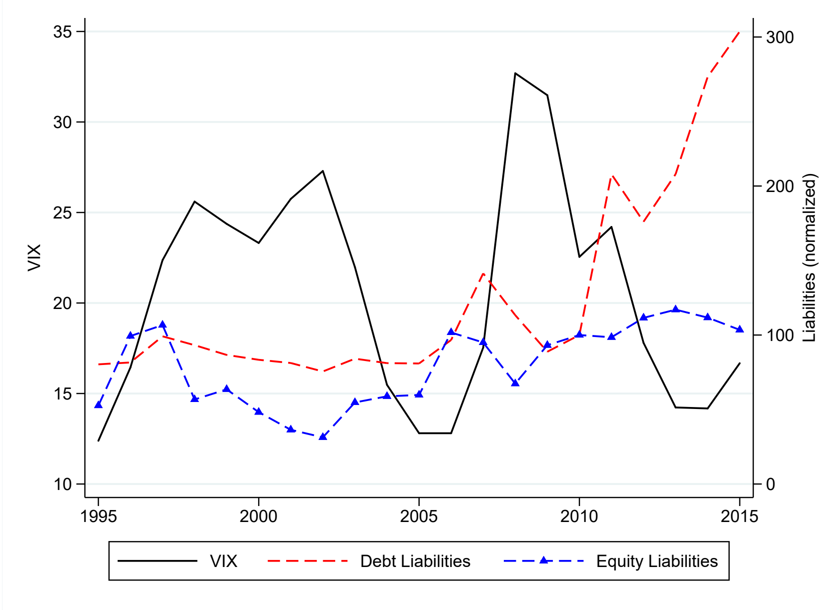
We perform various additional robustness checks. We delegate related regression tables to the appendix. Specifically, we obtain very similar results when we replace the VIX with its subcomponents, risk aversion and volatility (Table B1). We also consider country-fixed effects and additional control variables for which we have only limited data coverage (Tables B2, B3). Country-fixed effects do not change our results. Though some of the additional control variables are statistically significant 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 C2). 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. Further as explained earlier, our findings relate to inflow rather than outflow restrictions. 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 significantly correlated with capital inflow restrictions.

4.4. Comparison with Externality Literature

We documented that emerging markets which actively evaluate their capital control policies, tend to increase inflow restrictions during periods of high international financial distress. We subsequently 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 works 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.

Figure 15: *Foreign Equity/Debt Exposure and the VIX*



Notes: *The dashed red (dashed blue line with triangle markers) line portrays the average external 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 (displayed on the left y-axis). Ethiopia is excluded due to missing data. Sample: 1995-2015. Source: Lane and Milesi-Ferretti (2018).*

In Figure 15, we portray the exposure of emerging markets to foreign investments (equity, debt). 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 Asian Financial Crisis, the Dot-Com Bubble, and the Global Financial Crisis. 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.

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 (missing) 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. 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.

We propose a simple model in which regulators have an incentive to tax capital inflows to lower borrowing costs. This desire is particularly strong when investors are very sensitive to emerging market risk and demand a high premium as during global financial crises. We then empirically show that countries that actively reevaluate their capital inflow controls respond to global financial conditions, in particular volatility and risk aversion by tightening restrictions just as implied by our model.

Three concluding remarks are in order: First, we wish there was more narrative evidence as to why countries increase or decrease capital controls. EMs increased inflow restrictions during the Asian Financial Crisis to shield their economy from external influences, which aligns with our framework. Evidence, for the other two episodes, the Dot-Com Bubble and the Global Financial Crisis is however more limited. Further, previous work on the motives behind capital controls centers around Southern American countries and a few selected Asian countries (Chamon and Garcia, 2016; Keller, 2019; Batini et al., 2020). Capital controls are however widely used among other EMs as well. Second, while we justify capital inflow controls during periods of heightened international financial distress, it is important to realize that this intervention is only optimal from the perspective of the emerging market at the expense of international investors. Thus, capital controls are not socially desirable in our framework. We hence do not encourage EMs to implement capital controls according to the description in this paper. Indeed, macroprudential capital controls can limit the build-up of external debt and may also reduce borrowing costs during distress. Macroprudential policies are therefore complementary and possibly superior: they do not trade lower risk premiums at the expense of larger current account reversals. Third, after the Global Financial Crisis, there has been a steady trend towards macroprudential capital controls (Batini et al., 2020), probably due to the updated IMF view and recent theoretical advances. As such, the positive relationship between financial turmoil and capital inflow controls may have faded.

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 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 Default Spreads: Spreads on 1 year government bonds traded in US dollars. (Source: Bloomberg).

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. The highest score (least amount of risk) for each category is 12 (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: 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 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: 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. 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: 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: 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: 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 Restriction Index	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. Institutional Quality is the sum over 12 different categories. The highest score for each category is 12. The exchange rate statistic displays the coefficient of variation (standard deviation/mean).*

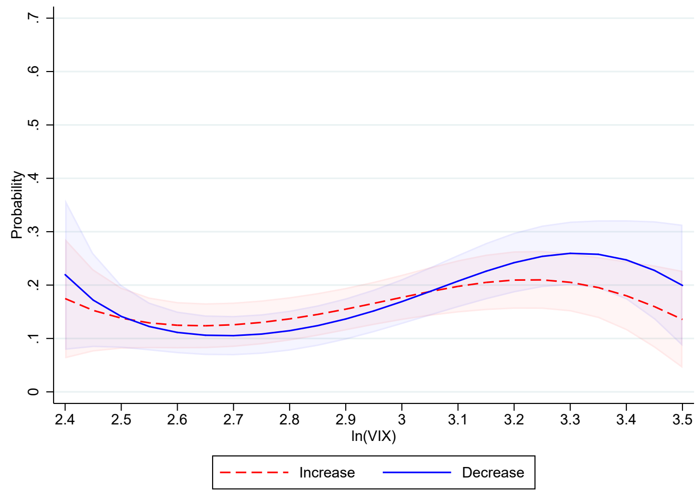
Table B8: *Calibration: Default in Emerging Markets and Financial Distress*

	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%).*

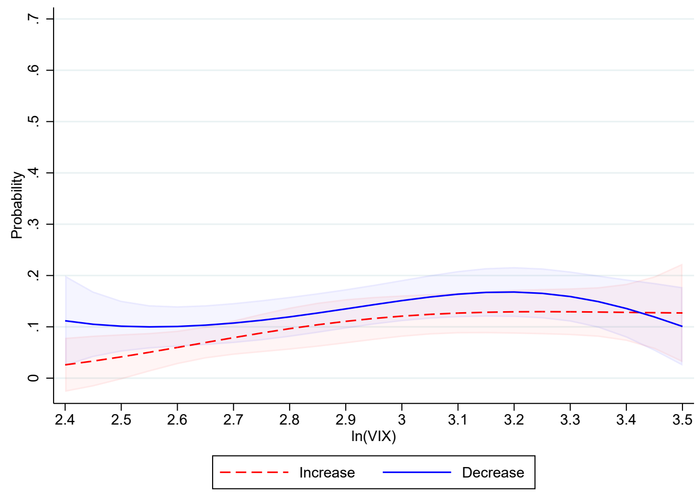
C. Appendix: Figures

Figure C1: *Capital Outflow Controls and the VIX*



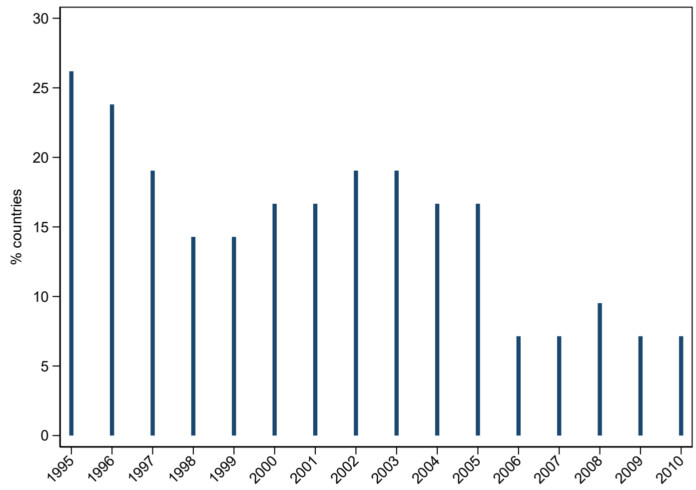
Notes: *The dashed red (solid blue) line displays the probability of increasing (decreasing) capital outflow controls (y-axis) as a function of ln(VIX) (x-axis). Shaded areas indicate 90% predictive margins. The underlying regression model is a logit model with a cubic polynomial and no control variables as portrayed in Equation (11), where we swapped inflows with outflows. Active emerging markets based on inflow controls only. Sample: 1995-2017.*

Figure C2: *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 (11). Active emerging markets only. Sample: 1995-2017.*

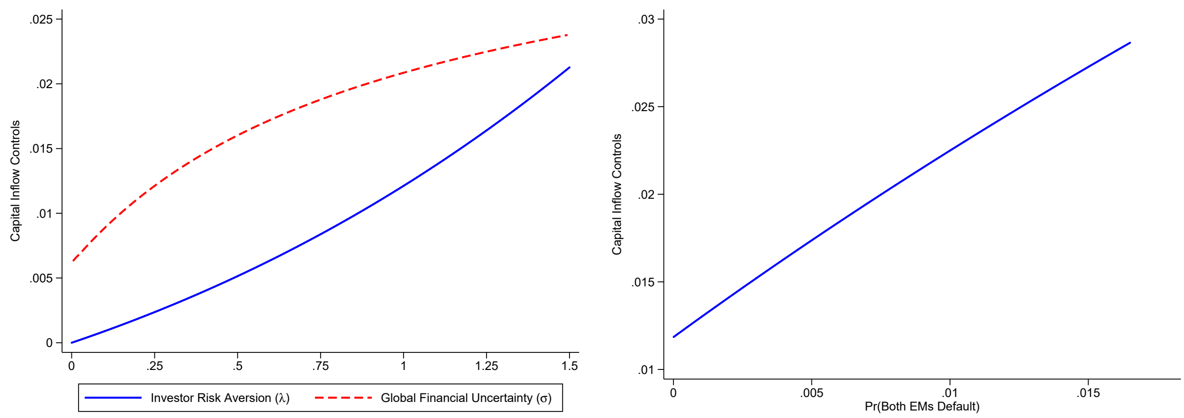
Figure C3: *External Debt Crises: Emerging Markets*



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 C4: *Capital Controls with CRRA Preferences*

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



Notes: *Panel (a): The plot displays the 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: χ=1, $e_{B,t}$-$(1+\overline{RP})\overline{b}_{B,0}$=-0.2, $e_{B,t+1}$+$\overline{b}_{B,T}$=20, $e_{I,t}$+$(1+\overline{RP})\overline{b}_{I,0}$=30, $\overline{b}_{I,T}$=0, μ=3, θ=1 (risk aversion borrowers), 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 level of capital controls τ (y-axis) as a function of the probability that both emerging markets default simultaneously (d). 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

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

We formally prove the uniqueness of the bond market equilibrium. Existence is trivial due to the choice of endowments as described in Section 2 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

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

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

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

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 1: We begin with the aggregate supply curve in the National Planner Equilibrium:

$$\frac{\chi}{B_{t+1} + \underbrace{E_{B,t} - (1+\overline{RP})\overline{B}_0}_{\tilde{E}_{B,t}}} = \frac{(1-p(\sigma))(1+RP_t)}{1-\lambda B_{t+1}RP_t}. \qquad \text{(AS:NP)}$$

The aggregate demand curve is given by Equation (AD). Capital controls are characterized as

$$\tau = \frac{\lambda RP_t \chi (1 - \tilde{e}_{B,t}(1 - p(\sigma))(1 + RP_t))}{(1 - p(\sigma))(1 + RP_t) + \chi \lambda RP_t}.$$

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):

$$RP_t - \frac{p(\sigma)}{1 - p(\sigma)} exp\left(\frac{\lambda(1 + RP_t)\chi(1 - \tilde{e}_{B,t}(1 - p(\sigma))(1 + RP_t))}{(1 - p(\sigma))(1 + RP_t) + \chi \lambda RP_t} \right) = 0.$$

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 2: Building on the derivation for Proposition 1, $\frac{\partial \tau}{\partial \sigma}|_{\text{total}}$ 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 $p'(\sigma) > 0$. Further $\frac{\partial \tau}{\partial RP_t} > 0$. 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. ■

Current Account: Aggregate debt (B_{t+1}) and the risk premium (RP_t) in equilibrium with exponential and log-quasilinear utility are jointly defined by

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

$$\frac{\chi}{B_{t+1} + \underbrace{E_{B,t} - (1 + \overline{RP})\overline{B}_0}_{\tilde{E}_{B,t}}} = (1 - p(\sigma))(1 + RP_t) \tag{AS}$$

The parameters $\overline{\sigma}$ and $\overline{\lambda}$ ensure that $(1 + \overline{RP})\overline{B}_0 = B_{t+1}$ and solve the following equation where $0 < E_{B,t} < (1 + \overline{RP})\overline{B}_0$:

$$\frac{\chi}{(1-p(\overline{\sigma}))E_{B,t}} - 1 = \frac{p(\overline{\sigma})}{1-p(\overline{\sigma})} exp\left(\overline{\lambda}\frac{\chi}{(1-p(\overline{\sigma}))E_{B,t}}(1+\overline{RP})\overline{B}_0\right).$$

Further, $\overline{B}_T$ is defined by $\overline{B}_T = (1+RP_t)B_{t+1} = \frac{\chi}{(1-p(\overline{\sigma}))E_{B,t}}(1+\overline{RP})\overline{B}_0$. The current account (net exports, or net exports + net transfer in case of default) is therefore zero when $\sigma = \overline{\sigma}$ and $\lambda = \overline{\lambda}$. We subsequently plug Equation (AD) into Equation (AS):

$$\frac{\chi}{(1-p(\sigma))(B_{t+1}+\tilde{E}_{B,t})} - 1 - \frac{p(\sigma)}{1-p(\sigma)} exp\left(\lambda\frac{\chi}{(1-p(\sigma))(B_{t+1}+\tilde{E}_{B,t})}B_{t+1}\right) = 0.$$

We utilize the Implicit Function Theorem to derive $\frac{\partial B_{t+1}}{\partial \lambda} > 0$ and $\frac{\partial B_{t+1}}{\partial \sigma} > 0$, which immediately implies Figure 5.

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.

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:

$$RP_t = \frac{p(\sigma)}{1-p(\sigma)}\frac{E_t\left[(E_{I,t}+(1+\overline{RP})\overline{B}_0 - B_{t+1} + A_{t+1} - \overline{B}_T)^{-\lambda}\right]}{E_t\left[(E_{I,t}+(1+\overline{RP})\overline{B}_0 + RP_t B_{t+1} + A_{t+1} - \overline{B}_T)^{-\lambda}\right]} \tag{AD}$$

$$\left(\frac{B_{t+1}+E_{B,t}-(1+\overline{RP})\overline{B}_0}{\chi}\right)^{-\theta} = (1-p(\sigma))\left(\frac{\overline{B}_T + E_{B,t+1} - (1+RP_t)B_{t+1}}{\chi}\right)^{-\theta}(1+RP_t) \tag{AS}$$

$$\left(\frac{B_{t+1}+E_{B,t}-(1+\overline{RP})\overline{B}_0}{\chi}\right)^{-\theta} = (1-p(\sigma))\left(\frac{\overline{B}_T + E_{B,t+1} - (1+RP_t)B_{t+1}}{\chi}\right)^{-\theta}(1+RP_t + \frac{\partial RP_t}{\partial B_{I,t+1}}B_{t+1}). \tag{AS:NP}$$

We apply the Implicit Function Theorem to the aggregate demand curve and obtain

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

Capital inflow controls equal

$$\tau = (1 - p(\sigma)) \frac{\left(\overline{B}_T + E_{B,t+1} - (1 + RP_t)B_{t+1}\right)^{-\theta}}{\left(B_{t+1} + E_{B,t} - (1 + \overline{RP})\overline{B}_0\right)^{-\theta}} \frac{\partial RP_t}{\partial B_{I,t+1}} B_{t+1}.$$

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 (9) and (10), 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

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

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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