WP/14/145

IMF Working Paper

Capital Flow Deflection

Paolo Giordani, Michele Ruta, Hans Weisfeld, and Ling Zhu

INTERNATIONAL MONETARY FUND

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Paolo E. Giordani
LUISS "Guido Carli" University

Michele Ruta
International Monetary Fund

Hans Weisfeld
International Monetary Fund

Ling Zhu
University of Maryland

Aug 8, 2014

Abstract

This paper focuses on the coordination problem among borrowing countries imposing controls on capital inflows. In a simple model of capital flows and controls, we show that inflow restrictions distort international capital flows to other countries and that, in turn, such capital flow deflection may lead to a policy response. We then test the theory using data on inflow restrictions and gross capital inflows for a large sample of developing countries between 1995 and 2009. Our estimation yields strong evidence that capital controls deflect capital flows to other borrowing countries with similar economic characteristics. Notwithstanding these strong cross-border spillover effects, we do not find evidence of a policy response.

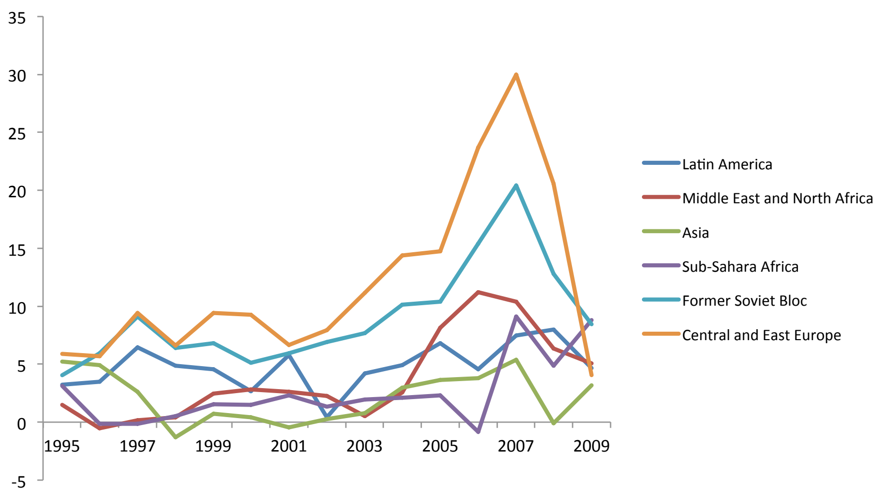
JEL No.: F3, F4, F5.
Keywords: capital flows, capital controls, cross-border spillovers, policy response.

*Corresponding Author: Michele Ruta (e-mail: mruta@imf.org). The authors would like to thank Tam Bayoumi, Chad Bown, Arnaud Costinot, Martin Kaufman, Lance Kent, Anton Korinek, Kamal Saggi, Sarah Sanya, Robert Staiger and seminar participants at University of Maryland, University of Groningen, George Mason University, Vanderbilt University, Stanford University, and International Monetary Fund for helpful comments and suggestions. The views expressed in this paper are those of the authors and do not necessarily reflect those of IMF.

1 Introduction

What type of multilateral institutions do countries need to govern international capital flows? As the size and volatility of capital flows, namely to developing countries, have largely increased in recent years (Figure 1), this question has raised the interest of both academic economists and policymakers. The ensuing debate has led the International Monetary Fund (IMF) to review its position on the liberalization and management of capital flows and to provide a set of recommendations to help countries deal with these flows. Part of this new institutional view is the emphasis on the need for international agreements to coordinate or set the appropriate standards for policy intervention. However, as recognized by the IMF, "much further work remains to be done to improve policy coordination in the financial sector" (IMF, 2012, page 28).

Figure 1: Gross Inflows (% GDP) to Developing Countries by Region



The trade policy literature can be useful to macroeconomists interested in international policy coordination. This literature has shown that multilateral institutions are effective when they provide a framework to address relevant cross-border spillovers related to countries' unilateral policies. In particular, Bagwell and Staiger (1999 and 2002) have shown that the World Trade Organization (WTO) and its predecessor, the General Agreement on Trade and Tariffs (GATT), have effectively improved international trade cooperation because they allow countries to neutralize a relevant trade policy externality, the (intra-temporal) terms-of-trade effect. Similarly, *understanding what are the relevant spillovers associated with the use of capital controls is an essential building block to improving multilateral cooperation in the financial sector.*

This paper reviews the coordination problem among borrowing countries that have at their disposal capital controls as the instrument to manage capital inflows.[1] In the

[1]Capital controls encompass a variety of measures, such as taxes, quantitative restrictions and

spirit of the trade policy literature, we present a simple framework to identify a cross-border spillover associated with capital controls and then empirically test the relevance of this effect. Our key insight is that, just like tariffs in an importing country can deflect exports to other markets and may induce a policy response by affected importers (Bown and Crowley, 2006 and 2007), capital controls induce *capital flow deflection* and lead to policy response by affected borrowers.[2]

Figure 2 provides preliminary motivating evidence for our work. It shows the gross capital inflows (as a share of GDP) to South Africa and the inflow controls imposed by Brazil in a period where capital controls in South Africa were essentially stable. Inflow restrictions in Brazil appear to be associated to a surge in capital flows to South Africa in 1996-1997 and in 2008-2009. Two recent event studies focusing on Brazil (Forbes et al. 2013; and Lambert et al. 2011) provide further motivating evidence. In particular, Forbes et al. (2013) find that more stringent capital controls set by Brazil between 2006 and 2011, such as the introduction of a 2 percent tax on portfolio equity and debt inflows in 2009, have led investors to increase the share of their portfolios allocated to other countries, including Indonesia, Korea, Peru and Thailand. And interestingly, all these countries have imposed measures designed to limit capital inflows in 2010-11.[3]

To examine the problem of policy coordination among recipient countries and to guide our empirical analysis, we build a parsimonious model based on work by Korinek (2014). In this setting, governments have two main reasons for influencing capital flows. A first rationale comes from the desire to manipulate the inter-temporal terms-of-trade in their favor as discussed in Costinot et al. (2013). A large country setting capital controls takes into account that its policy choice affects the world interest rate and finds it unilaterally efficient to exploit this market power. The second motive for capital controls is to manipulate the domestic interest rate to address domestic distortions, such as financial fragility.[4] We refer to the latter as the *prudential* motive

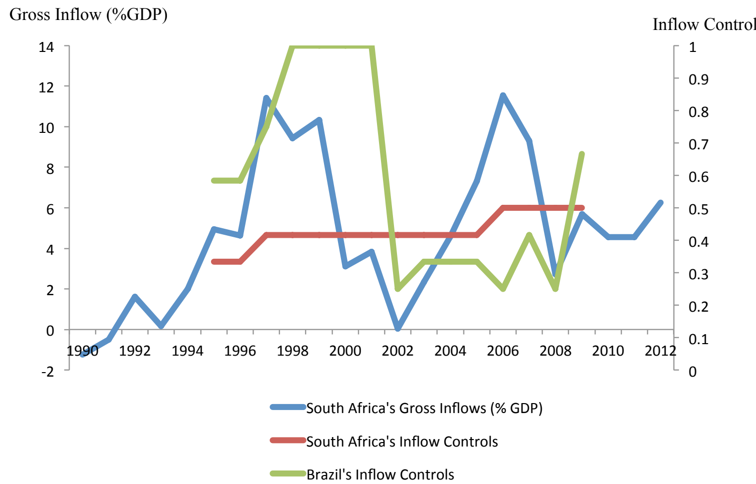
regulations, that affect cross-border financial activities by discriminating on the basis of residency (IMF, 2013).

[2]The term "trade deflection" was introduced in Bown and Crowley (2006) to indicate a situation where an increase in a trade barrier in one market determines a change in destination in exports. This is different from the concept of "trade diversion"(Viner, 1950), where the reduction of a tariff granted to a trading partner increases imports from the latter and reduces imports from other (potentially more efficient) exporters. An example of trade deflection discussed in Bown and Crowley (2007) is the steel safeguard, a set of tariffs and quotas, imposed by the US on Chinese exports in 2002. Shortly afterwards, the EU reacted with similar measures, claiming that the change in US policy had deflected Chinese steel exports to its market.

[3]In 2010, Peru increased the fee on non-resident purchase of central bank paper to 400 basis points (from 10 basis points), while Thailand imposed a 15 percent withholding tax on non-residents' interest earnings and capital gains on state bonds. In 2011, Indonesia introduced a limit on short-term foreign borrowing by banks to 30 percent of capital and Korea restored a 14 percent withholding tax on interest income on non-resident purchases of treasury bonds (IMF, 2013).

[4]In the words of Keynes (1943), "the whole management of the domestic economy depends upon being free to have the appropriate rate of interest without reference to the rates prevailing elsewhere in the world. Capital control is a corollary to this."

Figure 2: Brazil's Controls and South Africa's Flows



Note: The left vertical axis provides the scale for gross inflows as share of GDP. The right vertical axis provides the scale for inflow controls as measured by Schindler (2009).

(as it is often called in the literature), while the first is the *terms-of-trade* motive. Note that while this model is parsimonious and does not explicitly account for other uses of capital controls, such as targeting the real exchange rate or preserving monetary policy independence (i.e. dealing with the "trilemma"), it captures their essential rationales: capital controls either aim at altering the world interest rate, or the domestic interest rate, or both.

In this context, we formally investigate the causes and consequences of capital flow deflection. Inflow restrictions imposed by a large country, or a sufficiently large set of small countries, lower the world interest rate, as they subtract demand for capital from the world market. This change in the world interest rate leads to higher borrowing by recipient countries that have not altered their capital controls. The cross-border policy spillover effect among borrowers is what we refer to as capital flow deflection. It is insightful to look at this effect of capital controls from the perspective of foreign investors. For them all borrowing countries are identical (by assumption), except for capital controls. As international investors perceive a lower return of exporting capital to countries that tightened capital controls, they reallocate their capital to the other borrowers. This insight plays an important role in our empirical strategy.

Capital flow deflection, in turn, induces a policy response by borrowers. Importantly, while the spillover effect is independent of the underlying rationale for capital controls, this is not the case for the policy response. Specifically, capital flow deflection has an ambiguous impact on the terms-of-trade motive for capital controls. Intuitively, the incentive to manipulate the international interest rate with capital controls depends on the elasticity of global savings faced by the country. On the other hand, the prudential motive for capital controls is strengthened by capital flow deflection. The higher inflows exacerbate domestic distortions and increase the incentive to manipulate the domestic interest rate with capital controls to offset them. This result has an interesting corollary. If the primary motive for capital controls is to manipulate the domestic interest rate, as for prudential controls, then uncoordinated inflow restrictions can magnify exogenous shocks, such as a sudden increase in global liquidity. Intuitively, with capital flow deflection, inflow restrictions are complementary policies, so that a shock initiates a chain reaction and leads to a multiplier effect.[5]

In the empirical investigation, we use a dynamic panel model to estimate the impact of capital controls on inflows to other countries and on the policy response. To our knowledge, this is the first paper that investigates these issues in a cross-sectional study. There is a well known literature on the push and pull factors that determine capital flows (e.g. Forbes and Warnock, 2012; Ghosh et al. 2013), but these studies generally abstract from the role of capital controls by third countries. Two exceptions, as discussed above, are the event study approach by Forbes et al. (2013) and Lambert et al. (2011) that find evidence of capital flow deflection spurring from the policies implemented in Brazil between 2006 and 2011. Finally, a small recent literature examines the factors that cause policymakers to change capital controls (Fratzscher, 2012; Fernandez et al. 2013). These studies, however, disregard the policy response to the capital controls imposed by other borrowers.

We use data on gross capital inflows for a large sample of developing countries between 1995 and 2009 and use the so called Schindler index (Schindler, 2009) which allows us to identify the capital controls aiming at restricting inflows. To test the model, we divide countries into groups of likely substitutes based on common characteristics, such as geographic location, export specialization, return and risk. This is an important step, as the model features symmetric countries and, therefore, abstracts from the multiple features of cross-country heterogeneity that may influence investors' decisions in practice. In the first set of regressions, we introduce a variable capturing the level of capital controls in the rest of the group in an otherwise standard push-pull analysis. In the second set of regressions, we use a probit model to estimate the probability that capital controls by some countries may trigger a reaction in a country of the same group.

We find strong evidence of a capital flow deflection. The spillover effect of inflow restrictions is estimated to be strong and significant among borrowing countries that have similar risk level. Perhaps surprisingly, we find no significant spillover effects on countries in the same region. This finding is consistent with the view that investors are guided by the similary economic characteristics of countries, rather than their geographic location -a result that confirms in a cross-section the evidence of existing event studies. Capital flow deflection is also found to be economically relevant. While some-

[5]Similar arguments have been informally made by others. In particular, Ostry et al. (2012) and Korinek (2014) talk of the possibility of a "capital control arms race".

how an extreme case, we estimate that gross inflows to South Africa as a share of GDP would have been between 0.5 and 1.0 percent lower if Brazil had not imposed higher inflow restrictions in 2009. Finally, these results are robust to a number of tests. In particular, spillovers to countries with similar economic characteristics continue to be significant when we use different measures of capital controls or risk, when we focus on episodes of capital flow surges and when we use an instrumental variable (IV) approach to address endogeneity problems.

Notwithstanding the strength of capital flow deflection, we find no evidence of a policy response. This result is independent of how we group countries and persists even if we focus on small economies, which have no terms-of-trade motives to set capital controls. We see three possible explanations for this somewhat puzzling result. The first has to do with the nature of the data on capital controls. The Schindler index, as the other available measures of capital controls, do not record a change in intensity of a measure (say, an increase in the tax on capital inflows from 2% to 4%), but only whether the measure is in place or not. To the extent that countries react to capital flow deflection by toughening the existing policies rather than creating new ones, the empirical findings would be biased against a policy response. The second reason has to do with the model we use to guide our empirical analysis. As discussed in a large literature following the seminal work of Bartolini and Drazen (1997), capital controls can work as a signal to markets in presence of uncertainty over the government type. If policymakers anticipate this, they may be more reluctant to use capital controls in the short run in fear that investors will interpret them as a change in the course of future policies.[6] In this case, a policy response can be muted even in presence of capital flow deflection. Finally, a third explanation is that prudential controls are less relevant in practice than the theory seems to suggest. This may be either because governments resort to instruments other than inflow restrictions to deal with capital flow deflection or because there are situations where this deflection can have a positive impact, such as when borrowing countries have difficulties accessing international financial markets.

The rest of the paper is organized as follows. Section 2 presents a simple general equilibrium model of capital flows and establishes the two main results on capital flow deflection. Section 3 brings these two predictions to the data. We first provide evidence of the cross-border spillover effect of capital controls and then we focus on the policy reaction to inflow restrictions. Concluding remarks and policy implications are in Section 4. The proofs and a detailed data description are in the technical Appendix.

[6]Some may see this argument as contradicting the notion that capital controls can be a legitimate (even if second-best) instrument to address a domestic distortion. This idea, however, has only recently become widely accepted (for instance, the institutional view of the IMF on capital flow management was published in 2012), while our dataset covers the period 1995-2009. An interesting question is, therefore, whether in the future a policy response to capital flow deflection will become a more permanent feature of the international financial system.

2 A Two-Period Model of Capital Controls

In this section we introduce the simplest model of international capital flows. In a multi-country world lasting two periods ($t = 1, 2$), economic agents face a standard intertemporal consumption decision problem. There is a single homogeneous good that is tradable across boarders and an intentional bond denominated in the tradable good allows consumers to shift consumption across the two periods. Each country can introduce capital controls to affect consumers' decisions.

The model is a further simplified version of the framework presented in Korinek (2014). Even this, admittedly highly stylized, theoretical framework is however sufficient to identify the two effects that we are interested in, and that will later be investigated empirically: (i) the *capital flow deflection*, whereby a borrowing country raising its capital controls leads to higher capital inflows to other borrowing countries; (ii) the *policy response*, whereby a borrowing country alters its capital controls in response to a change in controls by other borrowers. We start by introducing the characteristics of a generic country i.

2.1 Economic Structure of Country i

Country i is populated by a unit mass of identical consumers who earn y_t^i at time t and value consumption c_t^i according to the following utility function:

$$U^i(c_1^i, c_2^i) = u(c_1^i) + \beta^i u(c_2^i) + e(C_1^i - Y_1^i), \tag{1}$$

with $u' > 0, u'' < 0$ and $\beta^i < 1$, and where C_1^i and Y_1^i denote, respectively, *aggregate* consumption and income in country i at time 1, which are both taken as exogenous by the individual. Country i is defined as borrower (lender) whenever $C_1^i - Y_1^i > 0$ ($C_1^i - Y_1^i < 0$). Function $e(\cdot)$ captures the fact that capital inflows may be associated with negative external effects, such as the risk that results from domestic households ignoring the consequences of their foreign borrowing decisions on the country's financial stability (financial fragility). Specifically, this externality is defined as

$$e(C_1^i - Y_1^i) \equiv \begin{cases} -x(C_1^i - Y_1^i) & \text{when } C_1^i - Y_1^i > 0 \\ 0 & \text{when } C_1^i - Y_1^i \leq 0, \end{cases}$$

where $x(\cdot)$ is a positive twice continuously differentiable function with $x'(\cdot), x''(\cdot) > 0$.[7] If a country is a lender ($C_1^i - Y_1^i \leq 0$), the externality is null. If instead a country is a borrower ($C_1^i - Y_1^i > 0$), the externality associated with capital inflows enters individual welfare function.

[7] The convexity of the externality function is a common assumption in the literature. In the context of financial fragility, convexity is justified by the fact that the risk to a country's financial stability is likely to increase at a faster rate as foreign borrowing rises.

Consumers must satisfy the following intertemporal budget constraint:

$$(c_1^i - y_1^i)(1+\tau^i)R = y_2^i - c_2^i + T^i, \tag{2}$$

where $R \equiv 1+r$ is the world gross real interest rate, and τ^i is a tax/subsidy on individual borrowing at time 1. In the context of a representative agent economy, τ^i can also be interpreted as the capital control policy at time 1. A positive τ^i denotes a capital inflow tax when the country is a borrower, and a capital outflow subsidy when the country is a lender; and a negative τ^i has the opposite interpretation. In the rest of the paper, we simply refer to τ^i as capital controls. The tax revenue when $\tau^i > 0$ (or the cost of the subsidy when $\tau^i < 0$) is assumed to be lump-sum rebated to (or financed from) consumers, so that $T^i = (C_1^i - Y_1^i)\tau^i R$.

In each country i, the representative consumer maximizes her objective function (1) while satisfying the budget constraint (2), and taking the world interest rate R, the policy τ^i as well as the aggregate variables as given. Maximization gives rise to the usual Euler Equation:

$$u'(c_1^i) = \beta^i R u'(c_2^i)(1+\tau^i), \tag{3}$$

implying consumption demands $c_1^i(\overset{-}{R}, \overset{-}{\tau^i})$ and $c_2^i(\overset{+}{R}, \overset{+}{\tau^i})$. Assuming substitution effect dominates income effect, a higher interest rate implies higher savings ($c_1^i \downarrow, c_2^i \uparrow$), and hence a fall in the demand of capital inflows in borrowing countries and a surge in the supply of capital outflows in lending countries. On the other hand, a country i that raises its capital controls ($\tau^i \uparrow$) creates a wedge between the world interest rate and the domestic interest rate ($R^i = R(1+\tau^i)$), thus stimulating domestic savings ($c_1^i \downarrow, c_2^i \uparrow$) and, hence, reducing its demand of capital inflows.

2.2 Optimal Capital Controls

For a world economy made up of n countries we now characterize the optimal capital control policy of each individual country i and the resulting world market equilibrium. The mass of country i is denoted by $m^i \in [0,1]$, with $\sum_{i=1}^n m^i = 1$. Hence, $m^i = 0$ implies that country i is small with respect to the world economy. Whether country i is large or small, its national planner maximizes the following social welfare function:

$$W^i(c_1^i, c_2^i) = u(c_1^i) + \beta^i u(c_2^i) + e(c_1^i - y_1^i), \tag{4}$$

subject to the budget constraint

$$c_1^i - y_1^i = \frac{(y_2^i - c_2^i)}{R}. \tag{5}$$

The crucial difference between the individual's and the social planner's optimization problem is that the latter *internalizes* the aggregate impact of individual consumption plans on capital inflows to country i. The socially optimal consumption plans for country i are implicitly determined by the following Euler equation:

$$u'(c_1^i) - \beta^i R u'(c_2^i) - x'(c_1^i - y_1^i) - \beta^i u'(c_2^i)(c_1^i - y_1^i)\frac{dR}{d[m^i(c_1^i - y_1^i)]} = 0. \qquad (6)$$

A comparison of the two Euler equations (3) and (6) shows that there are two reasons for policy intervention in this economy. A first reason results from the presence of a domestic externality. The government may restrict capital inflows as a means to manipulate the domestic interest rate ($R^i = R(1+\tau^i)$), thus affecting agents' saving patterns and offsetting this distortion. We follow the literature on financial fragility and refer to this rationale as the *prudential* motive for capital controls. While not explicitly modeled here, other non-prudential motives commonly discussed in the literature (e.g. targeting the real exchange rate or dealing with the "trilemma") can also fit into this category. As prudential controls, they aim at manipulating the domestic rather than international interest rate.

A second source of market failure arises whenever country i is large enough to affect the world interest rate ($m^i > 0$). It is well known in the literature that large countries attempt to exploit their market power by taking advantage of the effect that their policy has on the world interest rate (terms-of-trade effect). For instance, a borrowing country exploits its monopsonistic power in the capital market by taxing capital inflows so as to limit domestic demand and thus keep a "low" cost of capital. In solving the optimization problem defined above, the national planner of country i knows that R depends on its own domestic capital demand $m^i(c_1^i - y_1^i)$ through the following market-clearing condition for the world economy, stating that the sum of net supplies of capital for the world as a whole must be null:

$$\sum_{i=1}^{n} m^i[y_1^i - c_1^i(R, \tau^i)] = 0. \qquad (7)$$

In the rest of the paper, we refer to this second rationale for imposing capital controls as the *terms-of-trade* motive.[8]

We are now ready to formally characterize the optimal capital control for country i.

Proposition 1 *(Unilaterally Optimal Capital Controls) The unilateral optimal policy*

[8] As the above discussion highlights, in this standard macro framework, we could define national welfare as $W^i(R^i, R)$; that is, directly in terms of the local and world interest rates that capital control selections imply. This general formulation is equivalent to the one used in the trade policy coordination literature (Bagwell and Staiger, 1999 and 2002), where the governments' objectives are a function of the local and world prices implied by tariff selection.

(τ^{i*}) can be decomposed into a prudential motive ($\widehat{\tau^i}$) and a terms-of-trade motive ($\widetilde{\tau^i}$), such that

$$1 + \tau^{i*} = (1 + \widehat{\tau^i})(1 + \widetilde{\tau^i}), \tag{8}$$

with

$$\widehat{\tau^i} = \begin{cases} \frac{x'(c_1^i - y_1^i)}{u'(c_1^i) - x'(c_1^i - y_1^i)} & \text{when } c_1^i - y_1^i > 0 \\ 0 & \text{when } c_1^i - y_1^i \leq 0 \end{cases}. \tag{9}$$

and

$$\widetilde{\tau^i} = m^i \cdot \varepsilon^{-i}, \tag{10}$$

where ε^{-i} is the inverse elasticity of global savings faced by country i, and it is given by $\varepsilon^{-i} = [dR/d(Y_1^{-i} - C_1^{-i})] \cdot (Y_1^{-i} - C_1^{-i})/R$ with $Y_1^{-i} \equiv \sum_{j \neq i} m^j Y_1^j$ and $C_1^{-i} \equiv \sum_{j \neq i} m^j C_1^j$.

Capital controls can be imposed for prudential or terms-of-trade reasons. Expression (9) captures country i's optimal prudential controls. They are null whenever i is a lender. In fact, since the externality is null, the solution to the welfare maximization for a rational forward-looking national planner coincides with the utility maximization of the representative consumer, and the optimal prudential policy is no-intervention: $\widehat{\tau^i} = 0$. Capital controls are instead strictly positive when country i is a borrower. In particular, the expression $x'(c_1^i - y_1^i)/[u'(c_1^i) - x'(c_1^i - y_1^i)]$ tells us that (i) low levels of current consumption -and thus a high marginal utility of it- imply weak optimal capital controls; (ii) a strong marginal effect of the negative externality implies strong capital controls.

Expression (10) is the well known formula for the unilaterally optimal tax of a country that exploits its market power. A borrowing country faces a positive elasticity ($\varepsilon^{-i} > 0$), and hence taxes capital inflows ($\widetilde{\tau^i} > 0$). In particular, a more rigid supply of capital from the rest the world (that is, a higher ε^{-i}) commands stronger controls on capital inflows (that is, a higher $\widetilde{\tau^i}$). On the other hand, a lending country faces a negative elasticity ($\varepsilon^{-i} < 0$), and hence taxes capital outflows ($\widetilde{\tau^i} < 0$). Moreover, a more rigid demand of capital from the rest of the world (that is, a lower ε^{-i}) implies stronger controls on capital outflows (that is, a lower $\widetilde{\tau^i}$).

We conclude this section with the definition of equilibrium for this economy. The equilibrium is a configuration in which agents maximize their utility, each national planner implements the unilaterally optimal capital control policy, and the international market for capital clears. Specifically,

Definition. *(World Market Equilibrium) A world market equilibrium is defined as the gross real world interest rate R^* and each country's consumption plan and capital controls $\{c_1^{i*}, c_2^{i*}, \tau^{i*}\}_{i=1}^n$ that satisfy (3), (5), (7), and (8).*

2.3 Capital Flow Deflection

In this section and the next we focus on countries that are borrowers, and we analyze the cross-border spillovers associated with capital controls as well as the policy reactions to these spillovers. In particular, we carry out a comparative statics exercise in this section to analyze the effects of a change in capital controls in a set of countries on the world interest rate, as well as on the amount and the distribution of capital flows to the borrowing countries. Denote by Ω the set of borrowing countries , and by S any subset of it, $S \subseteq \Omega$, with country i belonging to S.[9] We start with the following statement.

Lemma 1. *A rise in the capital controls in the set of borrowing countries S^{-i} (with $S^{-i} \equiv S \backslash i$), ($\tau^{S^{-i}} \uparrow$)*

(i) lowers the equilibrium world interest rate ($dR^*/d\tau^{S^{-i}} < 0$) and

(ii) lowers the total amount of world savings ($d[\sum_{\omega} m^{\omega}[Y_1^{\omega} - C_1^{\omega}(R, \tau^{\omega})]]/d\tau^{S^{-i}} < 0$ $\forall \omega : Y_1^{\omega} - C_1^{\omega} > 0$).

The findings of Lemma 1 are instrumental to prove our next propositions on the multilateral effects of capital controls. The first of these effects is *capital flow deflection*, which is the spillover effect of more stringent controls in one (or more) borrowing countries on the amount of capital inflows accruing to other borrowing countries. This effect is studied in the following

Proposition 2 *(Capital Flow Deflection) A rise in the capital controls in the set of borrowing countries S^{-i} ($\tau^{S^{-i}} \uparrow$) causes an increase in capital inflows to country i, that is:*

$$\frac{d[c_1^i(R, \tau^i) - y_1^i]}{d\tau^{S^{-i}}} > 0 \ \forall i \in S.$$

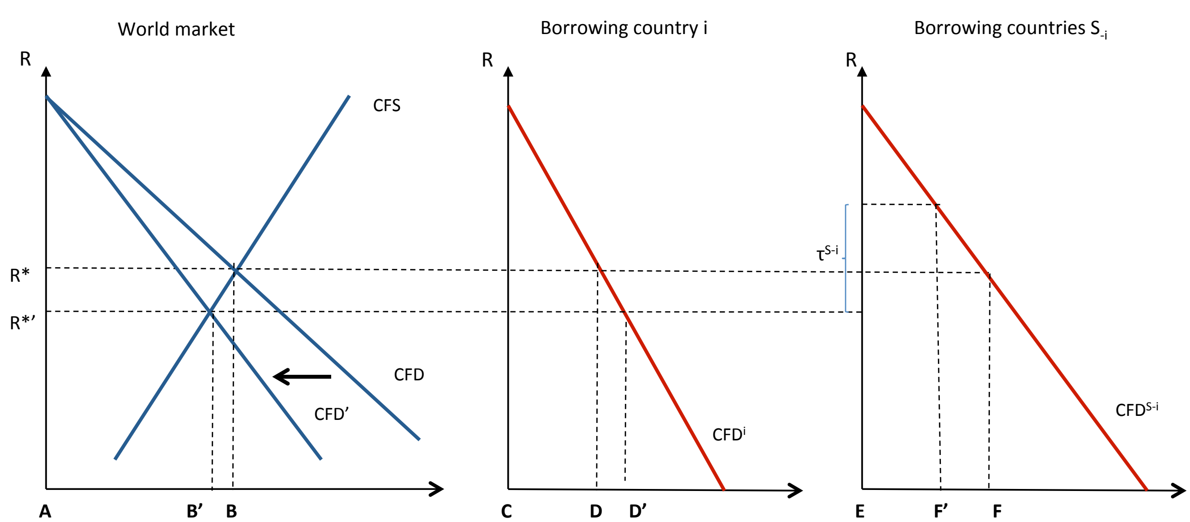
Proposition 2 simply states that, when a borrowing country raises its barriers to capital inflows, it deflects part of these flows to other borrowing countries. The existence of this cross-country spillover effect of capital controls will be verified empirically in the second part of this paper.

The intuition behind capital flow deflection is illustrated graphically in Figure 3. The graph is divided in three parts. Part (i) plots the world demand (CFD) and

[9] We allow $S \subset \Omega$ as in practice financial markets may be (partially) segmented, for instance because different subgroups of borrowing countries may be considered imperfect substitutes by international investors. While we here prefer to remain general and avoid unnecessarily complicated formalization, in the empirical analysis $S \subset \Omega$ will in fact denote a subgroup of possibly "similar" borrowing countries from the perspective of investors (say, in terms of geographic location or country risk). See subsection 3.2.3 for details.

supply (CFS) of capital. Parts (ii) and (iii) instead represent the demand of capital for respectively the borrowing country i (CFD_i) and the rest of the borrowing countries S^{-i} ($CFD^{S_{-i}}$), where for simplicity we assume $S = \Omega$. The initial world market equilibrium is such that R^* equalizes the supply of capital (measured by the distance AB) to the demand of capital (measured by the distance $CD + EF$). A rise in the capital controls of the borrowing countries S^{-i} ($\tau^{S^{-i}} \uparrow$) shifts the demand of capital to the left (from CFD to CFD'), thus generating lower world savings and a lower world interest rate $R^{*\prime}$ (Lemma 1). In particular, $R^{*\prime}$ is now such that the new lower capital supply (AB') equalizes the new lower capital demand ($CD' + EF'$). The spillover effect arises because, as a consequence of a lower interest rate, capital inflows accruing to the borrowing country i increase (by the measure DD'). In other words, while less capital flows to borrowing countries as a whole (capital flow "depression"), part of the capital flows previously directed towards countries S^{-i} are now deflected to the borrowing country i.

Figure 3: Capital Flow Deflection



2.4 Capital Controls' Response

We now introduce the policy response of borrowing countries to capital controls imposed by other borrowers. We show that the nature of this policy response depends on the motive (prudential or terms-of-trade) for capital controls. Our findings are summarized in the following

Proposition 3 *(The Policy Response) A rise in the capital controls in the set of borrowing countries S^{-i} ($\tau^{S^{-i}} \uparrow$) causes a policy response by country i which can be decomposed* *into*

$$\frac{d\tau^{i*}}{d\tau^{S^{-i}}} = \frac{d\widehat{\tau^i}}{d\tau^{S^{-i}}}(1+\widetilde{\tau^i}) + \frac{d\widetilde{\tau^i}}{d\tau^{S^{-i}}}(1+\widehat{\tau^i}).$$

where

$$(i)\ \frac{d\widehat{\tau^i}}{d\tau^{S^{-i}}} = \frac{d\widehat{\tau^i}}{dR}\frac{dR^*}{d\tau^{S^{-i}}} > 0 \quad and \quad (ii)\ \frac{d\widetilde{\tau^i}}{d\tau^{S^{-i}}} = -\frac{m^i \frac{d\varepsilon^{-i}}{d\tau^{S^{-i}}}}{m^i \frac{d\varepsilon^{-i}}{d\widetilde{\tau^i}} - 1} \lesseqgtr 0.$$

We have isolated two, possibly opposing, forces that govern the relationship of capital control policies among borrowing countries. The presence of a capital inflows' negative externality makes the policies complementary, while the exploitation of market power by large borrowing countries may or may not act in the same direction depending on the impact of capital controls on the elasticity of global savings.

This result can be rationalized as follows. A rise in capital controls in a set of countries (or just in a single large country) lowers the equilibrium interest rate ($dR^*/d\tau^{S^{-i}} < 0$) and raises capital inflows to country i (Proposition 2). This exacerbates the negative domestic externality and thus leads country i to "defend itself" from an excessive capital inflow by raising its own capital controls for prudential reasons ($d\widehat{\tau^i}/dR < 0$). If country i is small, its reaction to an increase of capital controls in other borrowing countries is unambiguous: it responds by raising its own barriers (part (i)).

If country i is large, instead, the nature of the relationship among capital controls - that is, whether capital controls are complements or substitutes - also depends on the sign of $d\widetilde{\tau^i}/d\tau^{S^{-i}}$, which in turn depends on how the (inverse of the) elasticity of global savings faced by borrowing country i (ε^{-i}) responds to changes in the capital controls of the countries involved (part (ii)). In fact, in deciding its optimal policy response, a large country i takes into account, not only the effect of countries S^{-i}'s policies but also the one of its own policy on elasticity ε^{-i}. In the proof of Proposition 3, we show that both effects are ambiguous and ultimately rest on the preference fundamentals of consumers. In particular, we show that the complementarity or substitutability of the terms-of-trade driven capital controls depend on whether these controls become more or less effective in affecting the world interest rate as they increase.[10]

The proposition shows how prudential controls (and, more broadly, any inflow restrictions aiming at manipulating the domestic interest rate) respond to exogenous

[10] This is not surprising: by definition, optimal terms-of-trade driven controls for country i are stronger, the greater the sensitivity of the world interest rate to the supply of capital faced by country i ($dR/d(y_1^{-i} - c_1^{-i})$). As a result, if an increase in $\tau^{S^{-i}}$ implies an ever greater impact of capital inflows on the world interest rate ($d^2R/d(y_1^{-i} - c_1^{-i})^2 \cdot d(y_1^{-i} - c_1^{-i})/d\tau^{S^{-i}} > 0$), then, other things equal, country i is more likely to respond to such increase by raising its own policy, thus implying that the terms-of-trade driven capital controls are more likely to be complementary ($d\widetilde{\tau^i}/d\tau^{S^{-i}} > 0$).

shocks. Taken together, Lemma 1 and Proposition 3 delineate a complementary relationship between the world interest rate and prudential capital control policies, whereby a lower interest rate leads to more restrictions on capital inflows, and *vice versa*. Such complementarity may amplify the effects of exogenous shocks to the world economy or to any subset S of it, thus giving rise to what is usually called a *multiplier effect*. More formally, denote by $\widehat{\tau^i}(R^*, \rho)$ the optimal prudential policy function for country $i \in S$, and where parameter ρ captures any feature that affects $\widehat{\tau^i}$ other than changes in R^* (such as the endowments y_t^i, or the discount factor β^i). We are now ready to formulate the following:

Corollary 1. *(The Multiplier Effect) A shock to any subset of borrowing countries S causes a prudential policy response of each borrowing country $i \in S$ which can be decomposed into*

$$\left|\frac{d\widehat{\tau^i}}{d\rho}\right| = \left|\frac{\partial\widehat{\tau^i}}{\partial\rho} + \frac{d\widehat{\tau^i}}{dR}\frac{dR^*}{d\tau^{S-i}} \cdot \frac{d\widehat{\tau^{S-i}}}{d\rho}\right| > \left|\frac{\partial\widehat{\tau^i}}{\partial\rho}\right|.$$

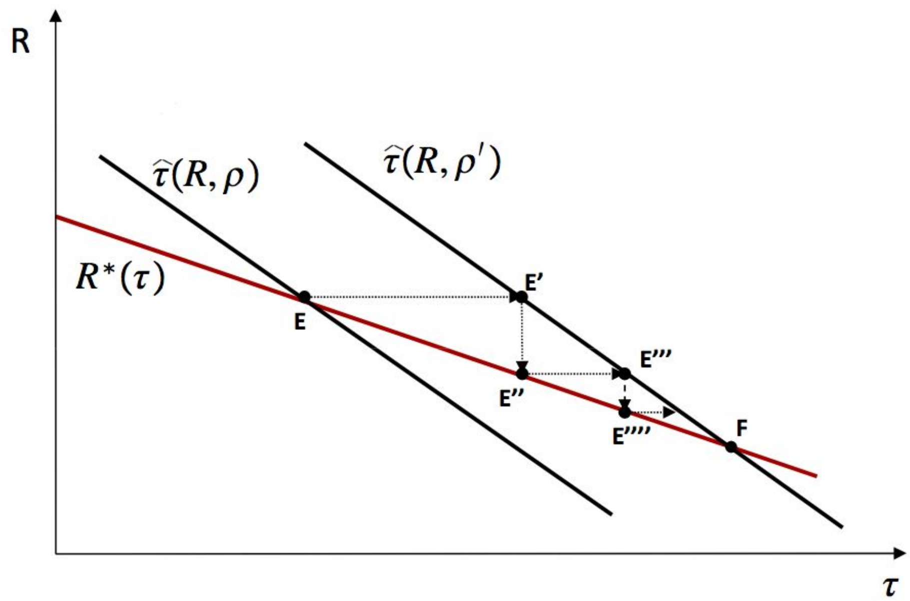
A multiplier effect characterizes the prudential capital control policy of each country i, as the total equilibrium response is higher than the partial equilibrium response because $(d\widehat{\tau^i}/dR)(dR^*/d\tau^{S-i}) > 0$.

The complementary relationship between $\widehat{\tau^i}$ and R^* that gives rise to the multiplier effect is illustrated graphically in Figure 4. To gain an intuition of this corollary, suppose a non-negligible fraction of borrowing countries are hit by an exogenous shock ($\rho \uparrow$) that induces them to raise their restrictions on capital inflows, say from point E to E' in Figure 4. This rise in capital controls lowers the world interest rate (as proven in point 1 of Lemma 1), which moves from E' to E''. Each country, however, reacts to a lower R by further increasing its optimal capital controls from E'' to E''', which in turn triggers a further decrease in the world interest rate, and so on and so forth. As a result of this chain reaction, the aggregate policy response to the shock, as measured by the horizontal distance between point E and point F, exceeds the initial capital controls imposed by each individual borrowing country, as measured by the length EE'.

2.5 Welfare

Let us close this section with a remark on the welfare implications of the theoretical model. It is well known that, from a global welfare perspective, prudential and terms-of-trade-driven controls have radically different consequences. Under the conditions stated in Korinek (2014) that the set of policy instruments and markets are complete, prudential controls are efficient both from a unilateral and from a multilateral point of view. Policy intervention aimed at exploiting the terms of trade effect is instead sub-

Figure 4: The Multiplier Effect in Capital Controls



optimal.[11] As a result, while unilateral capital controls driven by terms of trade motives call for a role of multilateral institutions to improve international policy coordination, no need for such institutions arises when policy measures are set for prudential reasons only. However, if the government has imperfect policy instruments (e.g. costly capital controls) or if markets are incomplete, the complementarity highlighted in the multiplier effect may lead to an inefficient world equilibrium characterized by excessively high restrictions and thus call for international policy coordination.

3 Do Capital Controls Deflect Capital Flows and Lead to a Policy Response?

The previous section shows the existence of a spillover effect of capital controls on other borrowing countries and of a policy response (Propositions 2 and 3). In this section, we investigate their empirical relevance. In particular, we use a dynamic panel and push-pull factors model to study the impact of inflow controls on gross inflows to other countries and the impact of inflow controls on capital controls imposed by other countries.

The recent empirical literature on capital flows differentiates between gross and net

[11] Indeed, it can be proven that aggregate welfare is maximized under the unilaterally optimal policy defined in expression (9). In this respect, the multiplier effect identified in Corollary 1 describes the chain of optimal prudential policy responses to a common shock hitting a borrowing region.

flows (Forbes and Warnock, 2012). Gross inflows are the net of foreign purchases of domestic assets and foreign sales of domestic assets. In other words, gross inflows measure the change in the stock of gross foreign liability before any valuation adjustment. Gross outflows measure the change in the stock of foreign assets before any valuation adjustment. Net flows are the difference between the two.

Capital controls can target either gross inflows or gross outflows. Inflow controls target gross inflows: these are restrictions imposed on foreign purchases of domestic assets and/or foreign sales of domestic assets. Inflow controls could be imposed either on the foreigner who trades the domestic assets with a domestic counterpart or on the domestic resident who trades the domestic assets with a foreign counterpart. On the other hand, outflow controls target gross outflows: these are restrictions imposed on domestic residents' purchases of foreign assets or domestic residents' sales of foreign assets. Such restrictions could be imposed either on the domestic resident who trades the foreign assets with a foreign counterpart or foreigner who trades the foreign assets with a domestic counterpart. Both inflow and outflow controls have in common that they discriminate on the basis of residency. In this respect, they differ from the broader set of capital flow management measures and from other (non-discriminatory) prudential measures (IMF, 2013).

In order to precisely test the theory in Section 2, we focus on a measure of inflow controls (rather than generic capital controls, which also include restrictions on capital outflows) and on gross inflows instead of net flows, because the latter include the gross outflow component. Our empirical investigation has two parts. First, we examine the impact of inflow controls imposed by other countries on one's gross inflows (capital flow deflection).[12] Second, we examine the impact of inflow controls imposed by other countries on one's inflow controls (policy response).

3.1 Data

Our sample consists of 78 less industrialized countries and emerging markets (see Table 1 for the full list). We focus on developing countries as they are more likely to employ capital controls than more advanced countries which are blessed with a wider set of policy instruments to address domestic distortions.[13] The sample period spans 15 years from 1995-2009 and the data are in annual frequency. A country is included in our sample only if it has at least ten years of observations for all variables used

[12]Obviously, capital controls can have more than one spillover effect. Gross outflows are directly affected by inflow controls in recipient countries as one's outflow is another's inflow. Following the terminology in the trade literature, we can refer to this spillover effect as capital flow *depression*, which differs from the capital flow deflection analyzed here.

[13]There are 443 instances of changes in inflow controls from 1995-2009 among developing countries, while the number is 69 among more advanced economies during the same period. The average inflow restriction index for the period is 0.5 among developing countries, while it is only 0.2 among more advanced countries.

in the regression models. While the sample period, data frequency and the selection of countries are inevitably constrained by data availability, the panel covers several interesting episodes including the crises in Asia in the 1990s and in South America in the early 2000s and the first two years of the Great Recession, 2007-2009.

Table 1. Country List by Risk

High Risk	High-Moderate Risk	Low-Moderate Risk	Low Risk
Angola	Albania	**Argentina**	Bahamas, The
Burkina Faso	Algeria	Azerbaijan	Bahrain
Congo, Republic of	**Armenia**	**Bolivia**	**Botswana**
Côte d'Ivoire	**Bangladesh**	**Brazil**	**Chile**
Dem. Rep. of the Congo	**Belarus**	**Bulgaria**	**China**
Ethiopia	**Cameroon**	**Dominican Republic**	**Costa Rica**
Guinea	**Colombia**	**Egypt**	**Croatia**
Guinea-Bissau	**Ecuador**	**El Salvador**	**Hungary**
Haiti	**Ghana**	**Gabon**	**Jordan**
Iraq	**Guyana**	**Guatemala**	**Kuwait**
Lebanon	**Honduras**	**India**	**Latvia**
Liberia	**Indonesia**	Iran	**Libya**
Malawi	**Kenya**	**Jamaica**	**Lithuania**
Mozambique	Madagascar	**Kazakhstan**	**Malaysia**
Myanmar	**Mali**	**Papua New Guinea**	**Mexico**
Nicaragua	**Moldova**	**Paraguay**	**Morocco**
Niger	Mongolia	**Peru**	**Namibia**
Nigeria	**Romania**	**Philippines**	**Oman**
Pakistan	**Senegal**	**Russia**	**Panama**
Sierra Leone	**Sri Lanka**	**South Africa**	**Poland**
Sudan	**Suriname**	Syria	Qatar
Togo	**Tanzania**	**Thailand**	**Saudi Arabia**
Turkey	**Uganda**	**Ukraine**	Trinidad and Tobago
Zambia	**Venezuela**	**Uruguay**	**Tunisia**
Zimbabwe	**Yemen**	Vietnam	United Arab Emirates

Note: Time-invariant groups by composite risk. The countries in bold are used in the regression analysis. All the countries listed are used in computing $\tau^{S^{-i}}$.

We use Schindler's (2009) index of capital controls, which is a *de jure* measure constructed from information contained in the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) provided by the IMF. The main advantage of this index relative to others commonly used in the literature such as Chinn and Ito (2006) is that the Schindler index distinguishes between controls on capital inflows and outflows. In particular, Schindler's index calculates inflow controls as the average of the restriction dummies on the following series of international transactions: purchase of financial assets locally by nonresidents, sale or issue of financial assets abroad by residents, collective investment by nonresidents to residents, financial credits by nonresidents to residents, inward direct investment, and liquidation of direction investment.[14] The index varies between 0 (i.e. no restriction) and 1 (i.e. restrictions on all

[14]Financial assets are shares or other securities of a participating nature, bonds or other debt se-

international transactions). Schindler also computes outflow controls in a similar way.[15] We will use this second set of restrictions in our robustness analysis.

The data on capital controls are depicted in Figure 5. Panel 5.A plots the inflow controls by regions, with higher numbers indicating more stringent restrictions.[16] There are noticeable differences as well as some common trends across regions. Asian and former Soviet bloc countries are more likely to have higher inflow restrictions than Latin American and central and east European countries. Countries across all regions tightened inflow controls during the Asian financial crisis, and the high level persisted in most regions except for central and east European countries that were going through capital account liberations in preparation for EU membership. During the 2007 financial crisis, most regions tightened inflow controls except for countries of the former Soviet bloc whose restrictions were nevertheless very stringent compared to other regions except for Asia.

Figure 5 also depicts inflow restrictions when we group countries by economic characteristics rather than geographic location. Specifically, we focus on export specialization (Panel 5.B), growth rate (Panel 5.C) and composite risk (Panel 5.D). By dividing countries into groups, we aim at capturing characteristics that render them close substitutes from the perspective of international investors. In this regard, the natural way to group countries together is based on the similarity of risk and return, as they are the two main determinants of investment decisions. Forbes et al. (2013) find that countries exporting to China are affected by Brazil's capital inflow restrictions. Since these countries are mostly commodity exporters, we also consider export specialization as a relevant country grouping.[17] Just like geographic location, groups by economic characteristics also display some interesting common patterns. In particular, countries with lower composite risk tend to display more stable and lower capital controls relative to riskier countries. Primary goods and service exporters tend to have lower inflow restrictions than fuel, manufacturing and diversified exporters. Finally, no clear pattern emerges when we group countries by growth rate.

Following Forbes and Warnock (2012) we compute gross capital inflows as the sum of net portfolio investment liabilities, other liabilities, and net foreign direct investment. All components of gross capital inflows are available from the IMF's International Finan-

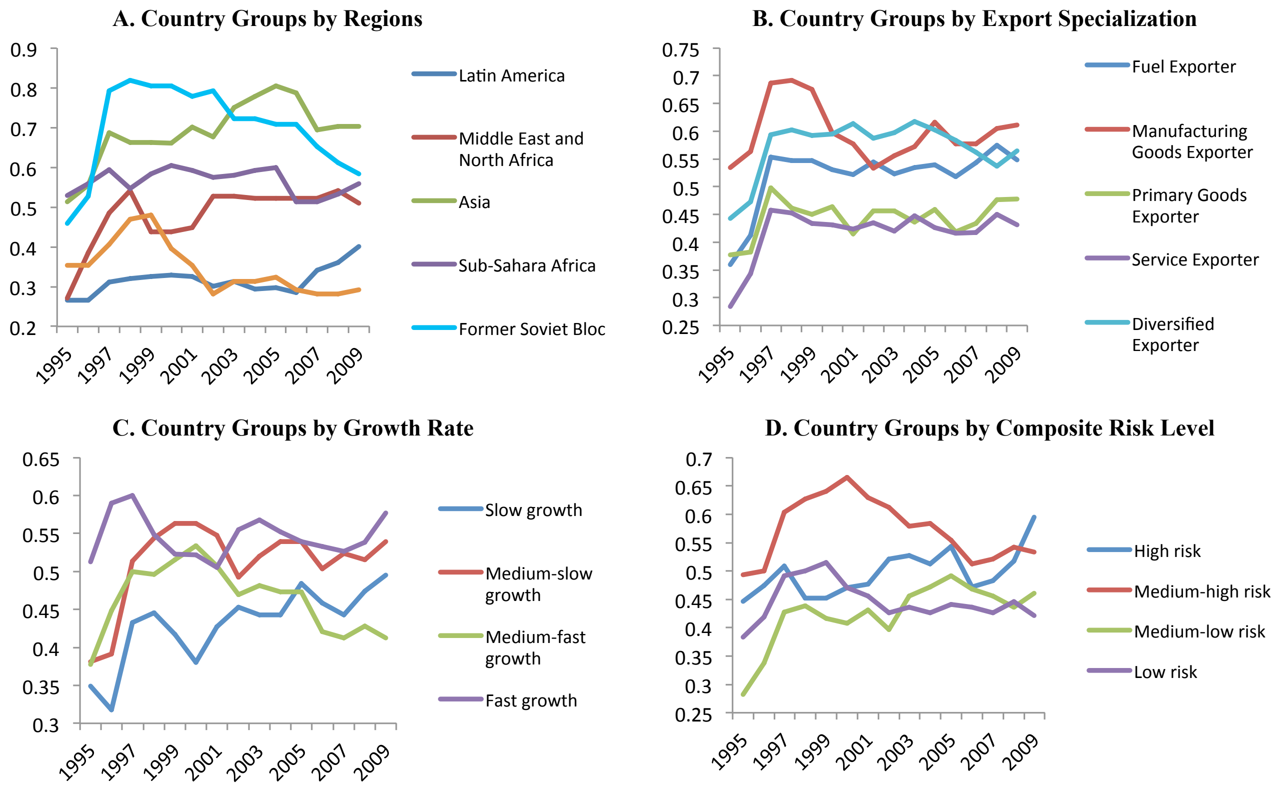
curities, other market instruments. A more detailed description of the index and its methodology are available in the appendix.

[15]Restrictions on capital outflows are the average of the restriction dummies on purchase of financial assets abroad by residents, sale or issue of financial assets locally by nonresidents, collective investments by residents to nonresidents, financial credits by residents to nonresidents, and outward direct investment.

[16]We follow the IMF World Economic Outlook (WEO) and divide countries into six regional groups: Latin America, Middle East and North Africa, Sub-Sahara Africa, Former Soviet Bloc, and Central and East Europe.

[17]For export specialization we continue to follow the WEO classification and divide countries into five groups: fuel exporters, primary goods exporters, manufacturing exporters, service exporters, and diversified exporters.

Figure 5: Schindler's Inflow Control Index by Groups



cial Statistics (IFS) database as reported in BPM5 format.[18] Table 2 shows summary statistics of inflow controls, gross inflows, and other variables used in the regression analysis. Table 3 reports the data sources. Note that we have two measures that capture the risk of investing in a country: composite risk and law and order. Higher values indicate lower risk. The composite risk index is a measure of a country's combined economic, financial, institutional, and political risks, while law and order index captures mainly the institutional risk of a country. For this reason, we focus on the composite risk index as the proxy for country risk in our main regressions. The other measure of country risk is used in the robustness analysis. The other variables in the spillover analysis are standard taken from the push-pull factor literature. We use real US interest rate as a proxy for world real interest. This is computed from annualized US three month treasury rate adjusted by US inflation. The VIX index is used as a proxy for global volatility. Inflation and other country specific variables come from the WEO, while we use Ilzetzki et al. (2010) for exchange rate regime classifications.

[18]Some components of gross inflows have value 0 in some countries, but our data source does not specify whether these are really zero or missing information. In our regressions, we try both interpretations and they lead to the same findings. Below, we report the results where gross capital flows are computed by treating a 0 observation as no capital inflows.

Table 2. Summary Statistics by Country Groups

Variable	Obs	Mean	S.D.	Min	Max
Schindler index (inflows restrictions)	1170	0.49	0.34	0.00	1.00
Gross inflows (% GDP)	1108	4.84	8.08	-38.99	63.85
VIX	1170	21.54	6.45	12.58	34.04
Real US interest rate	1170	0.94	1.63	-2.36	3.18
Inflation	1135	15.01	54.01	-9.86	1061.21
Real GDP growth rate	1169	4.12	4.72	-24.79	62.19
Nominal GDP per capita in USD (logged)	1159	7.42	1.17	4.38	10.66
Nominal GDP in USD (logged)	1170	10.10	1.70	6.47	15.42
Real effective exchange rate	1170	106.78	33.93	56.09	597.37
Composite risk	1138	66.24	8.72	28.00	86.70
Law and order	1138	3.38	1.14	1.00	6.00
de facto exchange rate regime	1134	2.17	1.15	1.00	6.00

Table 3. Data Sources

Data	Source
Capital flows	International Financial Statistics (IFS)
Capital controls	Schindler (2009)
VIX	Yahoo Finance
US three month treasury rate	Federal Reserve Economic Data (FRED)
Inflation rate	World Economic Outlook (WEO)
Real GDP growth rate	WEO
Nominal GDP per capita in US$	WEO
Nominal GDP in US$	WEO
Real Effective Exchange Rate	Information Notice System (INS)
Composite risk index	Political Risk Service (PRS)
Law and Order	PRS
de facto Exchange rate regime classification	Reinhart et al. (2008)
Election Year	Database of Political Institutions (DPI)
Political Orientation of the Ruling Party	DPI

3.2 Evidence of Capital Flow Deflection

In this subsection, we present evidence that capital controls deflect capital flows to other countries. We first present our empirical strategy, which extends the standard push-pull factor model to account for spillover effects. Then we present the regression results for the entire sample of developing economies and for groups of countries that are likely substitutes from the perspective of international investors. Finally, we undertake a series of robustness tests.

3.2.1 Empirical Strategy

We follow closely the empirical literature on the determinants of capital flows (e.g. Ghosh et al. 2012, Forbes and Warnock, 2012) and use a standard pull-push model with an additional variable that captures the spillover effect of inflow restrictions.[19] Specifically, the regression equation is

$$\omega_t^i = \beta_0 + \beta_1 R_t + \beta_2 \tau_{t-1}^i + \beta_3 \tau_t^{S^{-i}} + \beta_4 x_t^i + u_t^i, \tag{11}$$

where ω_t^i denotes country i's gross capital inflow as a percentage of GDP at time t (henceforth, subscript t denotes the time and i denotes the country), R_t is the real world interest rate, τ_{t-1}^i denotes country i's capital inflow controls (lagged once), $\tau_t^{S^{-i}}$ denotes the (weighted average of the) inflow restrictions of all countries in the set S^{-i} (where, recall, $S^{-i} = \{S/i\}$ and $i \in S$), which is computed from

$$\tau_t^{S^{-i}} = \frac{\sum_{j \in S^{-i}} y_t^j \tau_t^j}{\sum_{j \in S^{-i}} y_t^j}, \tag{12}$$

y_t^i being real GDP, x_t^i is a vector of the rest of pull-push factors that determine ω_t^i commonly used in the literature, and u_t^i is the error term.

The model in Section 2 predicts that β_1 and β_2 are negative as households reduce current consumption by borrowing less when the world real interest rate goes up or when inflow restrictions tighten, so that the domestic interest rate raises vis-a-vis the world interest rate. Differently from previous studies, we also include $\tau_t^{S^{-i}}$ as an explanatory variable since capital controls in the set of countries S^{-i} can deflect capital flows to country i. β_3 captures this spillover effect, and our model predicts it to be positive. The rest of the standard pull-push factors include global volatility, lagged real GDP growth rate, lagged real GDP growth rate shock[20], lagged real GDP per capita, and country risk.[21] We lag all the domestic pull factors as well as domestic inflow controls to reduce endogeneity problems. Global push factors and the rest of the world's capital inflow controls are contemporaneous as they are less likely to suffer from endogeneity with the dependent variable. The expected signs of explanatory variables are reported in the last column of the regression tables for convenience.

[19] See Magud et al. (2012) for a survey of the literature.

[20] The real GDP growth rate shock is the log difference between the real GDP growth rate and its H-P filtered trend.

[21] In the regressions, we also introduce additional controls used in the literature of push and pull factors. They include: domestic inflation, real effective exchange rate overvaluation, de facto exchange rate regime. The findings discussed below are robust to the inclusion of these additional variables. However, we do not include them in our baseline regressions because their coefficients are never significant.

3.2.2 Benchmark Regression

Table 4 shows the OLS estimation results of equation (11) for the entire sample (i.e. when $S = \Omega$). For expositional clarity, variables are divided into three blocks: global push variables that only vary across time and are invariant across countries; domestic pull factors that vary across both time and countries; and the spillover variable –the rest of world's capital inflow control– which also varies both across time and countries. Column (1) reports the OLS coefficients for equation (11). To reduce possible omitted variable bias, column 2 reports the OLS coefficients when year fixed effects are included. Since global push factors only vary over time but do not vary across countries, they drop out in the specification with year fixed effects.

Table 4. Capital Flow Deflection (Entire Sample)

	(1)	(2)	Expected Signs
Global Push Factors			
Real US interest rate	-0.337**		-
	(0.152)		
VIX	-0.132***		-
	(0.0490)		
Domestic Pull Factors (all lagged)			
Real GDP growth rate	0.595***	0.504**	+
	(0.188)	(0.194)	
Real GDP growth rate shock	-0.434**	-0.406*	-
	(0.209)	(0.207)	
Real GDP per capita (logged)	0.652	0.481	+
	(0.571)	(0.565)	
De jure Capital inflow control	-2.468*	-2.455*	-
	(1.341)	(1.440)	
Composite risk index	0.150**	0.143**	+
	(0.0647)	(0.0646)	
Spillovers			
ROG's inflow control	23.00***	8.013	+
	(5.807)	(27.50)	
Year fixed effects	No	Yes	
Observations	1,007	1,007	
R-squared	0.135	0.167	

Note: Robust standard errors clustered at country level in parentheses. *** p< 0.01, ** p < 0.05, * $p < 0.1$

Both specifications are able to explain more than 10% of the variation in gross capital inflows. All variables except for real GDP per capita are significant determinants of gross capital inflows and their coefficients have the expected signs.[22] Our key variable of

[22]A priori, it is not obvious what sign the coefficient on real GDP per capita should have. On the

interest, the rest of group's capital inflow controls ($\tau_t^{S^{-i}}$), is significant in the standard push-pull factor model. But the variable becomes insignificant once we control for the year fixed effects, implying that the spillover effect found in column (1) is likely to be due to omitted variable bias. In particular, global push factors other than the ones included in regression (11) may cause gross capital inflows in a developing country and capital controls in the rest of the world to move in the same direction. The lesson from Table 2 is, therefore, that the pull-push model (11) explains gross capital inflows to developing countries reasonably well, but the evidence of spillover effects from the rest of the world is not robust.

The lack of evidence of capital flow deflection for the entire sample is hardly surprising and is in line with other studies (Forbes et al., 2013). In particular, note that this exercise is not a good test of the model in Section 2. An underlying assumption of the model is that countries are identical, if not for the capital controls they implement. In other words, there is a single perfectly integrated world capital market, where all these countries are perfect substitutes from the perspective of investors. This assumption clearly does not hold when we consider the entire sample, where countries are highly heterogeneous, but it could be more reasonable when we look at a smaller group of countries with similar characteristics. Specifically, capital flow deflection may be significant within well defined groups of developing economies, while still be on average irrelevant for the broad (and highly heterogeneous) sample. This is precisely what we investigate next.

3.2.3 Capital Flow Deflection within Country Groups

In this subsection, we divide countries into groups of likely substitutes based on some common characteristics and investigate the existence of capital flow deflection within these groups. In particular, we group countries based on geographic location, export specialization, return, and risk. In other words, we consider the subset of countries S to which country i belongs either as a geographic region (say, Latin America or Sub-Saharan Africa) or as a group defined by certain economic characteristics (say, fuel exporters, fast growing economies, or high risk countries).

As discussed above, we use the composite risk index as a proxy for country specific risk and real GDP growth rate as a proxy for country specific return. We divide countries into four groups depending on the countries' average real GDP growth rates and average composite risk across the sample period. For example, a country i belongs

one hand, higher real GDP per capita is associated with higher level of financial development, which should lead to more inflows. On the other hand, lower real GDP per capital is also associated with weak economic infrastructure and financial capacity, which implies more need for foreign investment and capital inflows. Previous studies find mixed results. Ghosh et al. (2012) find real GDP per capita to reduce the probability of experiencing a net flow surge, while Forbes and Warnock (2012) find no evidence that real GDP per capita is associated with gross inflow surge.

to the low return group if its sample average growth rate is in the bottom 25 percentile of all countries. We call these groups as *time-invariant* groups since the composition of the groups remains the same over time. To allow the composition of groups to change over time, we also consider *time-variant* groups. For example, a country i belongs to the low return group at time t if it is in the bottom 25 percentile among all countries at t. So a country could move from the low return group to a medium-low return group as it grows faster over time. Export specialization and geographic regions follow the definitions used in the IMF's WEO. As mentioned earlier, there are six geographic regions and five export specializations. Table 1 shows the time-invariant groups based on risk.[23]

Table 5 reports the coefficients for $\tau_t^{S^{-i}}$, which is our main variable of interest. The coefficients for other variables are almost identical to the ones in Table 4.[24] Each coefficient in Table 5 comes from a different specification of (11), and there are 36 regression specifications in total. These specifications differ by country-groups (which gives the six rows in the table) and by the set of controls (which gives the six columns in the table). Specifically, in columns (1)-(3) and (4)-(6) we control for a different combination of group contagion variable and country fixed effects, with the number of controls increasing as the column number ascends. Country fixed effects are introduced to reduce omitted variable bias. The group contagion variable is computed as the GDP weighted fraction of countries in S^{-i} that experience gross inflow surge and is included to control for the common shocks to the group.[25] Finally, we lag the rest of the group's inflow controls by one period in (4)-(6) to alleviate possible endogeneity problems between ω_t^i and $\tau_t^{S^{-i}}$.[26]

We find strong evidence of within-group capital flow deflection when countries are grouped based on risk as all coefficients have the correct sign and are highly significant. Not surprisingly, grouping countries by time-variant risk groups gives more robust results relative to the time-invariant risk groups (significance is at the 1% level), as foreign investors are likely to be sensitive to changes over time to the riskiness of a country.

[23]There are 124 countries in the list, 78 of which are in bold. All the countries listed have both GDP and capital inflow restriction data available throughout the sample period, which allows us to compute the rest of the group's capital inflow restrictions. The countries in bold are the ones with at least ten years of observations for the rest of the explanatory variables, and hence are used for regressions.

[24]The only major difference is the coefficient for a country's own capital controls, which is positive but insignificant in the specification with country fixed effects. This finding is consistent with the empirical literature (see Magud et al., 2011) and results from the well-known endogeneity problem between a country's own capital controls and inflows (i.e. higher flows induce a country to adjust prudential restrictions). Given the persistence of capital controls, it is not surprising that simply lagging inflow restrictions does not entirely solve this problem. Forbes et al. (2013) use a propensity score matching method to deal with this econometric challenge. They find that, while broad measures of inflow controls may not be systematically effective, specific measures (e.g. those targeting equity or bond flows) and "major" policy changes lead to a significant reduction in capital inflows.

[25]The group contagion variable is computed as $\frac{\sum_{j\in S_{-i}} y_t^j Surge_t^j}{\sum_{j\in S_{-i}} y_t^j}$ where $Surge_t^j$ is defined in 3.2.4.

[26]In subsection 3.2.5, we use an IV approach to further address endogeneity concerns.

Table 5. Within-Group Capital Flow Deflection

	(1)	(2)	(3)	(4)	(5)	(6)
Group by geographic location	-1.573	-1.573	2.128	-0.699	-0.699	3.898
	(2.388)	(2.388)	(4.539)	(2.403)	(2.403)	(4.698)
Group by export specialization	0.277	0.380	7.535*	0.618	0.750	8.508**
	(2.829)	(2.762)	(4.452)	(2.938)	(2.855)	(4.043)
Groups by returns						
Time-invariant groups by growth rate	4.124	3.875	6.948	3.704	3.416	3.752
	(3.999)	(3.880)	(6.062)	(3.700)	(3.605)	(3.578)
Time-variant groups by growth rate	1.574	0.825	-1.247	-0.238	-0.338	-2.722*
	(2.214)	(2.259)	(1.647)	(2.199)	(2.188)	(1.407)
Groups by risks						
Time-invariant groups by composite risk	10.32*	10.26*	16.85***	7.434	7.619	12.29*
	(5.831)	(5.780)	(6.032)	(5.492)	(5.665)	(6.268)
Time-variant groups by composite risk	8.752***	7.223***	3.839**	11.52***	10.47***	6.624***
	(2.816)	(2.610)	(1.742)	(3.367)	(3.095)	(2.421)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Group Contagion	No	Yes	Yes	No	Yes	Yes
Country FE	No	No	Yes	No	No	Yes
Lagged ROG's inflow control	No	No	No	Yes	Yes	Yes

Note: The table reports the spillover coefficient β_3 in regression equation (11) for 36 different specifications. Robust standard errors clustered at country level in parentheses. *** p< 0.01, ** p < 0.05, * $p < 0.1$

We find no within-group spillover effect when counties are grouped by geographic location, export specialization or returns. The results are robust when we deduct FDIs from the definition of gross inflows, which suggests that short-term (portfolio and other investment) flows are the main drivers of the spillover effect.[27]

To interpret the coefficients and therefore to understand the magnitude of capital flow deflection, we compute the range of spillover effects for the increase in capital inflow restrictions in Brazil in 2009 on the gross inflows of capital to South Africa. Both countries belong to the same time-variant and time-invariant risk group. In 2009, Brazil increased its capital inflow restriction by 0.42, and in the same year South Africa's gross capital inflows were 5.69% of its GDP. The coefficient estimates of β_3 when countries are grouped by (time-variant) risk ranges between 3.84 and 8.75 (without lagging τ_t^{S-i}). Using the lowest and highest estimate, our calculation shows that South Africa's gross capital inflows would have been between 5.21% and 4.72% of its GDP if Brazil had not increased its inflow restrictions in 2009. In other words we find that Brazil's introduction of inflow controls in 2009 increased gross inflows to South Africa by between 0.48% and 0.97% of its GDP. To get an idea of how large this spillover effect is, compare it to

[27]Coefficients for the spillover variable are very similar to the ones shown in Table 5 and, hence, are not reported in this paper.

the effect caused by a 1 percentage point reduction in real US interest rate. Our estimation from Table 4 predicts that a 1 percentage point reduction in the real US interest rate increases gross inflows by 0.34%. Hence spillover effects coming from another country's change in capital controls could be several magnitude higher than the effect of a change in US monetary policy, at least when the restricting country is a major emerging economy like Brazil and the policy change is significant.

Our findings indicate that capital flow deflection affects countries with similar economic characteristics, more than neighbors. The lack of evidence of spillover effects at the regional level, however, has more than one explanation. One possibility is that investors, on average, do not see countries in the same region as sufficiently similar to justify reallocation of investment within the group when one country increases capital controls. However, a second explanation is that the capital deflection model presented in the previous section is not the only mechanism at work. For instance, investors may take an increase in inflow restrictions in one country as a signal that others will introduce similar measures and, therefore, reduce rather than increase investment to the latter. If this "policy emulation" or "contagion" effect is perceived to be stronger among neighboring countries (perhaps because the electorate is more likely to be informed on, and politicians to be influenced by, policy developments in a nearby country), then it is possible that the capital flow deflection is offset by a separate spillover effect in the opposite direction in regional groupings. In this case, the average effect is imprecisely captured in regression analysis and results in an insignificant coefficient.

3.2.4 Robustness Tests

This subsection looks at several robustness tests of the result on capital flow deflection. Specifically, we look at surges in capital inflows (rather than at the level of gross inflows); we use measures of inflow restrictions other than the Schindler index. We finally perform a number of additional robustness tests.

First, we focus on surges in capital inflows. Recent studies such as Ghosh et al. (2012) and Forbes et al. (2013) focus on episodes of extreme capital inflow that they refer as surges. Instead of studying the spillover effects on the magnitude of gross inflows, we investigate whether restrictions in other countries affect the probability of experiencing a surge. We use a probit model in an otherwise identical push-pull model:

$$Prob(Surge_t^i = 1) = \Phi(\beta_0 + \beta_1 R_t + \beta_2 \tau_{t-1}^i + \beta_3 \tau_t^{S^{-i}} + \beta_4 x_t^i + e_t^i), \tag{13}$$

where $Surge_t^i$ equals to one if country i experiences a surge at time t, and zero otherwise. Similar to Ghosh et al. (2012), we define a country to have a gross inflow surge in a year if its gross inflow to GDP is greater than 80% of its historical values across time and 80% of all countries' values in that given year.[28] The probit regression results of

[28]Ghosh et al. (2012) use the threshold of 70% and look at net flows.

(13) are reported in Table 6. The results are largely consistent with the findings in Table 5.

Table 6. Within-Group Capital Flow Deflection: Surges

	(1)	(2)	(3)	(4)	(5)	(6)
Group by geographic location	-0.113	0.0755	-0.0656	0.161	0.345	-0.0645
	(0.665)	(0.625)	(0.243)	(0.653)	(0.595)	(0.194)
Group by export specialization	-0.399	-0.504	0.148	-0.388	-0.488	0.119
	(0.558)	(0.562)	(0.204)	(0.575)	(0.581)	(0.162)
Groups by returns						
Time-invariant groups by growth rate	0.781	0.805	0.563**	0.696	0.705	0.511***
	(0.767)	(0.783)	(0.254)	(0.713)	(0.737)	(0.184)
Time-variant groups by growth rate	0.0884	-0.0177	-0.0480	-0.222	-0.392	-0.115
	(0.446)	(0.466)	(0.0608)	(0.542)	(0.559)	(0.0756)
Groups by risks						
Time-invariant groups by composite risk	-0.657	-0.400	0.373**	-1.581	-1.355	-0.0905
	(1.265)	(1.284)	(0.183)	(1.199)	(1.223)	(0.226)
Time-variant groups by composite risk	1.746**	1.568**	0.181**	1.867**	1.611**	0.191**
	(0.752)	(0.769)	(0.0789)	(0.749)	(0.762)	(0.0877)
Regression	Probit	Probit	OLS	Probit	Probit	OLS
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Group Contagion	No	Yes	Yes	No	Yes	Yes
Country FE	No	No	Yes	No	No	Yes
Lagged ROG's inflow control	No	No	No	Yes	Yes	Yes

Note: The table reports the spillover coefficient β_3 in Probit model (13) for 24 different specifications in columns (1),(2),(4), and (5). Columns (3) and (4) report the results from the linear probability model with country fixed effects. Robust standard errors clustered at country level in parentheses. *** p< 0.01, ** p $<$ 0.05, * $p < 0.1$

The second robustness test relates to our measure of inflow restrictions. To see if the existence of capital flow deflection relies on the use of the Schindler index of inflow controls, we use four alternative proxies of capital controls. The first two proxies, called CAPIN and CAPITAL, come from the work of Quinn et al. (2009). CAPIN measures capital account restrictions imposed on non-residents. CAPITAL captures capital account restrictions on both residents and non-residents. The third proxy, called FINCONT2, gives financial sector specific controls and comes from the work of Ostry et al. (2012). [29] As both CAPITAL and FINCONT2 represent general capital controls

[29]The data for the CAPITAL index cover restrictions imposed on capital flows by residents and by nonresidents. FINCONT2 is computed as an average of three components: (i) differential treatment of accounts held by nonresidents; (ii) limits on borrowing from abroad; and (iii) restrictions on maintenance of accounts abroad. The correlation between the various indexes is reported in Appendix. We rescale all proxies along the interval $[0, 1]$ with 0 indicating full capital account liberalization, so they are comparable to the Schindler's index of inflow controls. The pairwise correlations of these proxies are provided in Table 10 in the Appendix.

that include restrictions on both inflows and outflows, the last proxy we consider is the Schindler's index of general capital controls.[30]

We replicate the same regressions as in Tables 5 with these variables. The results are reported in Table 7, where each row reports the coefficients for τ_t^{S-i} in equation (11) in the time-variant group. Due to data availability, we have a smaller sample. As for the regressions with the Schindler index, there is no spillover effect when we do not divide countries into groups. However, once we divide countries into groups based on (time-variant) risks, we find evidence of capital flow deflection in most specifications as in Table 5.

Table 7. Within-Group Spillover Effects of Inflow Control on Gross Inflows: Using Other Proxies of Capital Controls

	(1)	(2)	(3)	(4)	(5)	(6)
CAPIN	12.547***	13.114***	5.060	13.130**	13.092**	5.221
	(4.314)	(4.263)	(3.815)	(5.553)	(5.567)	(4.671)
CAPITAL	12.383***	13.055***	7.840**	10.928***	11.000***	5.999
	(3.442)	(3.508)	(3.264)	(4.054)	(4.068)	(3.643)
FINCONT2	6.550*	8.958**	6.264**	9.842***	10.704***	9.360***
	(3.238)	(3.490)	(2.937)	(3.590)	(3.493)	(3.190)
Schindler's General Control	8.335**	6.077*	0.694	10.030**	8.436*	4.008
	(3.745)	(3.572)	(2.586)	(4.619)	(4.378)	(3.643)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Group Contagion	No	Yes	Yes	No	Yes	Yes
Country FE	No	No	Yes	No	No	Yes
Lagged ROG's inflow control	No	No	No	Yes	Yes	Yes

Note: The table reports the spillover coefficient β_3 in regression equation (11) with $CAPIN$, $CAPITAL$, $FINCONT2$, and Schindler's index of general control as proxies for capital controls. Due to the data availabilities of $CAPIN$, $CAPITAL$, and $FINCONT2$, the samples for regressions associated with these proxies are much smaller than the one for regressions with Schindler index, so we divide the countries into two groups based on composite risk for those regression analyses. The Robust standard errors clustered at country level in parentheses. *** p< 0.01, ** p < 0.05, * $p < 0.1$

Finally, we also undertake a number of additional robustness tests.[31] First, to see if

[30] Another commonly used proxy for capital controls comes from Chinn and Ito (2009). However this measure is less refined than the Schindler index and the other measures used here. Specifically, the Chinn-Ito index is compiled from a broader set of policies than capital controls: they include exchange rate policy, trade policy, and current account policy. As this measure is less appropriate to test our theory, we are not surprised to find no robust capital flow deflection when we proxy capital controls with the Chinn-Ito index. For more discussions on and detailed comparisons of various proxies of capital controls refer to Quinn et al. (2011).

[31] The findings of these exercises are not reported here, but are available upon request. All the

the consistent finding of spillover effects among risk groups depends on the composite risk measure, we consider other measures of country risk. In particular, we divide countries based on their index values of law and order and we still continue to find robust capital flow deflection. Second, we use other proxies for returns. Specifically, we divide countries by return on assets, return on equities, and short term treasury bond yields. The sample is smaller as coverage for these variables is more limited. In any event, we do not find evidence of capital flow deflection across groups of countries with similar returns with any of these proxies.[32] Last, we replace the inflow controls by general capital controls, which is the average of inflow controls and outflow controls and redo the regressions in Table 5. Capital flow deflection still holds. This finding is consistent with an interpretation of the signaling story in Bartolini and Drazen (1997) that international investors may interpret tighter outflow controls as a signal for future tighter inflow controls.

3.2.5 Endogeneity

To address possible endogeneity bias, we follow an instrumental variables approach to estimate specification (11). Omitted variables may be a concern as countries can experience a surge in inflows because of a common shock to the group. If some countries react to the surge by increasing their controls while others do not, we can find a correlation between the policy of the first and the inflow surge to the latter, but this correlation would not reflect a causal relationship. Furthermore, reverse causality may also be a concern as the rest of the group might see higher capital inflows to a member as a signal of a capital inflow surge to the entire group. If this is the case, the rest of the group may respond to inflows to country i by increasing contemporaneous capital inflow restrictions. For these reasons, we generate three instruments that are correlated with the capital controls in the rest of the groups but not with the capital inflows to country i, and use shocks to these variables to identify the effect on inflows to i.

The first instrument is based on the electoral cycle, as governments may be more willing to raise capital controls before elections in an attempt to depreciate the real exchange rate and improve competitiveness. This instrument, denoted by $elect_t^{S^{-i}}$, is the GDP weighted fraction of the countries belonging to the subset S^{-i} that have an election in the upcoming year. This variable is computed as

$$elect_t^{S^{-i}} = \frac{\sum_{j \in S^{-i}} y_t^j elect_{t+1}^j}{\sum_{j \in S^{-i}} y_t^j},$$

regressions in this subsection are robust when we deduct FDI from gross inflows.

[32]The full list of the different ways we grouped countries by return is: (i) Return on assets from bank-level data; (ii) Return on equity from bank-level data; (iii) Government bond yield; (iv) Stock market return. In addition, we also ran regressions dividing countries by GDP per capita (a proxy for the level of development) and GDP (a proxy for the country size). As discussed in the main text, we found no significant capital flow deflection using these variables.

where $elect_{t+1}^j$ equals 1 if country j has an election in year $t+1$, and 0 otherwise.

The second instrument is based on the content of Free Trade Agreements (FTAs), as in certain cases they may include provisions on the liberalization of the capital account (WTO, 2011). Specifically, "deep" FTA (i.e. agreements going beyond preferential tariffs and covering numerous non-tariff areas of a regulatory nature) involving EU, US and Japan as signatories generally contain enforceable rules that restrict the use of capital controls. The instrument, denoted by $FTA_t^{S^{-i}}$, is the GDP weighted-fraction of countries that signed a deep FTA with EU, US, or Japan. The variable is computed as

$$FTA_t^{S^{-i}} = \frac{\sum_{j \in S_{-i}} y_t^j FTA_t^t}{\sum_{j \in S_{-i}} y_t^j},$$

where FTA_t^t equals 1 if country j has a deep FTA with EU, US, or Japan in year t, and 0 otherwise.[33]

The third instrument is based on the political leaning of the ruling government, as the right-wing governments are generally found to be less likely to employ capital controls (Grilli and Milesi-Ferretti, 1997, and Ghosh et al., 2014), possibly for ideological reasons. This instrument, denoted as $right_t^{S^{-i}}$, is the GDP weighted fraction of countries with a right-wing government. The variable is computed as

$$right_t^{S^{-i}} = \frac{\sum_{j \in S^{-i}} y_t^j right_t^t}{\sum_{j \in S^{-i}} y_t^j},$$

where $right_t^t$ equals to 1 if country j has a right-wing government in year t, and 0 if it has a left-wing or a centrist government.[34]

The results for the IV specification when countries are grouped by (time-variant) risk are reported in Table 8.[35] As discussed above, we expect that our instruments are correlated with inflow restrictions in group S^{-i}, but that they do not directly affect the dependent variable, as there is no a priori reason why the electoral cycle, the political color or the FTA participation of countries in the same group as country i are directly

[33]Data on deep FTAs are from the WTO's database on the content of trade agreements. See WTO (2011) for a detailed description. A possible concern with this instrument is that deep FTAs are correlated with FDI flows to member countries. In particular, Orefice and Rocha (2013) document the two way relationship between deep agreements and production networks. While to the best of our knowledge there is no evidence that deep FTAs affect FDIs to third countries (a sort of investment diversion), one may still worry that the exclusion restriction is not satisfied with respect to FDIs. For this reason, we run our regressions both including and excluding FDIs from the definition of gross inflows. All results discussed below do not change.

[34]The data on election year and the government's political orientation are from World Bank's Database of Political Institutions.

[35]Due to the data restriction, we have smaller samples for IV regressions. Hence we divide countries into three groups instead. The results in Table 5 continue to hold when countries are divided into three groups.

associated with capital inflows to i. In fact, the first stage results have the expected sign and the F-statistic of the regression indicates that none of the instruments is weak. Specifically, the upcoming election instrument is positive and significant, while the deep FTA and right-wing government instruments are negative and significant. The second stage regression results show that the capital controls in the rest of the group still have a positive impact on capital flows to country i and the size of the coefficients is comparable to the main regressions. When we use upcoming elections and deep FTAs as instruments, we find stronger significance, possibly due to the smaller sample of countries for which we have information regarding the political leaning of the government.[36]

3.3 Evidence of Policy Response

In this subsection we analyze the empirical evidence of policy responses to capital flow deflection (Proposition 3). In particular, we use a probit model to investigate whether the probability of imposing capital inflow restrictions in one country is affected by capital controls set by other countries.

There is little empirical literature on the determinants of capital controls. Fratzcher (2011) studies capital controls largely in the context of more industrialized economies.[37] Fernandez et al. (2013) investigate whether countries use capital controls for prudential reasons and focus only on the cyclical components of these measures. Due to the lack of established empirical literature in the field, we study the determinants of a country's decision to change capital inflow controls using a parsimonious empirical model with the pull-push factors that are found to affect capital inflows in the previous section, complemented by additional controls suggested by the theory in Section 2 and by other studies on capital controls. Our specification is:

$$Pr(Inc_t^i = 1) = \Phi(\beta_0 + \beta_1 \Delta\tau_t^{S^{-i}} + \beta_2 x_t^i + u_t^i), \qquad (14)$$

where Inc_t^i is a dichotomous variable that equals 1 if country i raises inflow restrictions at time t and 0 otherwise.[38] Φ is the cumulative normal distribution function. $\Delta\tau_t^{S^{-i}} = \tau_t^{S^{-i}} - \tau_{t-1}^{S^{-i}}$ is a measure of the change in inflow restrictions by countries in group S^{-i}, excluding country i. As indicated above, x_t includes the pull and push factors in the previous subsection. These factors may be important determinants of a change

[36] We also run the IV regression with the combination of $right_t^{S^{-i}}$ and $FTA_t^{S_{-i}}$ as instruments. However, we find this combination to be significant only at 11 percent and, therefore, we do not report the results in Table 8.

[37] We tried using the specifications in Fratzcher (2011) to study capital controls in developing countries, but the model yields little explanatory power.

[38] As countries are more likely to increase controls on destabilizing/short-term inflows such as bond inflows rather than FDIs, we run the same regressions in this subsection excluding FDI restrictions from the dependent variable, and the results are the same.

Table 8. IV: Within-group Spillover Effects of Inflow Controls on Gross Inflows for Time-Variant Groups by Composite Risk

	(1)	(2)
Second Stage		
Rest of the Group's Inflow Control	10.750***	8.424*
	(4.035)	(4.906)
First Stage		
Upcoming Election Instrument	0.0886***	0.185***
	(0.0205)	(0.0381)
Trade Agreement Instrument	-0.298***	
	(0.0224)	
Right-Wing Government Instrument		-0.291***
		(0.0399)
First Stage F statistics for the instruments	74.590	16.002
P-value of F statistics	0.000	0.000
Hansen J statistics	0.201	0.449
P-value of Hansen J statistics	0.654	0.503
Year FE	Yes	Yes
Group Contagion	Yes	Yes
Country FE	Yes	Yes
Observations	879	450
Countries	68	35

Note: Robust standard errors in parentheses. *** $p< 0.01$, ** $p < 0.05$, * $p < 0.1$

in capital inflow restrictions as they influence gross capital inflows, which in turn may trigger a policy response by the government. In addition x_t^i includes time fixed effects, group contagion variable, and a number of other variables (discussed below) that may be correlated with a government's decision to increase inflow restrictions.

The key variable of interest in this subsection is $\Delta\tau_t^{S-i}$. Proposition 3 predicts that whether capital controls are complements or substitutes depends on the motive for which they are used. If inflow restrictions are motivated by a desire to manipulate the domestic interest rate, such as in the case of prudential capital controls, then the country will respond to an increase in inflow restrictions by other borrowers by raising its own controls. On the other hand, when the motive for capital controls is to manipulate the world interest rate, then the nature of the relationship among capital controls imposed by different borrowing countries is ambiguous. As small countries cannot influence the world interest rate, they only have domestic motives to use capital controls. We then expect the coefficient of $\Delta\tau_t^{S-i}$ to be positive for small economies and ambiguous for large economies.

We also introduce in our specification a number of variables that may affect the decision of a government to increase capital controls, either to manipulate the world interest rate or to manipulate the domestic interest rate. Specifically, we control for the real GDP since the model in Section 2 predicts that larger countries are more likely to manipulate the inter-temporal terms of trade with their capital control policies. While developing economies play a small role in international financial markets relative to advanced economies, it is still possible that certain larger countries exert at least some market power if markets are segmented, for instance because various economies are perceived to be imperfect substitutes by international investors. We also include REER (real effective exchange rate) overvaluation, domestic inflation, a flexible exchange rate regime dummy, and external debt since these variables may affect the decision to use capital controls as a means to manipulate the domestic interest rate for prudential reasons or for other non-prudential reasons.

Table 9 reports the results of the probit regression (14) when countries are grouped following the approach of the previous subsection. Due to data availability of inflation and de facto exchange rate regime, our sample size now reduces to 64.[39] The probit model has a reasonable good fit as indicated by the Pseudo R-squares. To save space, we do not report the coefficients of the traditional pull factors that are not significant in any specification.

We find no evidence of within-group policy response as all the coefficients of $\Delta\tau_t^{S-i}$ are insignificant. This is true regardless of how we group countries: notably, this is true when we use risk-groups that display large and significant capital flow deflection. While our sample is composed of developing countries that are small relative to the size of the global financial market, one could argue that at least some of these countries are large within the groups they belong to and set capital controls to exploit this market power. If this is the case, then the lack of evidence may be resulting from the fact that capital flow deflection is leading these countries to respond by decreasing rather than increasing their controls. However, the lack of evidence of a policy response appears to be a very resilient result. In particular, it persists also if we drop larger developing economies from the sample to remove possible terms of trade motive (no matter what definition we give to "large economy").

We also undertake a series of robustness tests, none of which changes the finding of no policy response. First, we use a linear probability model of (14), where we introduce country fixed effects. The regression results are reported in Table 11 in the Appendix. Note that several of the control variables that were significant in Table 9 (such as the REER overvaluation) become insignificant, suggesting that unobserved country

[39] All the results from the previous subsection on spillover effect are robust to the smaller sample.

Table 9. Within-Group Policy Response

	(1)	(2)	(3)	(4)	(5)	(6)	Expected Sign
Domestic Variables (Lagged)							
Real GDP growth rate	-0.0489*	-0.0458*	-0.0466*	-0.0445*	-0.0459*	-0.0491*	+
	(0.0256)	(0.0251)	(0.0251)	(0.0242)	(0.0249)	(0.0252)	
Real GDP growth rate shock	0.0832**	0.0792**	0.0805**	0.0764**	0.0794**	0.0828**	-
	(0.0352)	(0.0344)	(0.0350)	(0.0345)	(0.0348)	(0.0349)	
REER overvaluation	-0.999*	-0.940	-0.956*	-0.936*	-0.920*	-0.989*	-
	(0.570)	(0.577)	(0.561)	(0.567)	(0.555)	(0.575)	
Inflation	0.194**	0.184**	0.184**	0.180**	0.177*	0.180*	+
	(0.0938)	(0.0911)	(0.0934)	(0.0910)	(0.0935)	(0.0935)	
Flexible Exchange Rate	-0.0367	-0.0219	-0.0251	-0.0246	-0.0276	-0.0312	-
	(0.155)	(0.141)	(0.142)	(0.144)	(0.139)	(0.148)	
Real GDP (logged)	0.116**	0.110**	0.114**	0.114**	0.111**	0.111**	+
	(0.0472)	(0.0467)	(0.0476)	(0.0472)	(0.0481)	(0.0472)	
External Debt	-0.177	-0.163	-0.165	-0.160	-0.165	-0.172	+
	(0.129)	(0.124)	(0.126)	(0.127)	(0.124)	(0.122)	
Change of Weighted Inflow Controls in the ROG							
Group by geographic location	-1.358						+
	(1.087)						
Group by export specialization		0.664					+
		(0.945)					
Time-invariant group by growth rate			-0.123				+
			(1.054)				
Time-variant group by growth rate				-0.124			+
				(0.286)			
Time-invariant group by composite risk					-1.064		+
					(1.335)		
Time-variant group by composite risk						0.0508	+
						(0.332)	
Observations	841	841	841	841	841	841	
Pseudo R-squared	0.151	0.151	0.150	0.150	0.150	0.150	

Note: The sample consists of 64 countries. GDP per capita and composite risk index are insignificant in all specifications and hence not reported in the table to save space. All regressions control for year fixed effects and group contagion variable. Robust standard errors clustered at country level in parentheses. *** p< 0.01, ** p < 0.05, * $p < 0.1$

characteristics, rather than the time dimension of these variables, are correlated with the decision to increase inflow restrictions. More importantly for our analysis, the OLS regression results of the linear probability model yield the same findings as the probit model, namely the coefficient of $\Delta\tau_t^{S-i}$ continues to be statistically insignificant for all country groups.[40]

As an alternative to the policy change variable $\Delta\tau_t^{S-i}$, we use a different definition of the main control variable and we replicate the results in Tables 9 and 11. In particular,

[40]We also run instrumental variable regressions replacing $\Delta\tau_t^{S-i}$ with the sets of instruments introduced in Section 3.2.5, and these regressions yield the same results.

we define D_t^{S-i} which is computed as

$$D_t^{S-i} = \frac{\sum_{j \in S_i} y_t^j D_t^j}{\sum_{j \in S_i} y_t^j},$$

where D_t^j is a categorical variable that takes value 1 if country j tightens inflow control at t, -1 if j lowers inflow control, and 0 if there is no change. The results are largely the same, except that we find a policy response within export groups, but it is only significant at 10%. The coefficient of the main variable of interest for all other groupings is never significant.

Next, we conduct the same exercises focusing on a decrease (rather than an increase) in inflow controls as the dependent variable. We rerun the regressions in Tables 9 and 11. Again, we do not find robust within-group policy response.

A final concern is that countries might experience a heterogeneity in externalities of capital inflows that is not captured by the model. For example, in countries facing borrowing constraints, the level of capital inflows might be sub-optimally low. In this case the capital flow deflection would correspond to a positive externality and hence it would not necessarily induce the government to increase inflow controls. To control for this, we introduce a dummy for countries that have experienced a recent default and interact this dummy with the spillover variable. We still do not find evidence of policy response for countries that have not had a recent default (i.e. for those that are less likely to face borrowing constraint).[41]

An important question is what explains the discrepancy between the theory in Section 2 and the lack of empirical evidence of a policy response in this section. While we do not have a firm answer to this question, we have three explanations for the puzzle. A first explanation has to do with the data methodology used to compile *de jure* indices of capital controls. These measures capture the extensive margin of restrictions, but not their intensive margin. In other words, if a regulation or a tax on a certain category of financial transactions becomes more stringent, this would not necessarily be reflected in the available indices that code information in a binary form (0 for unrestricted transactions and 1 for restricted ones).[42] This methodology could bias the regression results as it reduces the variability of capital controls by construction. The second explanation has to do with the dominant view on capital controls in the historical period under analysis. Until recently, restrictions to capital flows were not considered as "legitimate" prudential policies. In this environment, governments may have been concerned that the use of capital controls could send a negative signal to international markets, as highlighted in the work of Bartolini and Drazen (1997). In this case, governments would weigh the benefit of prudential controls to offset domestic market distortions arising from excessive capital inflows with the reputation costs of introducing

[41]The results of robustness checks are available upon request.

[42]See the Appendix for further details.

such measures. This may also suggest that governments might have preferred the use of policy instruments other than inflow controls when facing capital flow deflection. Again, the end result would be a muted policy response. A third explanation is that governments, or at least some governments, are in practice less likely to use prudential controls than predicted by the theory, because the problem that they face is a sub-optimally low level of capital inflows rather than excessively large and volatile flows. For these countries a sudden surge in inflows as a result of a policy change by others alleviates an existing market failure. While, as discussed above, we try to address this concern in our regression, difficulties to access international financial markets may still contribute to explain the low policy response to capital flow deflection that we find in the data.

4 Conclusion

This paper presents a simple model of capital flow deflection, by which we mean the increase in capital inflows to third markets as a result of tightening of capital controls in some countries, and of the policy response that this cross-border spillover effect can induce in other borrowing countries. We test the implications of the model for a large sample of developing economies between 1995 and 2009 and find strong evidence of capital flow deflection, but no evidence of a policy response.

These empirical findings complement recent work on capital controls, which allows to draw some, admittedly preliminary, conclusions. First, both the event studies on Brazil (Forbes et al, 2013, and Lambert et al, 2011) and our cross-sectional approach indicate that capital controls deflect inflows to countries with similar economic characteristics, most notably similar risk structure. This spillover effect is economically relevant and, when we focus on a change in policy in Brazil, the magnitudes are comparable across studies. These findings indicate that capital controls, even when improving the management of capital flows to a country, may render more difficult the management of flows for others. As discussed in the theory section, these multilateral effects could lead to an inefficient equilibrium in realistic environments where governments have limited policy instruments and/or markets are incomplete.

Second, both the studies on the determinants of capital controls (Fratzscher, 2013 and Fernandez et al, 2013) and our results on the policy response cast doubts on the use of capital controls for prudential reasons. However, this lack of evidence may be driven by the methodology used to collect cross-country data on inflow restrictions and/or by the specificity of the historical period under analysis, a period when capital controls were seen as stigma that governments might have been concerned with sending a negative signal to markets using capital controls. If this is the case, in the coming years the changing view on the use of capital controls (IMF, 2012) may well lead governments to manage capital flows more actively to address domestic distortions. This will also increase the frequency of episodes of capital flow deflection and, possibly, of retaliatory responses as predicted by our theory. Combined with the availability of more detailed data, future empirical work may provide a different upshot.

In concluding this paper, we would like to come back to the question we posed in the beginning. What does capital flow deflection imply for the design of the multilateral institutions needed to govern international capital flows? Ideally, multilateral rules on capital controls should aim at preserving some flexibility for efficiency enhancing capital controls, such as prudential controls, while limiting the negative consequences associated with capital flow deflection.

The regulation of safeguards in the WTO (i.e. the restriction of imports that cause injury to a country) may provide some useful lessons. Both safeguards and capital controls introduce valuable flexibility in their respective systems and both lead to deflection of trade and capital flows, respectively. But safeguards are tightly regulated in the WTO. First, they need to be temporary and respectful of the most favored nation (MFN) clause, that is safeguards cannot discriminate between different trading partners. Second, Art. XIX of GATT and other clauses of the WTO Agreements circumscribe the situations where a safeguard can rightfully be applied. Third, the use of safeguards is subject to the WTO dispute settlement mechanism, which allows any member affected by the measure to request that a neutral panel reviews its consistency with WTO rules. Whether this regulatory framework can serve as a source of inspiration to deal with capital flow deflection is a question left for future research.

References

[1] Bagwell, Kyle and Robert W. Staiger (1999). "An Economic Theory of GATT." The American Economic Review, 89(1), pp. 215-248.

[2] Bagwell, Kyle and Robert W. Staiger (2002). "The Economics of the World Trading System", Boston, MA: MIT Press.

[3] Bartolini, Leonardo, and Allan Drazen (1997). "Capital- Account Liberalization as a Signal." American Economic Review, Vol. 87 (March), pp. 138-54.

[4] Bown, Chad P. and Meredith A. Crowley (2006). "Policy Externalities: How U.S. Antidumping Affects Japanese Exports to the E.U." European Journal of Political Economy v22, n3 (September 2006): 696-714. [Special issue]

[5] Bown, Chad P. and Meredith A. Crowley (2007). "Trade Deflection and Trade Depression." Journal of International Economics v72, n1 (May 2007): 176-201.

[6] Chinn, Menzie and Hiro Ito (2008). "A New Measure of Financial Openness." Journal of Comparative Policy Analysis 10(3): 309-22.

[7] Costinot, Arnaud, Guido Lorenzoni, and Ivan Werning (2013). "A Theory of Capital Controls as Dynamic Terms-of-Trade Manipulation." Journal of Political Economy, Forthcoming.

[8] Farhi, Emmanuel, and Ivan Werning (2013)." Dilemma not Trilemma? Capital Controls and Exchange Rates with Volatile Capital Flows"

[9] Fernandez, Andres, Alessandro Rebucci, and Martin Uribe (2013) "Are Capital Controls Prudential? An Empirical Investigation". NBER Working Paper 19671, November 2013.

[10] Forbes, Kristin, Marcel Fratzscher, Thomas Kostka, and Roland Straub (2012). "Bubble Thy Neighbor: Direct and Spillover Effects of Capital Controls. "NBER Working Paper 18052.

[11] Forbes, Kristin and Francis Warnock (2012). "Capital Flow Waves: Surges, Stops, Flight and Retrenchment."Journal of International Economics, Volume 88, Issue 2, November 2012, Pages 235-25.

[12] Forbes, Kristin, Marcel Fratzscher, and Roland Straub (2013). "Capital Controls and Macroprudential Measures: What are They Good For?"MIT-Sloan Working Paper 5061-13.

[13] Fratzscher, Marcel (2012). "Capital Controls and Foreign Exchange Policy." CEPR Discussion Paper 8788, January 2012.

[14] Ghosh, Atish R., Jun Kim, Mahvash S. Qureshi, and Juan Zalduendo (2012). "Surges." IMF Working Paper 1222.

[15] Ghosh, Atish R., Mahvash S. Qureshi, and Naotaka Sugawara (2014). "Regulating Capital Flows at Both Ends: Does it Work?." mimeo, IMF.

[16] Grilli, Vittorio and Gian Maria Milesi-Ferretti (1995). "Economic Effects and Structural Determinants of Capital Controls." IMF Staff Papers, 42(3): 517-551.

[17] Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff (2010). "Exchange Rate Arrangements Entering the 21st Century: Which Anchor Will Hold?" Data updated at http://personal.lse.ac.uk/ilzetzki/IRRBack.htm

[18] IMF (2012). "The Liberalization and Management of Capital Flows: An Institutional View." International Monetary Fund Position Paper.

[19] IMF (2013). "Guidance Note on the Liberalization and Management of Capital Flows." International Monetary Fund Position Paper.

[20] Korinek, Anton (2014). "Capital Controls and Currency Wars." University of Maryland, Mimeo.

[21] Lambert, Frederic, Julio Ramos-Tallada, and Cyril Rebillard (2011). "Capital controls and spillover effects: evidence from Latin-American countries." Banque de France Working Papers 357.

[22] Magud, Nicolas, Carmen Reinhart, and Kenneth Rogoff (2011). "Capital Controls: Myth and Reality – A Portfolio Balance Approach." Peterson Institute of International Economics. WP 11-7.

[23] Orefice, Gianluca and Nadia Rocha (2014). "Deep integration and production networks: an empirical analysis." The World Economy, vol.37(1), pp.106-136.

[24] Ostry, Jonathan D., Atish R. Ghosh, Marcos Chamon, and Mahvash S. Qureshi (2012). "Tools for managing financial-stability risks from capital inflows." Journal of International Economics, Elsevier, vol. 88(2), pages 407-421.

[25] Quinn, Dennis P., Martin Schindler, and A. Maria Toyoda (2011). "Assessing Measures of Financial Openness and Integration." IMF Economic Review 59.3 (2011): 488-522.

[26] Quinn, Dennis P. and A. Maria Toyoda (2008). "Does Capital Account Liberalization Lead to Economic Growth?" Review of Financial Studies 21(3):1403-1449.

[27] Rey, Helene (2013). "Dilemma not Trilemma: The global financial cycle and monetary policy independence". Paper presented at the Jackson Hole Symposium, August 2013.

[28] Shindler, Martin (2009). "Measuring Financial Integration: A New Data Set." IMF Staff Papers, Vol. 56, No. 1.

[29] Viner, Jacob (1950). *The Customs Union Issue*. Carnegie Endowment for International Peace: New York.

[30] WTO (2011). *The WTO and Preferential Trade Agreements*. World Trade Report, 2011. WTO, Geneva.

5 Appendix I: Proofs

5.1 Proof of Proposition 1

Maximizing (4) subject to (5), and taking both market frictions into account -domestic externality and market power-, we obtain the following Euler equation:

$$u'(c_1^i) - \beta^i R u'(c_2^i) - x'(c_1^i - y_1^i) - \beta^i u'(c_2^i)(c_1^i - y_1^i)\frac{dR}{d[m^i(c_1^i - y_1^i)]} = 0. \qquad (15)$$

Let us investigate separately the two distinct motives for policy intervention, starting with the prudential motive. If country i does not affect the world market equilibrium ($m^i = 0$), then it is $dR/d[m^i(c_1^i - y_1^i)] = 0$. Hence, for a borrowing country ($c_1^i - y_1^i > 0$), the Euler equation above simplifies to

$$u'(c_1^i) = \beta^i R u'(c_2^i) + x'(c_1^i - y_1^i). \qquad (16)$$

In order for (3) to be equal to (16), it must be

$$\frac{u'(c_1^i)}{\beta_i R(1+\tau^i)} = \frac{u'(c_1^i) - x'(c_1^i - y_1^i)}{\beta^i R},$$

from which we obtain the formula for the optimal prudential capital controls as $\widehat{\tau^i} = x'(c_1^i - y_1^i)/[u'(c_1^i) - x'(c_1^i - y_1^i)]$.

For a lending country ($c_1^i - y_1^i \leq 0$) instead, it is $e(c_1^i - y_1^i) = 0$, and thus all frictions disappear. As a result, the solution to the welfare maximization for a rational forward-looking national planner coincides with the utility maximization of the representative consumer, and the optimal prudential policy becomes $\widehat{\tau_1^i} = 0$. Hence, depending on whether country i is lender or borrower, its optimal prudential capital controls can be described by the step function defined in (9).

Let us now introduce the terms-of-trade motive. If country i is able to affect the world market equilibrium ($m^i > 0$), then it is $dR/d[m^i(c_1^i - y_1^i)] \neq 0$, and its unilateral optimal policy is found by equalizing Euler equation (6) with the one solved under the decentralized optimization problem (3). After a few algebraic steps, we obtain the optimal policy as

$$1 + \tau^{i*} = (1 + \widehat{\tau^i})(1 + \widetilde{\tau^i}).$$

The expression for $\widehat{\tau^i}$ is given in (9), while the one for $\widetilde{\tau^i}$ is given by $\widetilde{\tau^i} = m^i \cdot \varepsilon^{-i}$, where ε^{-i} represents the inverse elasticity of global savings faced by country i, that is (and after defining $Y_1^{-i} \equiv \sum_{j\neq i} m^j y_1^j$ and $C_1^{-i} \equiv \sum_{j\neq i} m^j c_1^j$):[43]

$$\varepsilon^{-i} = \frac{dR}{d(Y_1^{-i} - C_1^{-i})} \frac{Y_1^{-i} - C_1^{-i}}{R}. \tag{17}$$

5.2 Proof of Lemma 1

(i) Define

$$F(R^*, \tau^{S^{-i}}) \equiv m^{S^{-i}}[y_1^{S^{-i}} - c_1^{S^{-i}}(R^*, \tau^{S^{-i}})] + \sum_{j\neq S^{-i}} m^j [y_1^j - c_1^j(R^*, \tau_1^j)] = 0.$$

as the implicit function of R^* w.r.t $\tau^{S^{-i}}$. From the implicit function theorem, we obtain

$$\frac{dR^*}{d\tau^{S^{-i}}} = -\frac{\partial F/\partial \tau^{S^{-i}}}{\partial F/\partial R^*},$$

which is strictly negative, as both $\partial F/\partial \tau^{S^{-i}}$ and $\partial F/\partial R^*$ are strictly positive.

(ii) World savings are defined as the sum of each individual lending country's savings, $\sum_\omega m^\omega [y_1^\omega - c_1^\omega(R, \tau^\omega)]$, with ω indexing all countries for which $y_1^\omega - c_1^\omega > 0$. The statement is true given that $dc_1^\omega(R, \tau^\omega)/dR < 0$ for any ω.

5.3 Proof of Proposition 2

The proof follows immediately from point (i) of Lemma 1 together with the fact that $dc_1^i(R, \tau^i)/dR < 0$. Formally, $dc_1^i(R, \tau^i)/d\tau^{S^{-i}} = (dc_1^i(R, \tau^i)/dR) \cdot (dR^*/d\tau^{S^{-i}}) > 0$.

5.4 Proof of Proposition 3

Deriving expression (8) with respect to $\tau^{S^{-i}}$ we obtain

$$\frac{d\tau^{i*}}{d\tau^{S^{-i}}} = \frac{d\widehat{\tau^i}}{d\tau^{S^{-i}}}(1 + \widetilde{\tau^i}) + \frac{d\widetilde{\tau^i}}{d\tau^{S^{-i}}}(1 + \widehat{\tau^i}),$$

where $\widehat{\tau^i}, \widetilde{\tau^i} > 0$ for a large borrowing country.

[43] In deriving the expression for ε^{-i}, we exploit the fact that $m^i(c_1^i - y_1^i) = \sum_{j\neq i} m^j (y_1^j - c_1^j)$.

(i) We now prove that $d\widehat{\tau^i}/d\tau^{S-i}$ is always strictly positive. It is

$$\frac{d\widehat{\tau^i}}{d\tau^{S-i}} = \frac{d\widehat{\tau^i}}{dR}\frac{dR^*}{d\tau^{S-i}}.$$

Lemma 1 has proven that $dR^*/d\tau^{S-i} < 0$. We only need to show that $d\widehat{\tau^i}/dR < 0$. Define

$$G(R, \widehat{\tau^i}) \equiv \frac{x'(c_1^i(R, \widehat{\tau^i}) - y_1^i)}{u'(c_1^i(R, \widehat{\tau^i})) - x'(c_1^i(R, \widehat{\tau^i}) - y_1^i)} - \widehat{\tau^i} = 0$$

as the implicit function of $\widehat{\tau^i}$ w.r.t. R when country i is a borrower. By the implicit function theorem, it is

$$\frac{d\widehat{\tau^i}}{dR} = -\frac{\partial G/\partial R}{\partial G/\partial\widehat{\tau^i}}.$$

The numerator writes as

$$\frac{\partial G}{\partial R} = \frac{u'(c_1^i)\cdot x''(c_1^i - y_1^i) - u''(c_1^i)\cdot x'(c_1^i - y_1^i)}{[u'(c_1^i) - x'(c_1^i - y_1^i)]^2}\frac{\partial c_1^i}{\partial R},$$

which is strictly negative, given that $u', x', x'' > 0$, $u'' < 0$, and $\partial c_1^i/\partial R < 0$.

On the other hand, the denominator can be calculated as

$$\frac{\partial G}{\partial\widehat{\tau^i}} = \frac{u'(c_1^i)\cdot x''(c_1^i - y_1^i) - u''(c_1^i)\cdot x'(c_1^i - y_1^i)}{[u'(c_1^i) - x'(c_1^i - y_1^i)]^2}\frac{\partial c_1^i}{\partial\widehat{\tau^i}} - 1,$$

which is also strictly negative. It then follows $d\widehat{\tau^i}/dR < 0$ for all borrowing countries, which completes the proof of part (i).

(ii) We are now going to prove that $d\widetilde{\tau^i}/d\tau^{S-i}$ may be positive or negative. Knowing that $\widetilde{\tau^i} = m^i\cdot\varepsilon^{-i}$, this derivative can be calculated from the implicit function defined by

$$H[\widetilde{\tau^i}, \tau^{S-i}] \equiv m^i\varepsilon^{-i}(\widetilde{\tau^i}, \tau^{S-i}) - \widetilde{\tau^i} = 0.$$

Applying the implicit function theorem to function H, we obtain

$$\frac{d\widetilde{\tau^i}}{d\tau^{S-i}} = -\frac{\frac{dH}{d\tau^{S-i}}}{\frac{dH}{d\widetilde{\tau^i}}} = -\frac{m^i\frac{d\varepsilon^{-i}}{d\tau^{S-i}}}{m^i\frac{d\varepsilon^{-i}}{d\widetilde{\tau^i}} - 1}, \tag{18}$$

which can be positive or negative. In fact, exploiting the expression for ε^{-i} given in

(17), we find that

$$\frac{d\varepsilon^{-i}}{d\tau^{S^{-i}}} = \frac{1}{R}[\underset{>0}{\frac{d(Y_1^{-i}-C_1^{-i})}{d\tau^{S^{-i}}}}(\underset{\lessgtr 0}{\frac{d^2R}{d(Y_1^{-i}-C_1^{-i})^2}}\underset{>0}{\frac{Y_1^{-i}-C_1^{-i}}{R}} + \underset{>0}{\frac{dR}{d(Y_1^{-i}-C_1^{-i})}}) - \underset{<0}{\frac{dR}{d\tau^{S^{-i}}}}\underset{>0}{\varepsilon^{-i}}] \lessgtr 0,$$

and

$$\frac{d\varepsilon^{-i}}{d\widetilde{\tau^i}} = \underset{\lessgtr 0}{\frac{d^2R}{d(Y_1^{-i}-C_1^{-i})d\widetilde{\tau^i}}} - \frac{1}{R}\underset{>0}{\varepsilon^{-i}}\underset{<0}{\frac{dR}{d\widetilde{\tau^i}}} \lessgtr 0.$$

For ease of reference, the sign of each term is reported in the expression above. The sign of expression (18) is then ambiguous as both the numerator and the denominator can be either positive or negative.

5.5 Proof of Corollary

The proof of this statement is immediate given that, as proven in Proposition 3, $d\widehat{\tau^i}/d\tau^{S^{-i}} = (d\widehat{\tau^i}/dR)(dR^*/d\tau^{S^{-i}}) > 0$.

6 Appendix II: Schindler's Index

Schindler (2009) compiles *de jure* indices of inflow and outflow controls using publicly available information from the IMF's Annual Report on Exchange Arrangements and Exchange Restriction (AREAER). Schindler (2009) fully exploits the IMF's post 1996 disaggregated reporting of different categories of capital transaction. The categories covered in his index are as follows:

- Restrictions on transactions in equities (eq), bonds (bo), money market instruments (mm), and collective investments (ci). Transactions are divided into four categories:
  - Purchase locally by nonresidents (plbn)
  - Sale or issue abroad by residents (siar)
  - Purchase abroad by residents (pabr)
  - Sale or issue locally by nonresidents (siln)
- Restrictions on financial credits (fc) are divided into two categories:

- By residents to nonresidents (fco)
- By nonresidents to residents (fci)

- Restrictions on direct investment (di) are divided into three categories:
  - Outward investment (dio)
  - Inward direct investment (dii)
  - Liquidation of direct investment (ldi)

The information contained in the AREAER is coded in binary form, taking a value of 0 (unrestricted) or 1 (restricted). The data can be aggregated in different ways, allowing the construction of capital control sub-indices by asset category, by residency, and by the direction of flows. Sub-indices are aggregated by taking unweighted averages of the subcategories of interest. Indices for outflow controls are constructed for each individual asset category. For example:

$$\text{inflow controls on asset category } i \ (kai_i) = \frac{i_{plbn} + i_{siar}}{2}$$

where i stands for equities, money market instruments, bonds, or collective investment instruments. The aggregate inflow control (kai) is

$$kai = \frac{kai_{eq} + kai_{mm} + kai_{bo} + kai_{ci} + fci + dii}{6}.$$

7 Appendix III: Additional Tables

Table 10. Pairwise Correlation of Different Proxies of Capital Controls

	Schindler Inflow	Schindler General	CAPITAL	CAPIN	FINCONT2
Schindler Inflow	1.000				
Schindler General	0.936	1.000			
CAPITAL	0.734	0.802	1.000		
CAPIN	0.728	0.782	0.934	1.000	
FINCONT2	0.519	0.534	0.497	0.464	1.000

Table 11. Within-group Policy Response with Borrowing Constraint

	(1)	(2)	(3)	(4)	(5)	(6)	Expected Sign
Domestic Variables (Lagged)							
Real GDP growth rate	-0.00171	-0.000935	-0.00201	-0.00134	-0.00125	-0.00203	+
	(0.00799)	(0.00803)	(0.00783)	(0.00768)	(0.00771)	(0.00810)	
Real GDP growth rate shock	0.0101	0.00907	0.0100	0.00901	0.00930	0.0101	-
	(0.00946)	(0.00945)	(0.00944)	(0.00911)	(0.00932)	(0.00969)	
REER overvaluation	-0.0345	-0.0248	-0.0288	-0.0282	-0.0348	-0.0370	-
	(0.140)	(0.147)	(0.140)	(0.143)	(0.140)	(0.142)	
Inflation	0.0508	0.0523	0.0502	0.0504	0.0497	0.0510	+
	(0.0403)	(0.0393)	(0.0412)	(0.0405)	(0.0420)	(0.0416)	
Flexible Exchange Rate	-0.250***	-0.211***	-0.229***	-0.226***	-0.213***	-0.221***	-
	(0.0404)	(0.0338)	(0.0303)	(0.0282)	(0.0302)	(0.0360)	
Real GDP (logged)	0.00209	-0.0455	-0.0862	-0.0759	-0.0861	-0.0678	+
	(0.367)	(0.366)	(0.376)	(0.369)	(0.370)	(0.369)	
External Debt	-0.0226	-0.0125	-0.0169	-0.0160	-0.0175	-0.0187	+
	(0.0359)	(0.0381)	(0.0372)	(0.0372)	(0.0369)	(0.0371)	
Change of Weighted Inflow Controls in the ROG							
Group by geographic location	-0.278						+
	(0.236)						
Group by export specialization		0.0747					+
		(0.171)					
Time-invariant group by growth rate			-0.0610				+
			(0.230)				
Time-variant group by growth rate				-0.0244			+
				(0.0560)			
Time-invariant group by composite risk					-0.207		+
					(0.259)		
Time-variant group by composite risk						0.0189	+
						(0.0766)	
Observations	841	841	841	841	841	841	
R-squared	0.168	0.167	0.165	0.166	0.168	0.166	

Note: The sample consists of 64 countries. GDP per capita and composite risk index are insignificant in all specifications and hence not reported in the table to save space. All regressions control for year fixed effects, group contagionvariables, and country fixed effects. Robust standard errors clustered at country level in parentheses. *** p$<$ 0.01, ** p $<$ 0.05, * $p < 0.1$