Essays on International Capital Flows and Management in Emerging Market Economies

Kyongjun Kwak

A dissertation

submitted in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

University of Washington

2022

Reading Committee:

Yu-chin Chen, Chair

Philip Brock

Brian Greaney

Program Authorized to Offer Degree:

Economics

University of Washington

Abstract

Essays on International Capital Flows and Management in Emerging Market Economies

Kyongjun Kwak

Chair of the Supervisory Committee:
Yu-chin Chen
Department of Economics

In this dissertation, I study international capital flows with a focus on capital flow management measures (CFMs) in emerging market economies (EMEs). In **Chapter 1**, I explain the mechanism of CFMs with optimal tax rates by incorporating the significant increase of gross outflows in EMEs. I construct a simple three-period model of pecuniary externalities where private domestic agents do not consider the effect of borrowing or overseas investment decision on their own financial constraint. The model differs from previous efforts in that it explicitly differentiates gross inflows (i.e., borrowing from foreign investors) from gross outflows (i.e., overseas investment in foreign assets) to reflect the larger role of gross outflows in EMEs. I show that the optimal tax rate on gross inflows is 0.8%p higher when foreign assets are included in the model, which is due to greater unintended side effects of borrowing through the channel of foreign asset prices. The findings generalize previous models by illustrating how externalities can be corrected with Pigouvian tax on borrowing as well as subsidy on overseas investment.

This study also provides new policy insights into CFMs by suggesting separate management of gross inflows and outflows.

In **Chapter 2,** I seek greater insight into the evaluation of CFMs by investigating their impact on income inequality in a small open economy. I focus on the long-term effect of capital flow liberalization on capital income ratio between households and entrepreneurs. Going a step further from the existing model that assumes risk premium of entrepreneurs' external borrowing, I assume that households acknowledge a discount on the returns from their investments in foreign assets, which allows consideration of additional factors such as international transaction costs. According to the findings of this study, capital liberalization of gross inflows and outflows can have opposite impacts on income inequality through returns to capital and savings. Contrary to liberalizing gross outflows of households, liberalizing entrepreneurs' external borrowing (i.e., gross inflows) can contribute to the increase of income inequality. This indicates that managing gross inflows can have a positive distributional effect in the long term, which provides further theoretical understanding of CFMs.

In **Chapter 3**, Camilo Granados[*] and I conduct an empirical study to assess the effectiveness of CFMs in curbing the capital flows' fluctuations in EMEs caused by monetary policy shocks. In particular, we examine i) the extent to which CFMs mitigate the impact of US monetary shocks and ii) whether the mitigating effect differs between net capital flows and gross capital flows. Our results, based on a local projection panel estimation for the period 2000-2018, indicate that CFMs effectively reduce the fluctuations of both gross capital inflows and outflows when there are monetary policy shocks from the US. Our findings also show that the effect is

[*] School of Economics, Policy and Political Sciences. University of Texas at Dallas.

more pronounced when we check in gross flows rather than net. In contrast to the effects in gross flows, the mitigating effects on net flows are ambiguous in most specifications.

TABLE OF CONTENTS

LIST OF FIGURES/TABLES

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my PhD supervisor, Professor Yu-chin Chen, for her constant support and treasured guidance throughout my graduate study. Her invaluable advice led me to explore these topics in international macroeconomics. Without her patience and support, I truly believe I could not have achieved my goals.

I am also deeply indebted to my committee members. I received generous support and encouragement from Professor Philip Brock. His classes also inspired me to pursue topics in international capital flows. Professor Brian Greaney helped expand my vision with new ideas and move forward with his continuous support and feedback. I am also grateful to my GSR member, Professor Stephan Siegel, for insightful comments and kindness.

My appreciation extends to many people who have either directly or indirectly contributed to this study. I would like to thank Professor Fabio Ghironi for his insightful comments and encouragement. I am grateful to the departmental staffs, Simon, Kim and Heidi, for their kind help and support. I also thank my colleagues including Byunghoon, Changgi, Changhun, Dokyung, Euiran, Eunmi, Haeyun, Heejung (Kathy), Hyeonseok, Hyojin (Phil), Jeewon, Jonghyun, Kisan, Nahyeon, Raj, Reina, Seungryul, Sungcheol, Taehoon, Yida, Yoon, Yue and Zihao for a cherished time spent together at UW. My special thanks to Camilo and Daisoon whose knowledge and experience have encouraged me in all time of my research.

Finally, I would like to express my gratitude to my family. Without their tremendous understanding and encouragement, it would have been impossible for me to complete this research.

DEDICATION

To my wife, Yeonsoo.

Chapter 1. OPTIMAL TAX RATES ON GROSS CAPITAL FLOWS

1.1 Introduction

Financial crises, big or small, are usually associated with abrupt and volatile capital movement. When the liberalization of capital flows took place in the 1980s, emerging market economies (EMEs) began to experience a sudden reversal of capital flows or "sudden stops" as advanced economies (AEs) withdrew their invested funds before or during a crisis. In response to sudden stops of capital, EMEs introduced unconventional capital flow management measures (CFMs)—for example, taxing capital inflows to prevent future crises.[1] The role of CFMs was emphasized even further during the 2008 Global Financial Crisis when abundant capital flowed into EMEs due to expansionary monetary policies of AEs. The IMF has also made a change to its stance accordingly: CFMs can be used as a complementary measure to prevent financial crises and promote stable economic growth (IMF, 2012).

In the meantime, macroeconomic studies began to investigate how volatile capital flows can lead to a financial crisis and explore optimal policies that can mitigate the impacts. On the theoretical side, models of externalities provide theoretical tools to explain why capital flows can cause externalities or unanticipated side effects that amplify financial instability. They also examine how managing capital flows with policy measures can correct externalities and result in improved welfare. According to this strand of theoretical literature, excessive borrowing during normal times could render an economy more vulnerable to a financial crisis, providing a "natural

[1] Rebucci and Ma (2019) note that taxes on capital flows have been used countercyclically since the 1990s. For example, Chile imposed a tax on short-term capital inflows from 1991 to 1998 (Forbes, 2007). In the wake of the Global Financial Crisis, many countries (e.g., Brazil) actively utilized taxes on capital flows (Rebucci and Ma, 2019).

rationale" for the taxation of international capital flows (Jeanne and Korinek, 2010). Empirical studies, on the other hand, focus on identifying the drivers of capital flows (e.g., US monetary policy as an external factor and productivity growth as a domestic factor) and analyzing the effectiveness of CFMs. They thus provide important insights from financial and macro data that can enhance theoretical models in terms of practical relevance.

Recently, an increasing volume of empirical studies began to highlight the need to separate capital flow data into gross capital inflows and outflows (Broner et al., 2011; Forbes and Warnock, 2012; Cavallo et al., 2017; Davis and van Wincoop 2018). Most studies on CFMs, particularly theoretical models, only use net capital flows without disaggregating it into gross capital inflows and outflows for the sake of simplicity (Jeanne and Korinek, 2010; Bianchi, 2011; Benigno et al., 2013; Bianchi and Mendoza, 2018). Only few recent models in theoretical studies use gross capital inflows and outflows instead of net flows (Jeanne and Sandri, 2020; Caballero and Simsek, 2020). However, empirical evidence illustrates the importance of using gross flows: gross flows are more volatile compared to net flows and an offsetting relationship exists between gross inflows and outflows, which reduces the fluctuation of net flows. This reflects the reality of EMEs where domestic investors have increased overseas investment (i.e., gross outflows) in the mid-2000s. Thus, the movement of net inflows is often different from that of gross inflows. This implies that traditional modeling with net flows may overlook the role of gross outflows in understanding the underlying mechanism and management of international capital flows. My theoretical model, on the other hand, considers the role of gross outflows by incorporating foreign assets to find the implications for capital flow management in terms of optimal tax rates.

As a benchmark, I follow the theoretical model by Jeanne and Korinek (2010), which derives optimal tax rates based on net capital flows. Unlike their model, this study attempts to find optimal tax rates on *gross* capital flows. My model differs from previous efforts in that it explicitly differentiates gross inflows from gross outflows. By including gross outflows (i.e., foreign assets) in the model, externalities or unintended side effects of gross inflows on financial constraint become more severe via foreign asset prices. Intuitively, increasing the size of international borrowing during normal times will increase the size of repayment, which reduces net worth in the next period. This will tighten the collateral constraint not only via domestic asset prices (as indicated in Jeanne and Korinek (2010) and other models that only use net flows) but also via foreign asset prices. This implies a greater amount of excessive borrowing and thus a social planner should impose a higher tax rate than in a model where gross outflows are not considered.

The contributions of this study are twofold. First, the findings will add to the existing literature on international capital flows and sudden stops as it attempts to bridge the gap between empirical and theoretical literature. Secondly, the results can provide new policy insights on capital flow management. According to the IMF, each country developed its unique CFMs, a majority of which impose different measures on gross capital inflows and outflows.[2] For example, Kazakhstan and Singapore only regulate gross inflows. However, there is little empirical evidence and theoretical reasoning on managing inflows and outflows separately. By deriving and comparing optimal tax rates for gross capital inflows and outflows, my model can provide theoretical support and practical guidelines to countries using CFMs.

[2] According to the IMF 2019 Taxonomy Capital Flow Management Measures, countries introduced different measures to manage capital flows. However, the IMF's definition of gross capital flows does not completely match the definition used in related literature including Forbes and Warnock (2012) and this paper. For example, gross capital inflows in the IMF paper refers to capital flows—including both foreign and domestic—that "enter" home country; whereas in this paper, gross capital inflows indicate "foreign" capital inflows (investments from foreign investors).

1.2 RELATED LITERATURE

This study incorporates both theoretical and empirical literature on capital flows. Theoretically, it builds on the literature on financial crises and international capital flows. Related studies focus on explaining the externalities of international capital flows. According to the theoretical models of externalities, capital flows can create externalities that are not internalized by private agents; they do not consider the effect of their borrowing decision on their own collateral constraint via asset prices. While acknowledging both the benefits and costs of capital flows, this strand of literature emphasizes that some of the benefits and costs are external to private agents.

Models of Externalities

Jeanne and Korinek (2010), for example, use a simple three-period model with collateral constraints to show pecuniary externalities.[3] They find that domestic agents do not internalize their decisions' external effect on the price of collateralized domestic asset in their foreign borrowing limit, which leads to inefficient resource allocation. Bianchi (2011) also finds that pecuniary externalities of capital flows result from the feedback effect between borrowing decisions and financial constraints. The model introduces relative prices between tradable and non-tradable goods; only, non-tradable incomes are pledged as collateral instead of domestic assets.

Some further extensions were made to the existing models. The study by Benigno et al. (2013) incorporates a two sector (tradable and non-tradable) production economy. Bianchi and

[3] There are two types of externalities in the literature: pecuniary and aggregate demand externalities. While the former is associated with financial instability, the latter is often associated with a friction of a price or wage rigidity based on New Keynesian approach. According to the view of aggregate demand externalities, "prudential interventions in financial markets become desirable to manage the expansion to reduce the cost of the contraction" (Rebucci and Ma, 2019, p. 9) as there is a constraint on the optimal use of monetary policy, for example, a liquidity trap or a fixed exchange rate in the contractionary phase of the cycle (see Rebucci and Ma, 2019).

Mendoza (2018), following Jeanne and Korinek's assumption that domestic assets serve as collateral, analyze pecuniary externalities in a dynamic model with price-dependent collateral constraints. They state that "forward-looking nature of asset prices causes the optimal policy under commitment to be time-inconsistent: The regulator promises lower future consumption to prop up current asset prices when the constraint binds, but ex post, keeping this promise is suboptimal" (2018, p. 630). Jeanne and Korinek (2010b, 2019) also study an infinite discrete time model that confirms pecuniary externalities and the role of taxation on foreign debt. According to these models, the market will be able to determine how to allocate capital once the externalities of international capital flows are well identified and regulated (Erten et al., 2019).

The studies on externalities are often linked to the subject of *overborrowing*. Most theoretical models suggest that excessive borrowing occurs in normal times, often triggering a sudden reversal of capital flows in the event of a financial crisis. Thus, an ex-ante tax on capital inflows or foreign borrowing can be used to prevent such sudden stops. Bianchi (2011) as well as Jeanne and Korinek (2010) observe that externalities can lead to overborrowing and a tax on debt will bring welfare gains. Bianchi and Mendoza (2018) confirm the benefits of an optimal tax rate on debt by illustrating overborrowing in their dynamic set-up. Jeanne and Korinek (2010b, 2019) also demonstrate pecuniary externalities, which "always give rise to over-borrowing" and "a state-dependent Pigouvian tax on borrowing or equivalent quantity regulations may induce borrowers to internalize these externalities and increase welfare" (2019, p. 16). Benigno et al. (2013), on the contrary, find that private agents may *underborrow* rather than overborrow in normal times by incorporating production economy subject to a collateral constraint.[4]

[4] They argue there exists two forces that affect the agent's borrowing decision. The first force comes from pecuniary externalities regardless of the existence of production in the model. This ensures the private agent's overborrowing in normal times. The second force, which is the main feature of the model with the two-sector production, comes from the social planner's ability to relax its collateral constraint by raising the price of non-tradable when the constraint

Role of Gross Capital Flows

One of the common features of these existing models of externalities is that net capital flows are used instead of gross capital flows (See Jeanne and Korinek, 2010, 2019; Bianchi, 2011; Benigno et al., 2013; Bianchi and Mendoza, 2018). In other words, they do not differentiate gross inflows and outflows. This may be partly because the models focus on the net worth of indebted agents (Jeanne and Sandri, 2020), and the differentiation between gross inflows and outflows could only add to the complexity of the models. Also, the relative size of gross outflows (by domestic investors) compared to gross inflows (by foreigners) was negligible in EMEs until the 1990s. Thus, the gross outflows of domestic investors were often ignored in literature. However, with further liberalization of capital in the mid-2000s, domestic investors began to play a sizable role in the emerging markets as the volume of their overseas investment increased. The argument for capital controls has intensified accordingly, particularly after the 2008 Global Financial Crisis. As a result, the scope of empirical studies expanded: they began to emphasize the need to differentiate foreigners (i.e., gross inflows) from domestic investors (i.e., gross outflows).

In fact, a growing volume of empirical studies highlight the role of gross inflows and outflows. The study by Forbes and Warnock (2012) paved the way in extending the traditional literature on sudden stops from focusing only on net capital flows movements to differentiating gross capital inflows and outflows. In their study, extreme capital flow movements are classified into four types based on gross flows by foreign and domestic investors: surge, stop, flight and retrenchment. By doing so, Forbes and Warnock attempt to explain why many countries received abnormally high amounts of net capital flows during the Global Financial Crisis. If the episodes

binds with the reallocation of labor hours toward the tradable sector. This tends to make the social planner increase the borrowing compared to the private agent, indicating the private agent's underborrowing in normal times (see Benigno et al, 2013).

are correctly identified based on gross flows, the puzzling behavior of net flows could be explained as driven more by the behavior of domestic agents—rather than foreigners—who returned their overseas investment home (i.e., retrenchment). Broner et al. (2011) observe that gross capitals are not only large but volatile compared to net capital flows. Their study also finds that when foreigners invest in an economy, its domestic agents are more likely to invest abroad and vice versa. A similar point is made by Caballero and Simsek (2020), who state that "empirically, capital outflows are highly correlated with inflows, meaning that local investors come home as foreign investors leave the country" (p. 2289). This implies net capital flows are often less volatile because gross inflows and outflows tend to offset each other.

In the same vein, Davis and van Wincoop (2018) provide empirical evidence that financial globalization has significantly strengthened the correlation between gross capital inflows and outflows in both AEs and EMEs. Similarly, according to the IMF (2013), EMEs that are found to be relatively resilient against capital flow fluctuations are the ones that were able to offset foreign (gross) capital inflows with resident (gross) outflows. Additional support for this argument comes from Cavallo et al. (2017), who observe that sudden stops can be prevented if domestic investors repatriate some of their foreign investment when foreigners stop lending. These empirical findings shed light on the importance of differentiating gross inflows and outflows to understand and hence draw policy implications.

However, only a couple of very recent theoretical models have attempted to do distinguish gross capital inflow and outflows. Jeanne and Sandri (2020), for example, use a simple three-period model with a focus on the role of foreign reserves by private sector (as opposed to public foreign reserves). In their model, domestic investors still borrow from foreign investors only by issuing domestic bonds. Domestic agents choose the amount of illiquid domestic investment projects and liquid foreign assets. Holding liquid foreign assets in cash implicitly corresponds to increasing gross outflows in their model. Under this set-up, they derive unconventional outcome of underborrowing in normal times. Thus, it is optimal to increase international borrowing to accumulate foreign liquidity, which increases the price of domestic bond. Caballero and Simsek (2020) also present a model of gross capital flows where fickle global investors cause surges and retrenchments in capital flows. Interestingly, they introduce two types of domestic agents, banks and distressed sellers, whereas Jeanne and Sandri suppose a representative domestic agent.

The model of the present study shares similar features to the models above, especially Jeanne and Sandri (2020). I also use a simple three-period model with pecuniary externality that includes asset prices in the collateral constraints. However, unlike Jeanne and Sandri (2020) who use a preference shock, I use an endowment shock following the model of Jeanne and Korinek (2010). More importantly, Jeanne and Sandri implicitly assume that the domestic country receives funds from a foreign country and domestic agents partly save the funds as liquid cash as private reserves. The present study, however, allows that domestic investors can actively invest abroad. While Jeanne and Sandri's model shows underborrowing that requires a subsidy for borrowing, I derive the typical overborrowing and positive optimal tax rates with my model. Also, the focus of this study is on finding optimal tax rates on gross inflows and outflows, unlike Caballero and Simsek (2020) where the focus is on policy coordination among countries and the policy instruments are simplified to binary options (either allow or ban capital inflows).

1.3 THE MODEL

1.3.1 *Baseline Model*

Set up

As a benchmark, I use Jeanne and Korinek (2010)'s simple three-period model. The model is not only a seminal work in the literature of capital flows but also simple and clear to focus on the implication of incorporating gross capital flows instead of net capital flows. Following their model, I assume a small open economy with identical domestic agents (normalized to one) in a one-good world. The domestic agent borrows from foreign investors in period 0 and makes a repayment in periods 1 and 2. In period 1, the agent's ability to roll over debt may be restricted by a collateral constraint. For example, if the domestic agent borrows too much (overborrow) and high volume of capital inflows moves into the economy in period 0, then the corresponding amount of repayment should be returned to foreigners in periods 1 and 2. An endowment shock in period 1 can tighten the collateral constraint, and if binding, the shock may trigger a sudden reversal of capital flows or a sudden stop.

The domestic agent initially owns one unit of domestic assets, and the price of domestic assets in period t is denoted by P_t. Domestic asset market is assumed to be perfectly competitive but only accessible to the domestic agent. According to Jeanne and Korinek (2010, 2010b), the rationale behind the restriction that foreign investors cannot buy or sell domestic assets is that foreigners "have a strong comparative disadvantage in managing it" (2010, p. 403). Also, domestic agents "derive benefits from the control rights that ownership provides" (2010b, p. 6). I make an additional assumption that the domestic agent not only borrows from foreigners, but also invests in foreign asset markets. The resident's overseas investment can be rationalized by, for example, an international asset diversification motive.[5] I assume that the domestic agent does not own any foreign asset in period 0, and the price of foreign asset in period t is denoted by Q_t. Foreign asset market is assumed to be accessible to the domestic agent.[6]

An endowment of income *e* is revealed and obtained in period 1. The long-term, two-period investment on domestic projects yields fixed return y that materializes in period 2. Based on Jeanne and Korinek (2010), I assume that only return y, not endowment *e*, can serve as collateral on borrowing from foreigners in period 1. Due to the collateral constraint, the endowment shock (low realization) of *e* may trigger sudden stops of capital. This utility form enables to fix its period-2 marginal utility of consumption to one. The normalized riskless world interest rate is set at zero. The first-best level of consumption must be the same in periods 0 and 1, and therefore given by c^* that satisfies equal marginal utility of consumption, $u'(c^*) = 1$. Under these assumptions, the representative domestic agent maximizes own lifetime utility subject to the budget constraints in periods 0 to 2 and the collateral constraint in period 1 as follows:

$$U = u(c_0) + u(c_1) + c_2 \tag{1.1}$$

$$c_0 + \gamma_1 Q_0 = d_1^i + (1 - \theta_1) P_0 \quad \text{(where } \gamma_1 Q_0 = d_1^o\text{)} \tag{1.2}$$

$$c_1 + d_1^i = e + d_2^i + (\theta_1 - \theta_2) P_1 + (\gamma_1 - \gamma_2) Q_1 \quad \text{(where } \gamma_2 Q_1 = d_2^o\text{)} \tag{1.3}$$

$$c_2 + d_2^i = \theta_2 y + \gamma_2 Q_2 \tag{1.4}$$

$$d_2^i \leq \theta_1 P_1 + \gamma_1 Q_1. \tag{1.5}$$

[5] Caballero and Simsek (2020) state in their study that "an extensive literature studies capital flows in frictionless models of international risk sharing (see, e.g., Grubel, 1968; Cole and Obstfeld, 1991; van Wincoop, 1994; Lewis, 2000; Coeurdacier and Rey, 2013). The main reason for diversification in our paper is different from the reasons highlighted in this literature. In our model, investments abroad provide valuable liquidity to local banks during fire sales" (Caballero and Simsek, 2020, p. 2291).

[6] This asymmetry can be explained with the modeling of domestic and foreign countries after EMEs and AEs, respectively. It may be more likely for EME's agents to access AE's asset markets and vice versa due to factors such as different financial openness or institutional development.

d_t^i is the debt to be repaid at the beginning of period t and this amount corresponds to gross capital *inflows* in period t-1, so I use the superscript 'i.' Also, d_t^o is the amount of gross capital *outflows* in period t-1 using superscript 'o.' Then, net capital inflows in period t-1 can be defined as $\mathrm{d}_1 \left(\equiv d_1^i - d_1^o\right)$. Using net capital flows, the budget constraints are essentially the same as the Jeanne and Korinek's model. θ_t is the quantity of the domestic collateral held by the domestic agent at the beginning of period t.[7] According to Jeanne and Korinek, since domestic collateral asset cannot be sold to foreigners, θ_t must be equal to 1 in a symmetric equilibrium where all domestic agents behave in the same way.

Here, I make an additional assumption that γ_t is the quantity of the foreign asset held by the domestic agent at the beginning of period t with price Q_t. Since foreign assets can be sold to domestic agents, there is no restriction that γ_t must be one in a symmetric equilibrium. Also, the foreign asset is purchased by the domestic agent in period t-1 with price Q_{t-1}. Therefore, the amount of gross capital *outflows*, d_t^o equals $\gamma_t \mathrm{Q}_{t-1}$. The domestic agent faces a collateral constraint as in Equation (5), the micro-foundation being that the domestic agent can walk away from the agent's own debt when foreigners seize the agent's domestic asset and sell it to another domestic agent in the domestic asset market with price P_1. I make an additional assumption that the foreign asset held by the domestic agent can also be pledged as collateral. It has a similar micro-foundation: foreigners can seize the foreign asset and sell it to other foreigners in the foreign asset market with price Q_1.[8]

[7] According to Jeanne and Korinek (2010), "Domestic agents can buy or sell the domestic asset in a perfectly competitive domestic market, but in a symmetric equilibrium we must have $\theta_1 = 1$" (p. 404).
[8] The ability as collateral can be different between domestic and foreign assets. This asymmetry is explained in detail in the extension part.

Competitive Equilibrium (Laissez-faire)

The competitive (laissez-faire) equilibrium is solved using backward induction based on the benchmark model. A decentralized domestic agent makes decisions in periods 0 and 1 by determining the amount of borrowing (gross capital inflows), domestic asset holding, and foreign asset holding (gross capital outflows) for each period. Taking net worth $m_1(\equiv e - d_1^i + \gamma_1 Q_1 \equiv m_1^i + \gamma_1 Q_1)$ as given,[9] the domestic agent solves for the period-1 equilibrium first:

$$V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u(c_1) + c_2 + \lambda_{ce}\left(\theta_1 P_1 + \gamma_1 Q_1 - d_2^i\right), \text{ or}$$

$$\begin{aligned} V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} & \, u\left(e - d_1^i + d_2^i + (\theta_1 - \theta_2)P_1 + (\gamma_1 - \gamma_2)Q_1\right) \\ & + \theta_2 y + \gamma_2 Q_2 - d_2^i + \lambda_{ce}\left(\theta_1 P_1 + \gamma_1 Q_1 - d_2^i\right) \end{aligned} \tag{1.6}$$

where λ_{ce} is the shadow cost of the collateral constraint. The first-order condition (FOC) for θ_2 gives asset pricing equation for domestic asset, $P_1 = y/u'(c_1)$. This implies that domestic asset price in period 1 equals its expected return of domestic asset times the marginal utility of consumption in period 2 (equal to 1 from the lifetime utility form) divided by the marginal utility of consumption in period 1. Similarly, the FOC for γ_2 provides foreign asset pricing equation, $Q_1 = Q_2/u'(c_1)$. This means foreign asset price in period 1 is determined at which expected period-2 price of foreign asset times the marginal utility of consumption in period 2 divided by the marginal utility of consumption in period 1.[10] Finally, the FOC for d_2^i implies $u'(c_1) = 1 + \lambda_{ce}$.

---

[9] Note that the value of holding foreign asset is evaluated with current period-1 price of foreign asset, Q_1, not Q_0.

[10] Although the domestic country is a small open economy, the domestic agent's overseas investment determines the price of foreign assets in this model, which may not be the case. It is more reasonable to assume that foreign asset price is partially, not solely, affected by domestic investors. To reflect this concern, I can incorporate some exogenous parameters (e.g., EME's share in AE's asset market or financial openness) that restricts the range of γ_t, that weakens the impact on foreign asset price. Or, I can also incorporate an endogenous premium of foreign asset price into the model. In this setup, if domestic agent increases overseas investment, due to the ensuing high demand, domestic agents

If the equilibrium is unconstrained (i.e., $\lambda_{ce} = 0$), then $c_1 = c^*$ and thus $P_1 = y$ and $Q_1 = Q_2$.[11] The focus of this study is on the constrained equilibrium where collateral constraint is binding (i.e., $\lambda_{ce} > 0$). By substituting out $d_2^i = \theta_1 P_1 + \gamma_1 Q_1$, the budget constraint in period 1 becomes:

$$c_1 = m_1^i + (2\theta_1 - \theta_2)P_1 + (2\gamma_1 - \gamma_2)Q_1 \quad \text{(where } m_1^i \equiv e - d_1^i\text{), or}$$
$$c_1 = m_1 + (2\theta_1 - \theta_2)P_1 + (\gamma_1 - \gamma_2)Q_1 \quad \text{(where } m_1 \equiv m_1^i + \gamma_1 Q_1\text{).} \quad (1.7)$$

If I assume $\theta_t = 1$ in equilibrium, the equations above can be re-written by substituting domestic and foreign asset pricing equations:

$$c_1 = m_1^i + \frac{y + (2\gamma_1 - \gamma_2)Q_2}{u'(c_1)} \quad \text{or} \quad c_1 = m_1 + \frac{y + (\gamma_1 - \gamma_2)Q_2}{u'(c_1)}. \quad (1.8)$$

One point worth noting here is that if I assume that $\gamma_1 = \gamma_2$, i.e., the domestic agent invests in foreign assets and re-invest them all in period 1 (and holds them until period 2), the second equation in (8) presents the same formula in Jeanne and Korinek (2010) as below:

$$c_1 = m_1^i + \frac{y + \gamma_1 Q_2}{u'(c_1)} \quad \text{or} \quad c_1 = m_1 + \frac{y}{u'(c_1)}. \quad (1.9)$$

---

will be required to pay a premium although foreign asset price without the premium does not change ($\tilde{Q} = \bar{Q}$ + premium). This setup can align with the basic premise that a small open economy takes world prices as given and would not affect them. While keeping in mind this limitation of the present model, I still assume that foreign asset pricing depends on resident's overseas investment for the sake of simplicity. This may be analogous to "semi-small" open economy models in the international trade literature, which assumes monopolistically competitive domestic producers (e.g., Justiniano and Preston, 2010), or finance literature, which introduces endogenous risk premium (e.g., Lubik, 2007).

[11] According to Jeanne and Korinek (2010), this can happen "if and only if the value of collateral (or net worth) is high enough to cover period-2 debt" (p. 404).

This is consistent with the general notion that the model using gross capital flows will simply be a direct generalization of the model using net capital flows. Yet by focusing on the first equation in (9) using net worth defined as m_1^i ($\equiv e - d_1^i$), which only considers the endowment minus debt repayment in period 1, the results explicitly indicate that foreign asset price also plays a role in a similar way as domestic asset price does in decision making.[12]

Without imposing the additional assumption of $\gamma_1 = \gamma_2$, Equation (8) will be used hereafter as a general setup. As c_1 increases, the left-hand-side of Equation (8) increases along the 45-degree line, and the right-hand-side also increases assuming the typical decreasing marginal utility of consumption with $u'(c) > 0$ and $u''(c) < 0$. This is consistent with Jeanne and Korinek (2010). To rule out the multiplicity, I assume that the slope of the right-hand-side is smaller than 1.[13] Then, the left and right sides intersect only once at $c_1 = c^*$. In this set up, a small decrease in endowment e in period 1 will tighten the collateral constraint, thus reducing the period-1 consumption level. This means that the current marginal utility of consumption in period 1 increases against the next period consumption. This will affect both domestic and foreign asset prices. The domestic agent becomes less likely to invest in any assets since the agent highly values current period-1 consumption compared to period-2 consumption. Thus, both asset prices in period 1, $P_1 = y/u'(c_1)$ and $Q_1 = Q_2/u'(c_1)$ will decrease, again leading to the tightening of the collateral constraint. Jeanne and Korinek (2010) explains this as "the general mechanism behind standard models of financial acceleration or debt deflation" (p. 404).

[12] This suggests that pecuniary externalities can arise from the impact on foreign asset prices as well as domestic asset prices in the collateral constraint, which is discussed later.

[13] $(y + (2\gamma_1 - \gamma_2)Q_2)\frac{d(1/u'(c))}{dc} < 1$. Since $Q_2 > 0$ and $(2\gamma_1 - \gamma_2) > 0$, the slope of the right-hand-side in this study is steeper than that in Jeanne and Korinek (2010)'s model, $y\frac{d(1/u'(c))}{dc} < 1$. This implies that the condition in this study is more difficult to satisfy than the benchmark model.

In period 0, anticipating the period-1 equilibrium, the representative domestic agent solves period-0 maximization problem as below:

$$\mathcal{L}_{ce} = \max_{d_1^i, \gamma_1, \theta_1} u(c_0) + E_0 V_{ce}(m_1)$$

$$\text{where } V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u(c_1) + c_2 + \lambda_{ce}\left(\theta_1 \overline{P_1} + \gamma_1 \overline{Q_1} - d_2^i\right). \quad (1.10)$$

One essential feature in the literature of pecuniary externalities is that the decentralized agent takes the asset prices as given. Following this, I also assume that the agent does not internalize the impact of the agent's own borrowing or overseas investment decision in period 0 on asset prices in the collateral constraint in period 1. The FOC with respect to d_1^i gives $u'(c_0) = E_0[u'(c_1)]$, and this equation can determine period-0 equilibrium borrowing, d_1^i. Since the left-hand-side decreases and the right-hand-side increases in d_1^i, a unique solution can be derived. The FOCs for θ_1 and γ_1 provide asset pricing equations, respectively.[14] As already noted, I assume $\theta_t = 1$ in equilibrium, implying that domestic agents always invest in long-term domestic projects and hold them until period 2.

Social Planner Allocation

A constrained social planner faces the same lifetime utility function and constraints as decentralized domestic agents. The only difference from the competitive equilibrium is that the social planner internalizes asset pricing equations when making a decision in period 0. That is, the social planner considers the impact of borrowing decisions in period 0 on the asset prices and

[14] $P_0 = E_0[\{2u'(c_1) + \lambda_{ce}\}\overline{P_1}]/u'(c_0)$, $Q_0 = E_0[\{2u'(c_1) + \lambda_{ce}\}\overline{Q_1}]/u'(c_0)$

hence the collateral constraint in period 1. Using backward induction, the social planner chooses the same allocation in period 1 as in a competitive equilibrium. Denoting λ_{sp} as the shadow cost on the collateral constraint for the social planner, the FOC for d_2^i in period 1 is similar to that of competitive equilibrium, $u'(c_1) = 1 + \lambda_{sp}$. I can write the same reduced form for period-1 equilibrium consumption and asset prices as increasing functions of net worth, $c(m_1), P(m_1)$ and $Q(m_1)$. Anticipating this period-1 equilibrium, the social planner solves period-0 maximization problem as below:

$$\mathcal{L}_{sp} = \max_{d_1^i, \gamma_1, \theta_1} u(c_0) + E_0 V_{sp}(m_1)$$

$$\text{where } V_{sp}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u\big(c(m_1)\big) + c_2 + \lambda_{sp}\big(\theta_1 P(m_1) + \gamma_1 Q(m_1) - d_2^i\big) \qquad (1.11)$$

by internalizing $P(m_1) = y/u'(c_1)$ and $Q(m_1) = Q_2/u'(c_1)$. The FOC for d_1^i gives $u'(c_0) = E_0\big[u'(c_1) + \ \lambda_{sp}\{\theta_1 P'(m_1) + \gamma_1 Q'(m_1)\}\big]$. Since both asset prices increase the function of net worth, m_1 $(P', Q' > 0)$ and the focus is on the equilibrium with binding collateral constraint $(\lambda_{sp} > 0)$, the social planner will make the agents consume less and borrow less in period 0 compared to a decentralized economy. In other words, private agents who do not internalize the impact of their borrowing decision will borrow too much in period 0 (normal times). This confirms the previous findings of overborrowing by using gross capital flows.

Furthermore, the FOC for d_1^i determines the social planner's allocation depending on foreign asset prices as well as domestic asset prices. This means there can be another source of pecuniary externalities. For example, if a decentralized domestic agent borrows one additional unit so that the agent needs to repay in period 1, which pressures to reduce period-1 consumption. Thus, marginal utility of period-1 consumption becomes relatively higher than before so that the domestic agent is not likely to invest in any assets. Hence the decrease in both asset prices. A decline in foreign asset prices as well as in domestic asset prices will tighten the collateral constraint. Since the decentralized agent does not consider these external effects on any asset prices, pecuniary externalities arise from both domestic and foreign asset prices in the collateral constraint of the present model.

Pigouvian Tax on Gross Capital Inflows (Borrowing)

Externalities can be corrected by Pigouvian taxation on foreign borrowing, as widely suggested by the models that use net flows. I first focus on taxation on borrowing in comparison with the benchmark model, and then consider tax-cum-subsidy on overseas investment. The optimal level of borrowing (gross inflows) can be implemented in a decentralized economy with a tax rate τ_1^i on period-0 borrowing d_1^i and the tax is rebated in a lump-sum fashion. Recall that d_1^i is the debt to be repaid at the beginning of period t and this amount corresponds to gross inflows in period t-1. I assume that the tax is levied when gross inflows move into the domestic economy in period 0 and reduce the amount of borrowing at hand for the domestic agent. The timing of taxation implies an *ex-ante* policy in normal times. The budget constraints in periods 0 and 1 are now modified as follows:

$$c_0 + \gamma_1 \mathrm{Q}_0 = (1 - \tau_1^i) d_1^i + (1 - \theta_1) \mathrm{P}_0, \tag{1.12}$$

$$c_1 + d_1^i = e + d_2^i + (\theta_1 - \theta_2) \mathrm{P}_1 + (\gamma_1 - \gamma_2) \mathrm{Q}_1 + Transfer. \tag{1.13}$$

Anticipating the same period-1 equilibrium, the representative domestic agent under the Pigouvian tax solves period-0 maximization problem again in period 0:

$$\mathcal{L}_{ce} = \max_{d_1^i, \gamma_1, \theta_1} u\big((1-\tau_1^i)d_1^i + (1-\theta_1)\mathrm{P}_0 - \gamma_1 \mathrm{Q}_0\big) + E_0 V_{ce}(m_1)$$

$$\text{where } V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u(c_1) + c_2 + \lambda_{ce}\big(\theta_1 \overline{P_1} + \gamma_1 \overline{\mathrm{Q}_1} - d_2^i\big). \qquad (1.14)$$

The FOC with respect to d_1^i gives $u'(c_0) = E_0[u'(c_1)]/(1-\tau_1^i)$. The optimal tax rate can be obtained by equating two FOCs for d_1^i under laissez-faire and social planner's allocation: $u'(c_0) = E_0[u'(c_1)]/(1-\tau_1^i) = E_0\big[u'(c_1) + \lambda_{sp}\{\theta_1 P'(m_1) + \gamma_1 Q'(m_1)\}\big]$. This yields optimal tax rate on borrowing as follows:

$$\tau_1^{i,*} = \frac{E_0\big[\lambda_{sp}\{\theta_1 P'(m_1) + \gamma_1 Q'(m_1)\}\big]}{E_0\big[u'(c_1) + \lambda_{sp}\{\theta_1 P'(m_1) + \gamma_1 Q'(m_1)\}\big]}. \qquad (1.15)$$

If I do not consider foreign assets in the model (i.e., $\gamma_1 Q'(m_1) = 0$), the optimal tax rate in Equation (15) is basically consistent with the optimal tax rate in Jeanne and Korinek (2010).[15]

I use a numerical illustration in order to compare the results between this study and Jeanne and Korinek (2010). I follow the same set-up as their study by using log utility form and uniformly distributed endowment shocks on $[\bar{e} - \varepsilon, \bar{e} + \varepsilon]$ and the same parameter values ($\bar{e} = 1.3$, $y = 0.8$), but I additionally estimate γ_1 (=0.04) and assume that $\gamma_1 = \gamma_2$ and $\mathrm{Q}_2 = \mathrm{Q}_0 = y$ for simplicity.[16] With the latter assumption on Q_2, I eliminate the search-for-yield motives of domestic agents. I find that given the same endowment shocks with 10% maximum deviation ($\varepsilon \cong 0.13$) from the mean, $\bar{e}$, optimal tax rate on borrowing (gross inflows) is around 2.1%. When I restrict

[15] According to Jeanne and Korinek (2010), $\tau = \frac{E_0[\lambda_{sp} P'(m_1)]}{E_0[u'(c_1)]}$ where $1 + \tau \equiv \frac{1}{1-\tau^i}$. Hence, $\tau^{i,*} = \frac{E_0[\lambda_{sp} P'(m_1)]}{E_0[u'(c_1) + \lambda_{sp} P'(m_1)]}$.

[16] See Appendix B for a detailed numerical illustration.

$\gamma_1 = 0$ to exclude the foreign asset channel, the optimal tax rate is only 1.3%, which is the same as Jeanne and Korinek (2010). This shows that when considering gross outflows, the optimal tax rate on gross inflows should be (0.8%p or 57%) higher due to larger externalities or unintended side effects of borrowing via the foreign asset price channel.

Tax-cum-Subsidy on Gross Capital Outflows (Overseas Investment)

In addition to a tax on gross capital inflows (borrowing), one might consider a tax (or subsidy) on gross capital outflows.[17] I assume that a tax is levied when gross outflows move to the foreign asset market in period 0 and increase the amount of expenditure on overseas investment for the domestic agent from $\gamma_1 Q_0$ to $(1 + \tau_1^o)\gamma_1 Q_0$.[18] Since the domestic tax authority imposes this tax on the domestic investor, the actual amount of gross capital outflows is still measured by the quantity purchased by the domestic agent times foreign asset price, $\gamma_1 Q_0$. Thus, a tax rate τ_1^o on period-0 overseas investment $d_1^o (= \gamma_1 Q_0)$ can be included in the budget constraints with the tax on borrowing and adjusted lump-sum transfer in periods 0 and 1 as follows:

$$c_0 + (1 + \boldsymbol{\tau_1^o})\gamma_1 Q_0 = (1 - \boldsymbol{\tau_1^i}) d_1^i + (1 - \theta_1) P_0, \tag{1.16}$$

$$c_1 + d_1^i = e + d_2^i + (\theta_1 - \theta_2) P_1 + (\gamma_1 - \gamma_2) Q_1 + Transfer'. \tag{1.17}$$

[17] Domestic countries do have policy tools to control its domestic residents' overseas investment. Those regulations that deter the overseas investment can be replaced with tax on gross capital outflows, and on the contrary, policy encouragements can be modeled as subsidy (negative tax).

[18] I can also extend the study by considering the timing of taxation on gross outflows. Since domestic tax authorities can impose tax on domestic residents' earnings from foreign asset market when returned, period 1 (ex-post) taxation can be a more natural way to tax gross outflows. Moreover, since foreign asset prices in periods 0 and 1 are different, timing of taxation on gross outflows can be an important issue in making an investment decision.

In period 0, the representative domestic agent solves period-0 maximization problem below:

$$\mathcal{L}_{ce} = \max_{d_1^i,\gamma_1,\theta_1} u\big((1-\boldsymbol{\tau_1^i})d_1^i + (1-\theta_1)P_0 - (1+\boldsymbol{\tau_1^o})\gamma_1 Q_0\big) + E_0 V_{ce}(m_1)$$

$$\text{where } V_{ce}(m_1) = \max_{d_2^i,\gamma_2,\theta_2} u(c_1) + c_2 + \lambda_{ce}\big(\theta_1\overline{P_1} + \gamma_1\overline{Q_1} - d_2^i\big). \qquad (1.18)$$

The FOC with respect to d_1^i gives $u'(c_0) = E_0[u'(c_1)]/(1-\tau_1^i)$, which does not depend on τ_1^o. Thus, tax (> 0) on gross outflows does not affect gross inflows in this setup, while it reduces gross outflows.[19] A decrease in gross outflows leads to lower net worth in period 1, which may trigger the downward spiral through collateral constraint. On the contrary, a negative tax, i.e., a subsidy, can work in the opposite direction by raising net worth in period 1. As a result, it can be inferred that the subsidy on gross outflows, together with the tax on gross inflows, can effectively correct pecuniary externalities. Also, policy implications can be drawn: a country can operate two separate CFMs on gross inflows and outflows.

This type of policy intervention, which raises the net worth in period 1, is also considered in previous literature. For example, Jeanne and Korinek (2010) discuss bailouts. They note that bailouts during a crisis are "another common policy instruments that aim to loosen binding constraints by directly transferring resources to constrained agents" (p. 406). Also, bailouts have two important limitations: lack of resources for bailouts and moral hazard concerns (when bailouts are anticipated, agents increase borrowing). Unlike bailouts during a crisis, an ex-ante subsidy on

[19] The foreign asset price in period 0 is affected by the tax on outflows: $Q_0 = E_0\big[\{2u'(c_1) + \lambda_{lf}\}\overline{Q_1}\big]/(1+\tau_1^o)u'(c_0)$. For example, increasing a tax rate (> 0) on outflows implies reducing the foreign asset price in period 0. Therefore, even if I assume that γ_1 is fixed, the actual amount of gross capital outflows, $\gamma_1 Q_0$, decreases accordingly, while after-tax expenditure on overseas investment, $(1+\tau_1^o)\gamma_1 Q_0$, remains the same.

gross outflows in normal times can work in a similar way without raising concerns of moral hazard.[20]

This study is also closely related to the recent study by Jeanne and Sandri (2020), which use gross flows. Although the present study shares common features with their model under the three-period model with collateral constraints, as stated earlier, there are also differences in the setup such as different shocks (endowment versus preference shock). Also, while foreign assets are considered as private foreign reserves in Jeanne and Sandri's model, I regard foreign assets as an active overseas investment. Jeanne and Sandri suggest that the accumulation of private reserves can help raise domestic asset prices that loose collateral constraint in a crisis. In other words, the decentralized private agents only accumulate little foreign assets as they do not internalize the positive external benefits of reserves. In Jeanne and Sandri's study, the overall size of borrowing should be increased to accumulate more private foreign reserves. Therefore ironically, due to the positive externalities of private reserves, private agents underborrow during normal times, which is contrary to the conventional wisdom. The present study confirms overborrowing results in normal times, while positive externalities from residents' overseas investment partially offset negative externalities from borrowing.[21]

[20] The concern over resources for subsidy remains. However, this issue can be alleviated by also using Pigouvian taxation on gross inflows. This may raise a distributional issue between borrowers (taxpayers) and investors (subsidy recipients), which is not the case in this model with one representative identical domestic agent.

[21] According to Jeanne and Sandri's model, public foreign reserves can also work to correct positive externalities. Public foreign reserves as well as currency swaps can complement or substitute the subsidy on overseas investment by relaxing collateral constraints in a crisis.

1.3.2 *Extension: Asymmetry of Collateralizability*

The baseline model assumes that both domestic and foreign assets can serve as collateral. It is also implicitly assumed that their role as collateral is basically the same as long as they have the same market value. In reality, one type of asset can possess hidden perks compared to another type of asset. For instance, suppose that a country holds two types of foreign assets that have the same market value—one being the export proceeds payable under specific sales contract and the other being US Treasury Bill. Even if the assets have the same market value, their actual value as collateral can differ. Foreign creditors would prefer the US Treasury Bill since it is safe and highly tradable, and hence easily seized and sold in case of default. Thus, it can be viewed that this type of foreign assets can have better ability as collateral (collateralizability or pledgeability) than other types of foreign assets. Similarly, domestic assets can also have different collateralizabilities by type. This indicates, in general, there can be an asymmetry in the "relative" ability of domestic and foreign assets as collateral in the baseline model.

As an extension of the baseline model, I consider this asymmetry of ability as collateral between domestic and foreign assets. Since this study use both gross inflows and outflows unlike previous models using only net flows, the asymmetry can be explicitly incorporated into the model. Specifically, I add parameters κ^d and κ^f as coefficients of domestic and foreign collateral assets in the collateral constraint, which reflect the ability as collateral. Thus, the collateral constraint (5) becomes as follows:

$$d_2^i \leq \kappa^d \theta_1 P_1 + \kappa^f \gamma_1 Q_1. \tag{1.19}$$

To note, I restrict that $\kappa^d = \kappa^f (\equiv \tilde{\kappa})$. Then, the constraint becomes $d_2^i \leq \tilde{\kappa}(\theta_1 P_1 + \gamma_1 Q_1)$, which shows partial pledgeability of both domestic and foreign collateral assets. The fact that assets can only partially serve as collateral can be also found in the previous studies (e.g., Benigno et al., 2013, Fornaro, 2015; Jeanne and Sandri, 2020). By allowing the difference between κ^d and κ^f, this extension can generalize the existing models to the case of asymmetry of collateralizability between domestic and foreign assets.[22] Without the loss of generality, by normalizing κ^d to be one, $\kappa^f\,(\equiv \kappa)$ alone captures the degree of asymmetry. Then, the collateral constraint (19) becomes

$$d_2^i \leq \theta_1 P_1 + \kappa\gamma_1 Q_1 \tag{1.20}$$

where κ is assumed to be greater than 0. $\kappa = 1$ (i.e., no asymmetry) provides the same collateral constraint in the baseline model. If κ is less than 1, foreign assets are worth less to foreign creditors as collateral compared to domestic assets (e.g., export proceeds payable under the sales contract). If κ is larger than 1, foreign assets are worth more to foreign creditors as collateral compared to domestic assets (e.g., US Treasury Bill). In the meantime, the formulas for budget constraints remain the same. This is because I assume that κ can change the ability as collateral only, thus it does not change the formulas for expenditure on foreign asset in period 0, $\gamma_1 Q_0$, nor retrenchment value of foreign asset in period 1, $\gamma_1 Q_1$.[23]

With the new collateral constraint, the results are slightly affected. In period 1, the competitive equilibrium is determined based on the equation as follows:[24]

$$c_1 = m_1^i + \frac{y + ((1+\kappa)\gamma_1 - \gamma_2)Q_2}{u\prime(c_1)} \qquad \text{or} \qquad c_1 = m_1 + \frac{y + (\kappa\gamma_1 - \gamma_2)Q_2}{u\prime(c_1)}. \tag{1.21}$$

---

[22] Bianchi (2011) also includes separate fraction parameters κ^T and κ^N in the collateral constraint for tradable and non-tradable incomes respectively.

[23] This setup causes that net worth, $m_1(\equiv e - d_1^i + \gamma_1 Q_1 \equiv m_1^i + \gamma_1 Q_1)$ in period 1 does not depend on the size of κ.

[24] The derivation is provided in Appendix A.

The slope of the right-hand-side of Equation (21) is positively related to the size of κ. For example, when κ is greater than 1, the constrained equilibrium level of period-1 consumption increases. Intuitively, when foreign assets gain better ability as collateral, this can loosen the collateral constraint in period 1 so that consumption can be increased.

In period 0, the FOC with respect to d_1^i gives $u'(c_0) = E_0[u'(c_1)]$ where $c_0 = d_1^i + (1-\theta_1)P_0 - \gamma_1 Q_0$ and $c_1 = (e - d_1^i) + (2\theta_1 - \theta_2)P_1 + \big((1+\kappa)\gamma_1 - \gamma_2\big)Q_1$. Based on Jeanne and Korinek's model (2010), the equilibrium level of borrowing can be uniquely determined since both sides of the condition is decreasing in d_1^i. The borrowing increases with larger κ.[25] This can be interpreted that the anticipation of a loose collateral constraint in period 1 makes the domestic agent borrow more in period 0.

The social planner, who internalizes the impact of borrowing on asset prices in the collateral constraints, will decide the optimal level of borrowing using following FOC for d_1^i: $u'(c_0) = E_0\big[u'(c_1) + \lambda_{sp}\{\theta_1 P'(m_1) + \kappa\gamma_1 Q'(m_1)\}\big]$. Focusing on constrained equilibrium with binding collateral constraint ($\lambda_{sp} > 0$), it can be inferred that in the case of large κ (> 1), the social planner will make the agents consume and borrow even less in period 0 than laissez-faire decision in Jeanne and Korinek's model (2010). This suggests that external effects can be intensified, requiring the social planner to impose a higher Pigouvian tax on borrowing. That is, optimal tax

[25] The optimal level of d_1^i satisfies the condition: $u'\big(d_1^i + (1-\theta_1)P_0 - \gamma_1 Q_0\big) = E_0\big[u'\big((e - d_1^i) + (2\theta_1 - \theta_2)P_1 + ((1+\kappa)\gamma_1 - \gamma_2)Q_1\big)\big]$. Thus, κ is positively related to d_1^i.

rate on borrowing ($\tau_1^{i,*}$) should be an increasing function of κ, and this can be confirmed in the formula for optimal tax rates as below and generalizes the baseline model.[26]

$$\tau_1^{i,*} = \frac{E_0[\lambda_{sp}\{\theta_1 P\prime(m_1)+\boldsymbol{\kappa}\gamma_1 Q\prime(m_1)\}]}{E_0[u\prime(c_1)+\lambda_{sp}\{\theta_1 P\prime(m_1)+\boldsymbol{\kappa}\gamma_1 Q\prime(m_1)\}]}. \qquad (1.22)$$

1.4 CONCLUSION

This paper attempts to incorporate the growing importance of gross capital flows into theoretical modeling by differentiating gross capital inflows (borrowing from foreigners) from gross outflows (overseas investment in foreign assets). I extend the model of Jeanne and Korinek (2010) to find separate optimal tax rates on gross capital inflows and outflows. The main feature of my model is that the representative domestic agent not only borrows from the foreign investor but also actively invests in foreign assets.

The results replicate and generalize the results of the benchmark model. The decentralized agent does not internalize the external impact of the agent's own borrowing and investment decisions in normal times. As a result, the agent tends to overborrow in normal times as noted by Jeanne and Korinek (2010). Also, in a case where the social planner only manages gross flows by imposing a tax, the optimal tax rate on gross inflows is found to be approximately 2.1%. This is 0.8%p or 57% higher than the optimal rate (1.3%) in the benchmark model, which does not include foreign assets. Therefore, the difference is due to greater unintended side effects of borrowing through the channel of foreign asset prices. The findings of this study indicate that externalities

[26] In case of κ=1 (no asymmetry) and γ_1=0 (no overseas investment), $\tau^{i,*} = \frac{E_0[\lambda_{sp}P\prime(m_1)]}{E_0[u\prime(c_1)+\lambda_{sp}P\prime(m_1)]}$.

can be corrected with a Pigouvian tax on borrowing as well as a Pigouvian subsidy on overseas investment. This can provide new policy insights into capital flow management, especially for countries that use one-sided CFMs as well as countries that want to find an optimal policy mix to manage gross inflows and outflows.

The challenge for future research will be to extend the present model in a finite horizon to an infinite horizon that enables a generalization of the results. This would not only help elaborate the welfare comparison under diverse policy regimes, but also explain the distributional effect of tax-cum-subsidy on capital flows. Also, while the current study focuses on financial vulnerability, I can consider the composition of capital flows, which will have meaningful policy implications. For example, capital flows can be disaggregated into foreign direct investment (FDI) and portfolio investment. This can help balance the view on international capital flows by capturing the benefits of foreign borrowings for EMEs in terms of long-term productivity. It is also possible to extend the present model by incorporating exchange rates. This would help explain an additional source of financial amplification and obtain a better understanding of the channel, providing further insights into financial crises and the policies that can help prevent them.

Chapter 2. THE DISTRIBUTIONAL EFFECT OF CAPITAL FLOW MANAGEMENT

2.1 INTRODUCTION

Recent studies on international capital flows suggest a link between volatile capital flows and inequality, shedding light on how managing capital flows (e.g., taxation) can also affect economic distribution. Their findings suggest that international capital flows can impact inequality not only during a financial crisis or a sudden stop (Baldacci et al., 2002; de Haan and Sturm, 2017; Georgescu and Martin, 2021) but also under normal international market conditions (Bumann and Lensink, 2016; Liu et al., 2020). A large body of research already discusses the correlation between financial crisis and a rise in inequality (Bodea et al., 2021), indicating a potential connection between CFMs and inequality during a sudden stop. However, very little is known about the effect of CFMs on inequality in a steady state; a research area that can bring a fresh perspective to the evaluation of CFMs in a small open economy.[27]

The present study seeks to fill the gap in this literature by investigating how managing gross capital inflows and outflows can affect income distribution of domestic agents in a steady state. Specifically, I extend the overlapping generation (OLG) model by Liu et al. (2020), one of the very few theoretical explanations of how CFMs affect inequality. It examines the impact of

[27] As stated by Georgescu and Martin (2021), "the effect of macroprudential policy on inequality must be assessed considering the relation between financial crisis and inequality," and "if financial crisis results in a rise in inequality, then macroprudential measures may dampen the contractionary effect of the crisis and mitigate the potential rise in inequality" (p. 5). The current study, however, intentionally avoids discussions on the possible relationship between financial crises and income inequality. Instead, I focus on the distributional effect via capital income changes in a steady state as one of many different channels. It is a possibility that a financial crisis can affect long-term economic distribution by lowering overall productivity, in which case the impact of CFMs on inequality in a steady state may also change.

CFMs on income ratio between two types of domestic agents (households and entrepreneurs) when the government reduces tax rates on gross inflows (entrepreneurs' foreign borrowing) and/or on gross outflows (households' overseas investment). One of their main findings is that lowering tax rates on either gross capital inflows or outflows (i.e., capital liberalization) would increase the households' relative capital income, leading to a decrease in income inequality in the long term.

There are several advantages of using the model of Liu et al. (2020) as a benchmark to study the distributional effect of capital flow management.[28] First, their model explicitly uses *gross* capital flows rather than *net* capital flows. This enables us to reflect the growing role of emerging market economies (EMEs) in the global financial market: Gross capital outflows of domestic agents in EMEs have increased and are non-negligible after the global financial liberalization (Broner et al., 2011; Forbes and Warnock, 2012; Cavallo et al., 2017). Second, their model also features a domestic banking sector that takes deposits from households (savers) and lend them to entrepreneurs (borrowers). Incorporating domestic banks with the assumption of costly financial intermediation can help explain a credit spread that prevails in the real world by driving a wedge between domestic deposit and loan rates. In their model with taxes on capital flows, the world interest rate lies between the two domestic rates, and this may capture the search-for-yield motif, which is one of the main reasons for international diversification. Lastly, income inequality moves relatively slow compared to other macroeconomic variables.[29] An OLG model is thus suitable for analyzing the gradual movement of income inequality in the long term.

[28] The more recent version of the paper (Liu et al., 2021) mostly aligns with the 2020 paper. The only difference is that it considers a more general case by using constant elasticity of substitution (CES) production function instead of Cobb-Douglas production function. They introduce capital-skill complementarity with the CES function, which extends their study to explain the skill wage premium. In the present study, I use the 2020 model for the sake of simplicity. In future, the extension of the 2021 model will help understand the mechanism via a wage channel in addition to a return channel when households face discount on their returns of overseas investment.

[29] According to Frost and van Stralen, "income inequality is a slow-moving indicator, which will at any given point reflect the cumulative effect of a number of economic changes not only in the previous year but in the years and decade prior to that" (2018, p. 279).

Among many possible channels through which CFMs can affect income inequality, I limit the scope of this study to the channel of return to capital and savings, which is closely related to international financial liberalization. I argue that the liberalization of gross capital inflows and outflows have different impact on income inequality, measured by the capital income ratio between households and entrepreneurs. I also assume a discount for households' returns from their overseas investment, which reflects the reality that transaction costs increase with higher volumes of overseas investment (e.g., Rowland, 1999). This aspect sets my model apart from the model of Liu et al. (2020), which assumes a risk premium from entrepreneurs' foreign borrowing. With this study, I attempt to answer the following questions: How does taxation on international capital flows (i.e., separate tax rates on inflows and outflows) affect income distribution? In particular, does it increase or reduce income inequality measured by capital income ratio between domestic households and entrepreneurs?

The main findings of this study show that capital liberalization of inflows and outflows can affect the capital income ratio in opposite directions. On one hand, capital inflow liberalization (i.e., less strict CFMs on entrepreneur's external borrowing) can reduce both capital incomes of households and entrepreneurs in the long term,[30] potentially lowering the capital income ratio. On the other hand, capital outflow liberalization (i.e., less strict CFMs on household's overseas investment) will increase the capital income ratio. In other words, a lower tax rate on gross outflows will directly lead to a higher after-tax return of overseas investment, increasing the return to household savings in a steady state.[31]

[30] An increase in the entrepreneur's external borrowing results in higher output levels as well as larger capital accumulation. Under the assumption of production technology that exhibits diminishing marginal product of capital, the return to capital will decrease in a steady state, causing a decline in entrepreneurs' return to capital.

[31] The entrepreneur's capital income does not change if I exclude the assumption of risk premium (see Proposition I), hence the implication of a higher capital income ratio between the household and entrepreneur.

The remainder of this paper is organized as follows. Section 2 provides a review of related literature. In Section 3, I describe the model and incorporate the discount term. Section 4 provides a quantitative analysis, followed by the conclusion in Section 5.

2.2 Related Literature

This study falls under the broad scope of literature that explores the relationship between capital account policies and income/wealth distribution, i.e., inequality. Most of the existing literature examines how capital account liberalization affects inequality. Agnello et al. (2012) state that the effect of liberalization on inequality can vary across different types of policies. Based on a panel of 62 countries for the period 1973-2005, they find that liberalization policies, in general, "promote a more equal distribution of income," while noting that "trade openness seems to exacerbate income inequality […] because the expansion of traded goods sector due to greater openness of a country could lead to a rise in wage inequality through the employment channel" (2012, p. 587). Similarly, Delis et al. (2014) argue that the liberalization of the banking system overall reduces income inequality; in particular, "the liberalization of international capital flows also decreases income inequality," as it increases "the income share of the relatively poor" (2014, p. 1842).

Some recent researchers, on the other hand, find that liberalization can contribute to the increase of inequality, underlining the need for a cautious approach. Furceri and Loungani (2018) show that the Gini coefficient has increased by approximately 0.8 percent in the short term (1 year) and 1.4 percent in the medium term (5 years) after capital account liberalization in 149 economies between the period 1970-2010, suggesting the need for a more balanced approach to liberalization for countries that need to prioritize inequality reduction. Furceri et al. (2019) also find that capital account liberalization policies have adverse effects on inequality, especially "when domestic financial liberalization is low and not-inclusive or when a crisis follows liberalization" (2019, p. 195). However, they emphasize that the findings "do not imply that countries should not undertake capital account liberalization, but the results regarding distributional impacts do suggest an additional reason for caution" (2019, p. 195). Thus, the relation between capital account liberalization and inequality is not yet clearly understood both empirically and theoretically, particularly since inequality is measured over a long span of time.

This also signifies that very little is known about the influence of CFMs on inequality. A handful of recent empirical studies consider the distributional effects of CFMs. Frost and van Stralen (2018) use a panel of 69 advanced and emerging market and developing economies for the period 2000-2013. Their findings suggest that some macroprudential policies (i.e., CFMs) aggravate income inequality;[32] more specifically, countries that implement loan-to-value (LTV), debt-to-income (DTI) limits and reserve requirements tend to have higher income inequality. Georgescu and Martin (2021) show that there are two opposing effects of macroprudential measures on inequality. Since people are excluded from mortgage market at the introduction of macroprudential policies, the measures exacerbate inequality. On the flip side, they curb credit growth and alleviate financial crises and thus reduce inequality. Georgescu and Martin conclude by stating that that the measures empirically "have a small negative impact in terms of wealth inequality and a negligible positive impact on income inequality" (2021, p. 28).

The subject has received even less attention on the theoretical side[33]. Only a couple of recent models investigate how CFMs affect inequality. Bumann and Lensink (2016) construct a

---

[32] Frost and van Stralen (2018) also note that "the results identified here are associations, and substantially more work must be done to isolate causality," implying the possible endogeneity between specific policy choices and country specific economic conditions.

[33] Most of the theoretical models describe how the degree of inequality affects international capital flows, not in the other direction. Korinek and Sandri (2016), for example, find that rising wealth inequality calls for tighter capital flow management by constructing a model with two types of domestic agents: borrower and saver. Villalvazo (2021)

two-period model to examine restrictions on net capital flows and the impact on income distribution. Their model shows how the policies to liberalize the domestic banking sector by lowering reserve requirements or allowing more foreign funds that can be used to finance domestic loans can affect income distribution by increasing capital inflows. They also note that this depends on the depth of financial sector development. For example, the capital account liberalization policies tend to lower income inequality with an "already-deep" financial sector (2016, p. 160). Liu et al. (2020) also examine the distributional implications of capital flow management. Unlike Bumann and Lensink (2016), however, they use *gross* capital flows instead of *net* capital flows. According to their model with two types of domestic agents (households and entrepreneurs) and financial frictions, "changes in capital inflows and outflows can have quite different implications for income distributions, and the long-run distributional impact of capital flows is different from the short-run impact" (2020, p. 8). They emphasize that "adopting distinct inflow and outflow policies can be important for achieving the desired distributional outcomes" (2020, p. 8). The present study adds to the existing literature by focusing on how CFMs affect income inequality in the long term, particularly through the steady-state changes in capital incomes of households and entrepreneurs.

2.3 The Model

2.3.1 *Overview*

The basic set-up of my model is largely based on Liu et al. (2020)'s overlapping generation (OLG) model ("benchmark model") in a small open economy with two types of domestic agents:

suggest that higher wealth inequality can have a dampening effect on sudden stops by mitigating the downward pressure on asset prices.

households and entrepreneurs. I also assume a constant proportion of household, $\theta \in (0,1)$ out of total population size one, and households are all identical.[34] The representative household lives for two periods. The young household consumes and saves using their own labor income and transfer from the bequest of the older generation, while the old household consumes and leaves the bequest using their wealth. Importantly, the young household saves in two ways: deposits in a domestic bank and investments in foreign assets. However, the household does not invest in domestic capital,[35] which is not the case for the representative entrepreneur. The young entrepreneur not only consumes but also accumulates capital using own labor income and transferred bequest as well as funds from borrowing. The entrepreneur borrows from both a domestic bank and foreign investors. The old entrepreneur consumes and pays off the debt using returns from capital.

For the sake of simplicity, I also assume that there is only one type of consumption good in this economy, which is produced by competitive firms with a technology represented by Cobb-Douglas production function. Competitive domestic banks take deposits from households and provide loans to entrepreneurs, while foreign investors also lend to domestic entrepreneurs. The domestic government manages international capital flows by changing the positive tax rates imposed on gross inflows (i.e., entrepreneurs' foreign borrowing) and gross outflows (i.e., households' overseas investment). The steady-state equilibrium of the economy consists of allocations and prices that solve the optimization problems for the households, the entrepreneurs and the banks, while all markets clear given the international financial market condition. The

[34] For direct comparison, I use the same notations as Liu et al. (2020).

[35] This assumption is drawn directly from the benchmark model. One may question the plausibility of this assumption since domestic households can also participate in domestic capital accumulation process through domestic stock markets. This critique may be relevant, however, this study intentionally does not incorporate households' ability to accumulate capital, as it does not change the main results but only partially weaken the model's mechanism. I leave this area for future work.

solution method aligns with Liu et al. (2020), focusing on interior solutions with positive gross inflows and outflows in a steady-state equilibrium.

In a steady state, there are two no-arbitrage conditions that determine the relationships among domestic deposit rate (R), domestic lending rate (R_l) and the world interest rate (R^*). First, the representative household's interest from deposit in a domestic bank equals after-tax return on overseas investment in foreign assets. Second, foreign investors' after-tax return on lending to domestic entrepreneurs equals world interest rate. Liu et al. (2020) also assume that external foreign borrowing requires a risk premium, which increases the entrepreneur's borrowing cost from foreign investors. However, I symmetrically assume that households acknowledge a discount on their returns when they invest in foreign assets. This assumption can be explained with the increase in transactional costs and informational asymmetry, described in the following section. The discount term that decreases households' return on overseas investment closes the present model, as the risk premium term does in the benchmark model.

The assumption of discount leads to different results on the effect of capital inflow liberalization (with lower τ_l) on capital incomes. Liberalizing inflows will decrease domestic deposit rate (R) in a steady state.[36] Intuitively, entrepreneurs' foreign borrowing will substitute households' domestic savings. In other words, households will have to invest abroad with more discounted returns from overseas investment, lowering households' capital income in a steady-state equilibrium. Some outcomes remain consistent with the benchmark model. For example, liberalizing capital outflows still increase households' capital incomes under the assumption of discount. This is because a lower tax rate on outflows (τ_d) will directly lead to a higher after-tax

[36] See Proposition III.

return to overseas investment, raising domestic deposit rate (R) in the long term.[37] Further details will be given in the next two sections that describe the problems of economic agent and steady-state results.

2.3.2 *Set-up*

Households

The representative household with a log-utility in each period who discounts next period utility with $\beta \in (0,1)$, decides the amount of consumption both when young and old, as well as saving (i.e., deposit in a domestic bank and investment in foreign assets) to maximize the life-time utility (U_{ht}) subject to the budget constraints as described below:

$$\max_{C_{ht}^{y}, C_{h,t+1}^{o}, D_t, B_{ft}^{d}} U_{ht} = ln\left(C_{ht}^{y}\right) + \beta ln\left(C_{h,t+1}^{o}\right) \tag{2.1}$$

$$C_{ht}^{y} + D_t + B_{ft}^{d} = w_t H_{ht} + \Gamma_{ht} \tag{2.2}$$

$$C_{h,t+1}^{o} = R_t D_t + R_{ft}^{d} B_{ft}^{d} + T_{h,t+1} - \Gamma_{h,t+1} \tag{2.3}$$

$$R_{ft}^{d} \equiv (1-\tau_d) R_t^{*} \overline{\Psi}\left(\frac{B_{ft}^{d}}{Y_t}\right). \tag{2.4}$$

C_{ht}^{y} and $C_{h,t+1}^{o}$ denote consumption of the young household in the current period (t) and the old household in the next period ($t+1$). The young household deposits D_t in a domestic bank and invests B_{ft}^{d} in foreign assets, while earning labor income $w_t H_{ht}$ in a competitive labor market by working H_{ht} at a wage rate of w_t and receiving the bequest Γ_{ht} from the older generation. The old

[37] Indirectly, there will be a discount on the return to overseas investment. However, this indirect effect is dominated by the direct tax-cut effect. See Proposition III.

generation earns interest from deposit D_t in a bank with a gross domestic deposit rate of R_t, and receives return on overseas investment B_{ft}^d with a gross return rate of R_{ft}^d. The old household also receives $T_{h,t+1}$, sum of the lump-sum dividend from the bank as well as government transfers and leaves a bequest $\Gamma_{h,t+1}$ to the younger generation. The after-tax return on overseas investment R_{ft}^d pays the world interest rate R_t^* decreased with the tax rate $\tau_d(>0)$.

Unlike the benchmark model, however, I assume that the domestic household experiences a *discount* $\Psi(>0)$; in other words, the household's net return rate will decrease as they invest more abroad. This assumption can be rationalized for several reasons. First, according to the literature that discusses the benefits of international diversification, the existence of *transaction costs* is one of the main reasons why domestic investors have home bias.[38] Although there is no consensus yet whether transaction costs directly lead to home bias, it is widely accepted that transaction costs affect (expected) return on foreign assets. Some previous studies adopt the assumption that transaction costs are not fixed but proportional to the size of foreign investment (e.g., Constantinides, 1986; Uppal, 1993; Rowland, 1999). The increase in transaction costs can explain why households' return on foreign assets would be discounted. According to Rowland (1999), "[h]olding all else constant as the international transaction cost increases, the net return on the international asset relative to the net return on the US asset decreases" (p. 165).

Second, some households have informational advantage in foreign markets. This can result in higher transaction costs when households with less information start investing abroad.[39] Finally,

[38] According to Amadi and Bergin (2008), home bias means that "despite the potentially significant gains from foreign diversification investors hold a disproportionately small amount of foreign equity" (2008, p. 191).

[39] The idea that there can be different types of domestic agents with high and low transaction costs has been introduced by Amadi and Bergin (2008). They note that "[s]ome agents have a cost advantage in executing financial trades, be it due to larger size, better technology, or expertise. In combination with uniform fixed costs of entering a foreign market, only efficient agents with low per-unit costs find it profitable to enter" (2008, p. 192).

international financial integration may be correlated to slow global productivity growth and low global interest rates as emphasized in a number of recent studies (Caballero et al., 2008; Mendoza et al., 2009; Benigno et al., 2020). Benigno et al. (2020) argues that global productivity growth can slow down as more developing countries participate in the global financial markets.[40] In the present study, which assumes a small open economy with a fixed world interest rate, the relationship between financial globalization and low global interest rates can be interpreted as follows: As households in EMEs increase overseas investment, their expected future returns will decrease.

I introduce a *symmetric* functional form of the risk premium term that appears in the benchmark model.[41] The discount term will be assumed as follows: [42]

$$\Psi\left(\frac{B_{ft}^{d}}{Y_t}\right) = exp\left[\Psi_d\left(\kappa_d - \frac{B_{ft}^{d}}{Y_t}\right)\right]. \tag{2.5}$$

This expression implies that the discount term $\Psi(\cdot)$ decreases with the overseas investment to output ratio. Following Liu et al. (2020), for simplicity, the population ratio of households in the economy is constant at $\theta \in (0,1)$, and the bequest from the old generation is fixed fraction Γ of the old household's wealth:

$$\Gamma_{h,t+1} = \Gamma\left\{R_t D_t + (1-\tau_d) R_t^{*} B_{ft}^{d} + T_{h,t+1}\right\}. \tag{2.6}$$

[40] Increasing capital inflows from developing countries to the US leads to the shift of activity from innovative tradable sector to non-tradable sector, undermining the productivity growth in the US as well as the world. This phenomenon is called the "global financial resource curse." See Benigno et al. (2020).

[41] Risk premium term in Liu et al. (2020) is defined as follows: $\Phi\left(\frac{B_{ft}^{l}}{Y_t}\right) = exp\left[\Phi_b\left(\frac{B_{ft}^{l}}{Y_t} - \kappa_f\right)\right]$. The risk premium term is an increasing function of external debt to output ratio.

[42] $\Psi_d$and κ_d denote elasticity of discount on overseas investment and steady-state ratio of overseas investment to output, respectively.

The interior solution of the optimization problem implies the first no-arbitrage condition:

$$R_t = R_{ft}^d = (1-\tau_d)R_t^*\Psi\left(\frac{B_{ft}^d}{Y_t}\right). \tag{2.7}$$

Thus, not only a positive tax rate on gross outflows but also discount term forms a wedge between the domestic deposit rate and the world interest rate.[43]

Entrepreneurs

The set-up of this section largely follows the benchmark model. The proportion of entrepreneurs out of population in this economy is constant at $1-\theta$ and each entrepreneur is identical. The representative entrepreneur has the same life-time utility form as the household and chooses the amount of consumption, investment and borrowing (i.e., borrowing from a domestic bank and foreign investors) to maximize the life-time utility (U_{et}) subject to the budget constraints as below:

$$\max_{C_{et}^y, C_{e,t+1}^o, \mathrm{B}_{et}, \mathrm{I}_t} U_{et} = ln\left(C_{et}^y\right) + \beta ln\left(C_{e,t+1}^o\right) \tag{2.8}$$

$$C_{et}^y + q_t^k K_t^o + \mathrm{I}_t + \frac{\Omega_k}{2}\left(\frac{\mathrm{I}_t}{K_t^o} - \frac{\bar{I}}{\bar{K}^o}\right)^2 K_t^o = w_t H_{et} + B_{et} + \Gamma_{et} \tag{2.9}$$

$$C_{e,t+1}^o = [q_{t+1}^k(1-\delta) + r_{t+1}^k](K_t^o + \mathrm{I}_t) - \bar{R}_{lt}B_{et} + T_{e,t+1} - \Gamma_{e,t+1}. \tag{2.10}$$

[43] In the present model, the household does not consider the impact of their own investment decision on discount, which causes pecuniary externalities. In other words, the household takes the discount as given, $\Psi = \bar{\Psi}$, when making decisions. This is close to the benchmark model in which the representative entrepreneur does not consider the impact of their own borrowing decision on risk premium. In other words, both risk premium and discount cause externalities in these models.

C_{et}^{y} and $C_{e,t+1}^{o}$ denote consumption of the young entrepreneur in the current period (t) and the old entrepreneur in the next period $(t+1)$. The young entrepreneur consumes and buys existing capital K_t^o at the competitive price of capital q_t^k.[44] The entrepreneur accumulates capital by newly investing I_t on capital, which incurs capital adjustment costs. The young entrepreneur also earns labor income $w_t H_{et}$ and receives the bequest Γ_{et} from the older generation as does the young household.

In addition, the young entrepreneur can borrow from both domestic banks (B_t) and foreign investors (B_{ft}^l) at the domestic lending rate R_{lt} and foreign lending rate R_{lt}^d, respectively. Since the foreign lending rate is the same as the domestic lending rate in a steady state,[45] I can use the domestic lending rate R_{lt} for total financing amount $B_{et}(\equiv B_t + B_{ft}^l)$ as written in the budget constraint. The old entrepreneur earns returns from holding accumulated capital $K_t(\equiv K_t^o + \mathrm{I}_t)$ with capital rental rate r_{t+1}^k and reselling price q_{t+1}^k subject to capital depreciation rate $\delta \in (0,1)$. The law of motion for the capital stock is standard as follows:

$$\mathrm{K}_t = (1-\delta)\mathrm{K}_{t-1} + \mathrm{I}_t. \tag{2.11}$$

[44] The role of the price of capital (q^k) is also limited in this study as it is determined in a competitive domestic market. However, the price of capital can be affected by the movement of capital flows. Chatterjee and Naknoi (2007, 2010) argue that the price of investment good is closely correlated with capital inflows. The relationship depends on how effectively financial capital is transformed into physical capital subject to domestic technology. For example, in the economies with low efficiency in such transformation, there is a positive correlation between the price of physical capital and capital flows. Chatterjee and Naknoi (2010) also claim that "a rise in the efficiency of transforming financial capital into investment goods reduces the volume of capital flows" (p. 75). Based on their idea, I can extend the current study by assuming q^k as a function of capital flows. The increase of financial capital inflows will enable domestic entrepreneurs to accumulate more physical capital, while it can change the price of physical capital depending on the level of efficiency. This may help understand, for example, how the liberalization of capital inflows can affect domestic lending rate (R_l) and capital income ratio through the price of physical capital (q^k).

[45] This is due to the no-arbitrage condition of foreign investors, which is discussed further in the subsequent sections.

The old entrepreneur consumes the remaining income after paying off the debt to both domestic and foreign creditors. Same as the household, the old entrepreneur also receives $T_{e,t+1}$, sum of the lump-sum bank dividends and government transfers and leaves a bequest $\Gamma_{e,t+1}$ to younger generation, while I maintain the simplifying assumption that the bequest is a fixed fraction Γ of the old entrepreneur's wealth:

$$\Gamma_{e,t+1} = \Gamma\{[q_t^k(1-\delta) + r_{t+1}^k](K_t^o + \mathrm{I}_t) - \bar{R}_{lt}B_{et} + T_{e,t+1}\}. \quad (2.12)$$

Firms

Competitive firms produce output Y_t, using labor (of households and entrepreneurs) and capital with a simple Cobb-Douglas production technology: [46]

$$\mathrm{Y}_t = A\mathrm{K}_{t-1}{}^{1-\alpha}(H_{ht} + H_{et})^{\alpha} \quad (2.13)$$

where $\alpha \in (0,1)$ denotes the labor input elasticity, and A is the total factor productivity. From the cost minimization of firms, the Cobb-Douglas production function implies that the following two conditions should be met in the equilibrium:[47]

[46] In addition to its simplicity, the diminishing marginal product of capital is also a crucial feature of the Cobb-Douglas production function. Intuitively, output production level increases when capital inflows are liberalized, whereas marginal product of capital decreases. This also reduces the return to capital, which should be the same as the cost of capital (i.e., domestic lending rate) in a steady-state equilibrium. This may lower the entrepreneur's steady-state capital income as described in Proposition V. Other functional forms of production function that exhibit diminishing marginal product of capital will have a similar mechanism.

[47] On the flip side, the simplicity of the Cobb-Douglas production function with its inelastic labor supply assumption may hinder overall assessment by shutting down the channel via wage changes. Using the CES production function or allowing endogenous agent type selection can be possible extensions of this study.

$$w_t(H_{ht} + H_{et}) = \alpha \mathrm{Y}_t \tag{2.14}$$

$$r_t^k \mathrm{K}_{t-1} = (1-\alpha)\mathrm{Y}_t. \tag{2.15}$$

Banks

The role of competitive domestic banks in the model is financial intermediation: Banks take deposits from households at the domestic deposit rate R_t and lend to entrepreneurs at the domestic lending rate R_{lt}. Following the benchmark model, the financial intermediation is costly and the functional form of intermediation cost $\Xi(\cdot)$ is as follows:

$$\Xi\left(\frac{\mathrm{B}_t}{\mathrm{Y}_t}\right) = \xi\left(\frac{\mathrm{B}_t}{\mathrm{Y}_t}\right)^{\eta} \tag{2.16}$$

where the elasticity of intermediation cost η is assumed to be strictly greater than one to ensure the convexity of intermediation cost function.[48] The total cost incurred during the intermediation of B_t units of lending to entrepreneurs is $\Xi\left(\frac{\mathrm{B}_t}{\mathrm{Y}_t}\right)\mathrm{Y}_t$.

The representative competitive bank chooses the amount of deposit D_t and lending B_t given the market deposit rate R_t and lending rate R_{lt} to maximize own profit (i.e., dividend to shareholders) subject to its budget constraint as follows:

$$\max_{D_t, B_t} \Pi_t^b = D_t - B_t - \Xi\left(\frac{\mathrm{B}_t}{\mathrm{Y}_t}\right)\mathrm{Y}_t \tag{2.17}$$

$$R_{lt}B_t = R_t D_t. \tag{2.18}$$

[48] Liu et al. (2020) explain that the functional form of intermediation cost “reflects the bank’s diminishing effectiveness for intermediating lending activity and enforcing loan contracts” (p. 10) following Cúrdia and Woodford (2016).

The optimization condition of the bank forms the wedge between two domestic interest rates (i.e., a credit spread) as follows:

$$R_{lt} = R_t \left[1 + \Xi' \left(\frac{\mathrm{B}_t}{\mathrm{Y}_t}\right)\right] \tag{2.19}$$

with the credit spread $\Xi'(\cdot) > 0$, implying that the domestic lending rate is strictly higher than the deposit rate ($R_{lt} > R_t$).

Foreign investors

Foreigners that face one world interest rate R_t^* have incentives to lend to domestic entrepreneurs at the foreign lending rate $R_{lt}^d (= R_{lt})$, whereas they have no incentive to invest in domestic banks at the domestic deposit rate R_t, provided that the world interest rate lies between two domestic interest rates as follows:[49]

$$R_t < R_t^* < R_{lt}^d = R_{lt}. \tag{2.20}$$

Foreign investors face a tax on gross inflows, reducing after-tax return from lending to entrepreneurs with a tax rate $\tau_l (> 0)$. Liu et al. (2020) assume that "external debt also requires a risk premium" (2020, p. 10). Following their model, the no-arbitrage condition for foreign

[49] This implies that the credit spread derived from the costly financial intermediation becomes a fundamental assumption to this model. Furthermore, this set-up can capture the search-for-yield motif that explains the international investment diversification.

investors means that after-tax lending rate equals the world interest rate with risk premium Φ as described follows:

$$(1-\tau_l)R_{lt} = R_t^* \Phi\left(\frac{B_{ft}^l}{Y_t}\right) \tag{2.21}$$

$$\Phi\left(\frac{B_{ft}^l}{Y_t}\right) = exp\left[\Phi_b\left(\frac{B_{ft}^l}{Y_t} - \kappa_f\right)\right]. \tag{2.22}$$

The functional form of risk premium term $\Phi(\cdot)$ implies that the risk premium increases with higher external debt to output ratio.[50] As with the discount term, the individual entrepreneur does not internalize the impact of own borrowing decision on the risk premium, which causes externalities in the model.[51] For simplicity and tractability, I focus on the special case without the risk premium, i.e., the risk premium term always equals one ($\Phi = 1$).[52] With this different set-up, I focus on whether and how the distributional effect of capital liberalization will differ in the present model. As a result, the no-arbitrage condition of foreign investors is modified as follows:

$$(1-\tau_l)R_{lt} = R_t^*. \tag{2.23}$$

Equilibrium

An equilibrium consists of allocations $\{C_{ht}^y, C_{ht}^o, C_{et}^y, C_{et}^o, I_t, K_t, Y_t, H_{ht}, H_{et}, B_t, B_{ft}^l, D_t, B_{ft}^d, NX_t\}$ and prices $\{w_t, R_t, q_t^k, R_{lt}\}$ which solve problems for households, entrepreneurs and banks, while all markets including goods market, loan market and labor market clear as follows:

[50] Φ_b and κ_f denote elasticity of risk premium on external debt and steady-state ratio of external debt to output, respectively, following Liu et al. (2020).
[51] The discount term Ψ closes the present model as the risk premium term Φ does in the benchmark model.
[52] A possible area of future research is to generalize the model by including both the risk premium (for entrepreneurs) and discount (for households).

$$Y_t = C^y_{ht} + C^o_{ht} + C^y_{et} + C^o_{et} + I_t + \frac{\Omega_k}{2}\left(\frac{\mathrm{I}_t}{K^o_t} - \frac{\bar{I}}{\bar{K}^o}\right)^2 K^o_t + \Xi\left(\frac{\mathrm{B}_t}{\mathrm{Y}_t}\right) Y_t + NX_t \quad (2.24)$$

$$B_t + B^l_{ft} = B_{et} \quad (2.25)$$

$$H_{ht} + H_{et} = 1. \quad (2.26)$$

The government implements CFMs by imposing taxes on both gross inflows and outflows. Tax revenue as well as bank's profit (i.e., dividend) are returned to the households and entrepreneurs as lump-sum transfers, proportional to each population size, θ and $1-\theta$ as follows:

$$T_{ht} = \theta\left(\tau_d R^*_{t-1} B^d_{f,t-1} + \tau_l R_{l,t-1} B^l_{f,t-1} + \Pi^b_t\right) \quad (2.27)$$

$$T_{et} = (1-\theta)\left(\tau_d R^*_{t-1} B^d_{f,t-1} + \tau_l R_{l,t-1} B^l_{f,t-1} + \Pi^b_t\right). \quad (2.28)$$

Income inequality and planner's objective

Following the benchmark model, I define both labor and capital income of the household and the entrepreneur with superscript c for capital income and l for labor income of each type of agent:

$$W^c_{ht} = (R_{t-1} - 1)\left(D_{t-1} + B^d_{f,t-1}\right) \quad (2.29)$$

$$W^c_{et} = [q^k_t(1-\delta) + r^k_t](K^o_{t-1} + \mathrm{I}_{t-1}) - \left(R_{l,t-1} - 1\right)B_{e,t-1} - \left[q^k_{t-1}K^o_{t-1} + I_{t-1} + \frac{\Omega_k}{2}\left(\frac{\mathrm{I}_{t-1}}{K^o_{t-1}} - \frac{\bar{I}}{\bar{K}^o}\right)^2 K^o_{t-1}\right] \quad (2.30)$$

$$W^l_{ht} = w_t H_{ht} = \theta w_t \quad (2.31)$$

$$W^l_{et} = w_t H_{et} = (1-\theta) w_t. \quad (2.32)$$

The household's capital income W_h^c consists of interest from total household saving $S_h(\equiv D + B_f^d)$ with net domestic deposit rate $R - 1$. The entrepreneur's capital income W_e^c includes the return on accumulated capital $K(\equiv K^o + I)$, minus total borrowing $B_e(\equiv B + B_f^l)$ with net domestic lending rate $R_l - 1$ and investment cost. Assuming inelastic labor supplies, for simplicity, labor incomes for the household and the entrepreneur are constant fraction of competitive wage w.

Lastly, in this simple version of heterogeneous agent model, the planner uses the Pareto weight ω on the household's welfare and $1 - \omega$ on the entrepreneur's welfare and discounts future welfare with discount factor β. The planner's objective welfare U_t is described as follows:[53]

$$U_t = \omega\left(lnC_{ht}^y + lnC_{ht}^o\right) + (1 - \omega)\left(lnC_{et}^y + lnC_{et}^o\right) + E_t\beta U_{t+1}. \tag{2.33}$$

2.3.3 *Steady State Results*

Based on the benchmark model, I focus on the interior equilibrium and the special case without bequests nor lump-sum transfers ($\Gamma = T_{ht} = T_{et} = 0$). Furthermore, by adding the assumption of discount, the study also aims to compare its findings with the benchmark model.[54]

Domestic interest rates and output

The first analysis aims to examine how reduction in tax rates on capital flows (i.e., capital liberalization) affect domestic deposit rate (R), lending rate (R_l) and output (Y) in a steady state. First, the domestic lending rate (R_l) is directly determined from Equation (23) as below:

[53] One thing to note is that the function drawn from the benchmark model also implicitly assumes that the social planner values young and old agents equally. Considering that many countries have social welfare systems, favoring old agents relative to young agents may change the social planner's policy on the liberalization of capital flows.
[54] See the comparison with the benchmark model and full derivation in Appendix A and B, respectively.

$$R_l = \frac{R^*}{1-\tau_l}. \tag{2.34}$$

Given the world interest rate, reducing the tax on gross inflows (τ_l), i.e., liberalization of capital inflows, lowers the domestic lending rate (R_l). The intuition behind this simple equation is closely related to the production technology of this economy. Since the Cobb-Douglas production function exhibits diminishing marginal product of capital, greater capital inflows will eventually lower marginal product of capital as more domestic capital accumulates. In other words, the return to capital (or marginal product of capital) and the cost of capital (or domestic lending rate) will both decrease in a steady-state equilibrium. On the other hand, the domestic lending rate does not depend on capital outflow controls (τ_d), leading to the following proposition:

Proposition I. In the steady-state equilibrium, the domestic lending rate $R_l(\tau_l)$ increases with τ_l ($\frac{\partial R_l}{\partial \tau_l} > 0$). However, R_l does not depend on τ_d ($\frac{\partial R_l}{\partial \tau_d} = 0$).

Next, I examine the steady-state level of aggregate output (Y). Using the Cobb-Douglas production function in Equation (13) and the fact that the sum of inelastic labor supply of households and entrepreneurs equals one, the output is determined by the amount of capital given capital income share ($1-\alpha$). For example, capital accumulation in the case of capital inflow liberalization will increase the aggregate output, while the domestic lending rate (R_l) will decrease due to the diminishing marginal product of capital. This implies the negative relationship between the domestic lending rate (R_l) and aggregate output (Y) as described below:

$$Y = \left(\frac{1-\alpha}{R_l - 1 + \delta}\right)^{\frac{1-\alpha}{\alpha}} = \left(\frac{1-\alpha}{\frac{R^*}{1-\tau_l} - 1 + \delta}\right)^{\frac{1-\alpha}{\alpha}}. \tag{2.35}$$

Equation (35) shows that the aggregate output (Y) is directly affected by capital inflow controls (τ_l) as noted but irrelevant with capital outflow controls (τ_d). This relationship leads to the following Proposition:

Proposition II. In the steady state equilibrium, aggregate output $Y(\tau_l)$ decreases with τ_l ($\frac{\partial Y}{\partial \tau_l} < 0$). However, Y does not depend on τ_d ($\frac{\partial Y}{\partial \tau_d} = 0$).

I then investigate the impact of capital liberalization on domestic deposit rate (R) in a steady state. From the optimization condition of competitive banks in Equation (19), I can derive the domestic deposit rate as a function of the domestic lending rate as well as the credit spread $\Xi'(\cdot)$ (> 0) as follows:[55]

$$R = R_l \left[1 + \xi\eta \left(\frac{B}{Y}\right)^{\eta-1}\right]^{-1}. \tag{2.36}$$

Capital outflow liberalization does not change the domestic lending rate (R_l), the first term in the right-hand-side of Equation (36), as stated in Proposition I. In the meantime, outflow liberalization affects the second term in the right-hand-side through credit spread term. Intuitively, a lower tax on gross outflows will increase the household's overseas investment, while crowding out domestic

[55] The derivation follows the benchmark model, which also describes the relationship between the two domestic rates as in Equation (36).

bank deposit. The bank's binding budget constraint in Equation (18) implies that domestic lending also shrinks. This indicates a decrease of the domestic lending to output ratio $\left(\frac{B}{Y}\right)$, which reduces the credit spread and thus raises the domestic deposit rate (R) in Equation (36).

From a different angle, capital outflow liberalization increases the after-tax return of overseas investment in Equation (7), directly raising the domestic deposit rate. This is how the benchmark model derives the steady-state domestic deposit rate without the household's discount term. However, the discount term (Ψ) in this model implies indirect opposite effect on the deposit rate. When lower tax rate increases investment on foreign assets (i.e., gross outflows), discount term (Ψ) shrinks as the return on foreign asset diminishes, lowering the domestic deposit rate in a steady state. Among the two offsetting effects, the direct effect dominates the indirect effect as summarized in Proposition III below:[56]

Proposition III. In the steady-state equilibrium, the deposit rate $R(\tau_d, \tau_l)$ decreases with τ_d ($\frac{\partial R}{\partial \tau_d} < 0$) and increases with τ_l ($\frac{\partial R}{\partial \tau_l} > 0$).[57]

Also, when the tax on gross inflows (τ_l) decreases, domestic entrepreneurs will increase borrowing from foreign investors, partially substituting borrowing from domestic banks. The bank's binding budget constraint in Equation (18) along with Proposition I implies that the domestic deposit rate (R) decreases, implying a positive correlation with tax on external debt (τ_l) as described in Proposition III. In the presence of the discount term, the entrepreneur's foreign borrowing can

[56] This enables a prediction of results in a general case with both risk premium and discount terms: domestic deposit rate will also rise in a steady state when capital outflows are liberalized.
[57] See the proof in Appendix C.

have a negative impact on the household's capital income by lowering the deposit rate, which is discussed in the next section. This mechanism sets the present study apart from Liu et al. (2020) where domestic deposit rate does not depend on tax on inflows.

Household income

The following analysis investigates how capital liberalization affects the household's income in a steady state. First, from the property of the Cobb-Douglas production function, the household's labor income share of output is constant as follows:

$$W_h^l = \alpha\theta \mathrm{Y}(\tau_l) = \alpha\theta\left(\frac{1-\alpha}{\frac{R^*}{1-\tau_l}-1+\delta}\right)^{\frac{1-\alpha}{\alpha}}. \tag{2.37}$$

The relationship between the aggregate output (Y) and capital flows liberalization in Proposition II implies that the household's labor income will decrease with the tax on inflows (τ_l) but does not depend on the tax on outflows (τ_d). Intuitively, more capital accumulation in the case of capital inflow liberalization will increase the steady-state output level and thus raise the labor income for both the entrepreneur and household.

Next, the household will save a constant proportion $\frac{\beta}{1+\beta}$ of their labor income in the form of bank deposits and overseas investment from intertemporal optimization. In other words, total household saving (S_h) will depend on the amount of steady-state output level.

$$S_h \equiv D + B_f^d = \frac{\beta\alpha\theta}{1+\beta}\mathrm{Y}(\tau_l). \tag{2.38}$$

From Equation (29), the household's capital income in a steady state is described as follows:

$$W_h^c = (R-1)\left(D + B_f^d\right) = [R(\tau_d, \tau_l) - 1]\frac{\beta\alpha\theta}{1+\beta}\Upsilon(\tau_l). \tag{2.39}$$

Equation (39) implies that the capital income will be affected by both taxation on inflows and outflows. Capital outflow liberalization will increase domestic deposit rate (R), leading to a higher capital income of the household. This is summarized in Proposition IV.

Proposition IV. In the steady-state equilibrium, the household's capital income W_h^c decreases with τ_d ($\frac{\partial W_h^c}{\partial \tau_d} < 0$).[58] However, if the labor share α in production is sufficiently large ($\alpha > \frac{1}{1+\frac{\partial R}{\partial \tau_l}(1-\tau_l)\frac{R_l-1+\delta}{R_l(R-1)}}$), then W_h^c increases with τ_l ($\frac{\partial W_h^c}{\partial \tau_l} > 0$).[59]

When capital inflows are liberalized, there are two effects from larger capital accumulation that offset each other. On one hand, larger capital accumulation raises labor income for households (as well as entrepreneurs) as it leads to higher output levels in the long term. This increases the size of total savings as well as capital income for households. On the other hand, with the discount term, domestic deposit rate (R) will decrease, lowering capital income as described in Proposition III. Proposition IV shows that the impact via deposit rate dominates the impact via total savings (or output).[60] In other words, the household's capital income will decrease when the entrepreneur

[58] Unlike Liu et al. (2020), this relationship holds regardless of the size of labor share α.
[59] See the proof in Appendix C.
[60] This is more likely to happen with sufficiently large labor income share (α) as described in Proposition IV. The parameter condition can be interpreted as follows. Under the current setup with the Cobb-Douglas production function in Equation (13), higher labor income share (α) implies lower capital income share (1- α), which reduces the impact

can borrow more from foreign investors. This implies that the liberalization of capital inflows may have a negative distributional impact on the households compared to the entrepreneurs, which is the intuition behind the difference with Liu et al. (2020) in the results on capital inflow liberalization.

Entrepreneur income

As the next step, I examine how capital liberalization affects the entrepreneur's labor income and capital income in a steady state. The explanation for the household's labor income also applies to entrepreneur's labor income, since the entrepreneur's labor income share of output is also a constant fraction due to the assumption of Cobb-Douglas production function.

$$W_e^l = \alpha\alpha(1-\theta)\mathrm{Y}(\tau_l) = \alpha(1-\theta)\left(\frac{1-\alpha}{\frac{R^*}{1-\tau_l}-1+\delta}\right)^{\frac{1-\alpha}{\alpha}} \tag{2.40}$$

This indicates that the entrepreneur's labor income will also decrease with the tax rate on inflows (τ_l) but does not depend on the tax rate on outflows (τ_d) in a steady state.

As households hold a constant fraction of their income as total savings, entrepreneurs will hold a constant proportion $\frac{\beta}{1+\beta}$ of their labor income as net worth (N_e) under optimal intertemporal decisions. The net worth is defined as the amount of capital less total borrowings from both domestic banks and foreign investors as:

$$N_e \equiv K - B_e = K - \left(B + B_f^l\right) = \frac{\beta\alpha(1-\theta)}{1+\beta}\mathrm{Y}(\tau_l). \tag{2.41}$$

---

of capital accumulation on output production. Thus, a high α weaken the output (and total saving) channel compared to the deposit rate channel.

Using Equation (30), the entrepreneur's capital income in a steady state is simply expressed as:

$$W_e^c = (R_l - 1)N_e = [R_l(\tau_l) - 1]\frac{\beta\alpha(1-\theta)}{1+\beta}\mathrm{Y}(\tau_l). \quad (2.42)$$

The household's capital income is affected by total savings (and output) and domestic deposit rate in Equation (39); similarly, Equation (42) indicates that the entrepreneur's capital income is also determined by two factors: the net worth (and output) and domestic lending rate. However, unlike the household, the entrepreneur's capital income does not depend on the taxation on outflows (τ_d). In other words, the liberalization of capital outflows has no effect on the entrepreneur's capital income as described in the latter part of Proposition V.[61]

Proposition V. If the labor share α is sufficiently large (in particular, if $\alpha > \frac{(R_l-1)}{2(R_l-1)+\delta}$), then the entrepreneur's capital income W_e^c increases with τ_l ($\frac{\partial W_e^c}{\partial \tau_l} > 0$). However, W_e^c does not depend on τ_d ($\frac{\partial W_e^c}{\partial \tau_d} = 0$).[62]

More importantly, Proposition V explains how capital inflow liberalization affect the capital income of entrepreneurs. Equation (42) clearly shows two competing effects via output (or net worth) and domestic lending rate. As described in Proposition I, output will increase as entrepreneurs accumulate more capital. The production technology in this model, which exhibits diminishing marginal product of capital, indicates that the steady-state return to capital (or

[61] The feature sets this study apart from Liu et al. (2020) where capital outflow liberalization has a positive effect on entrepreneur's capital income.
[62] See the proof in Appendix C.

domestic lending rate) will decrease as stated in Proposition II. According to Proposition V, the domestic lending rate channel dominates the output channel, indicating that the entrepreneur's capital income will be reduced in the long term when capital inflows are liberalized.[63]

Income inequality

The final step of the steady-state analysis shows whether capital liberalization of gross inflows and outflows affects the income ratio between households and entrepreneurs. I focus on the capital income ratio between households and entrepreneurs, as the labor income ratio does not change with the Cobb-Douglas production function. The household's labor income compared to entrepreneur's labor income is constant as below:

$$\frac{W_h^l}{W_e^l} = \frac{\alpha\theta\mathrm{Y}(\tau_l)}{\alpha(1-\theta)\mathrm{Y}(\tau_l)} = \frac{\theta}{1-\theta}. \tag{2.43}$$

This suggests that taxing capital flows (with either τ_l or τ_d) do not affect the labor income ratio in the current simple model. Combining Equations (39) and (42), the household's relative capital income (i.e., the capital income ratio) is expressed as below:

$$W^c \equiv \frac{W_h^c}{W_e^c} = \frac{(R-1)\frac{\beta\alpha\theta}{1+\beta}Y(\tau_l)}{(R_l-1)\frac{\beta\alpha(1-\theta)}{1+\beta}Y(\tau_l)} = \frac{\theta}{(1-\theta)}\frac{[R(\tau_d,\tau_l)-1]}{[R_l(\tau_l)-1]}. \tag{2.44}$$

[63] This is more likely to happen with sufficiently large labor income share (α) because a high α weakens the output (or net worth) channel compared to the domestic lending rate channel.

According to Equation (44), the impact on output level is canceled out when I consider the household's relative capital income. In other words, liberalizing capital flows will affect domestic deposit and lending rates, and the impact on the two domestic rates will determine the capital income ratio. Proposition VI summarizes the distributional effect as follows:

Proposition VI. The household's relative capital income W^c decreases with τ_d ($\frac{\partial W^c}{\partial \tau_d} < 0$). However, under some conditions of ($\frac{1}{(R-1)}\frac{\partial R}{\partial \tau_l} > \frac{1}{(R_l-1)}\frac{\partial R_l}{\partial \tau_l}$), W^c increases with τ_l ($\frac{\partial W^c}{\partial \tau_l} > 0$).[64]

In a steady state, liberalizing outflows (with lower τ_d) will improve the capital income ratio by increasing the household's capital income (through a higher domestic deposit rate), while it does not change the entrepreneur's capital income (nor the domestic lending rate). On the contrary, liberalizing inflows can have a negative distributional impact. As the domestic deposit rate falls in the presence of the discount term, the household's capital income decreases. As a result of the diminishing return to capital, entrepreneurs will also have a smaller capital income in a steady state. Therefore, the capital income ratio can decrease depending on the parameter condition as Proposition VI states.[65] Therefore, lower tax rates on gross inflows and gross outflows can have opposite effects on capital income ratio in a steady state.[66]

---

[64] See the proof in Appendix C.

[65] $\frac{1}{(R-1)}\frac{\partial R}{\partial \tau_l} > \frac{1}{(R_l-1)}\frac{\partial R_l}{\partial \tau_l}$. This condition implies that the effect of increasing tax rate on gross inflows via deposit rate is greater than the effect via lending rate.

[66] This is contrary to Liu et al. (2020): their steady-state results show that both policies with lower tax rates on gross inflows and gross outflows have the same positive distributional effect. This also indicates that in a general setup with both assumptions of risk premium and discount, capital outflow liberalization will increase the household's relative capital income, while the effect of capital inflow liberalization on capital income ratio is ambiguous, requiring further study.

2.4 QUANTITATIVE ANALYSIS

In this section, I demonstrate the steady-state results using calibrated parameters. I focus on the change in steady-state values when there are changes to the tax rates on capital inflows and outflows.[67] While I largely follow the parameter values from the benchmark model, I also include two additional parameters related to the household discount.[68]

Table 2.1. Effect of Tax Rates on Capital Inflows and Outflows

	Baseline	Case I (+5%p in τ_l)	Case II (+5%p in τ_d)
Domestic deposit rate (R)	1.3940	1.4560 (+4.4%)	1.3770 (-1.2%)
Domestic lending rate (R_l)	1.6476	1.7447 (+5.9%)	1.6476 (0.0%)
Aggregate output (Y)	0.3850	0.3583 (-7.0%)	0.3850 (0.0%)
Household's capital income (W_h^c)	0.0203	0.0219 (+7.7%)	0.0194 (-4.3%)
Entrepreneur's capital income (W_e^c)	0.0164	0.0176 (+7.0%)	0.0164 (0.0%)
Household's relative capital income (W^c)	1.2353	1.2433 (+0.6%)	1.1820 (-4.3%)

In the baseline model, the steady-state value of the household's relative capital income is 1.2353, while the capital incomes of the household and entrepreneur are 0.0203 and 0.0164, respectively. In the case of tighter capital flow management of gross inflows (i.e., 5 percent point increase in the tax rate on gross inflows), the capital incomes of both the household and entrepreneur are

[67] While Liu et al. (2020) show a transitional path after a temporary increase in tax rates, I focus on the steady-state values in the long term in case of an overall increase in tax rates.
[68] See Appendix D for the calibration parameters. Symmetrical to the benchmark model, the elasticity of household discount on overseas investment (Ψ_d) is 3 and the steady-state overseas investment to output ratio (κ_d) is 0.04. Further study may be required to validate the calibration.

expected to increase in the long term based on Proposition IV and V. Due to a stricter management of gross inflows, there will be less capital accumulation. This will lead to a decrease in output level by 7.0%, as shown in Table 1 (from 0.3850 to 03583). However, the return to capital will increase in the new steady state considering the diminishing marginal product of capital. As stated in Table 1, the domestic lending rate increases by 5.9% (from 1.6476 to 1.7447), raising the entrepreneur's capital income by 7.0% (from 0.0164 to 0.0176). The domestic deposit rate also increases with the tax rate on inflows (τ_l) by 4.4% (from 1.3940 to 1.4560) according to Proposition III. A higher domestic deposit rate can explain the increase in the household's capital income by 7.7% (from 0.0203 to 0.0219). Since the household's capital income increased more than that of the entrepreneur, the relative capital income of the household (or the capital income ratio) increases by 0.6%, which is consistent with Proposition VI.

With a higher tax rate on gross capital outflows (τ_d), the capital income ratio between the household and entrepreneur decreases by 4.3%, confirming Proposition VI. Since the domestic lending rate, output and entrepreneur's capital income do not depend on τ_d in Proposition I and III, there is no change in such values in the new steady state: lending rate (1.6476), output (0.3850) and capital income of entrepreneurs (0.0164). Since a higher tax rate on overseas investment will negatively affect the after-tax return, no-arbitrage condition of households implies that the domestic deposit rate will decrease as stated in Proposition III. It reduces by 1.2% (from 1.3940 to 1.3770) in Table 1.[69] Since the household's capital income only declines, capital income ratio will decrease with the same rate of 4.3% (from 1.2353 to 1.1820).

[69] There will be less discount on the returns from overseas investment, which partially offsets the direct negative effect of higher taxation on domestic deposit rate.

2.5 EXTENSION

To extend the baseline model, I distinguish two types of households: those with access versus no access to foreign asset markets. The baseline model is largely based on the assumption that the representative household can invest in foreign asset markets, which implies that all identical households can access foreign asset markets. However, some domestic households may not have access to foreign asset markets due to high transaction costs or lack of information. According to Amadi and Bergin (2008), the heterogeneity in transaction costs may result from different size, technology, or expertise among households. Thus, in this extension, I assume three types of domestic agents: household with full access, household without access and entrepreneur (with full access).[70] With a constant exogenous proportion, $\rho \in (0,1]$, of households who have access to foreign asset market, the proportion of households with and without access are $\rho\theta$ and $(1-\rho)\theta$ out of total population one, respectively.[71]

While the baseline model focuses on the capital incomes of households and entrepreneurs, the presence of the two types of households may or may not affect the impact of capital flow management on income inequality. The results depend on whether the households with access can adjust their saving portfolio from domestic deposit to overseas investment. An overall reduction in overseas investment from B_f^d to ρB_f^d leads to an increase of the return on overseas investment due to less discount. This creates arbitrage opportunities between domestic deposits and overseas

---

[70] In future research, this study can be extended by disaggregating entrepreneurs into those with and without access to foreign investors. This variation will show the similar dynamics with the assumption of differentiating households that have access to foreign asset markets and those who do not.

[71] The assumption of two types of households will be useful in incorporating "capital-skill complementarity" into the model as done by Liu et al. (2021). Liu et al. (2021) assume that entrepreneurs are skilled workers whereas as households are unskilled workers. Their study can be further developed using three types of agents (i.e., two types of households and one entrepreneur). As a future study, I can additionally assume that the households that have access to foreign asset markets are skilled works, while the households that do not have access to foreign asset markets are unskilled workers.

investment. I assume two scenarios. In the first scenario, I assume flexible adjustment of portfolio, which will enable the households with access to shift their domestic deposit to overseas investment. This adjustment will increase overall overseas investment level back to initial level B_f^d, lowering the discount term to the initial steady-state level. Consequently, the households' limited access to foreign asset markets cannot affect income inequality among households nor between households and entrepreneurs in the long term.

In the other scenario, I do not allow for a flexible adjustment of saving portfolio (i.e., the households with access are restricted to their initial portfolio due to a limit on overseas investment per household, etc.). In this case, no-arbitrage condition indicates that the domestic deposit rate will rise at the equilibrium. The after-tax return (less discounted) on overseas investment will match the domestic deposit rate but at a higher level. Even so, the capital income of all types of households should be the same since the rate of return and total savings will be the same for both types. Yet this still can affect the capital income ratio between households and entrepreneurs. This scenario is more favorable to households compared to entrepreneurs because the domestic lending rate remains at the initial level given the same world interest rate, whereas the domestic deposit rate increases. Under this scenario, the income ratio between households and entrepreneurs can be improved when there is only limited proportion ($\rho < 1$) of the households with access to foreign asset markets as apposed with the case where all households have access ($\rho = 1$).[72]

[72] The total amount of domestic deposit increases because the households without access now only save domestically while households with access maintain their initial savings portfolio. The increase in deposits implies that banks can lend more to entrepreneurs, who will substitute out the foreign borrowings. Under the current set-up which does not incorporate the risk premium term, the no-arbitrage condition for foreigners will not be affected. In a more general set-up which assumes risk premium, less foreign borrowing implies reduced premium. This may lower the domestic lending rate and reduce entrepreneurs' capital income in a steady state. This will also be relatively more favorable to households compared to entrepreneurs.

2.6 Conclusion

This paper seeks to explain the long-term distributional effect of CFMs in a model with two types of domestic agent: households and entrepreneurs. Among many different channels through which CFMs can affect income inequality, I focus on how the liberalization of gross capital flows affect capital incomes in a steady state. By distinguishing gross inflows (i.e., entrepreneurs' foreign borrowing) from outflows (i.e., households' overseas investment), I investigate the different effects of capital liberalization depending on the type of flows. One distinctive feature of this study is the assumption that households face a discount on their return to overseas investment, which reflects factors such as international transaction costs.

The results of this study show that liberalizing capital inflows (with lower τ_l) can have a negative distributional effect in the long term.[73] In other words, managing gross inflows with tighter regulations may have a positive effect on distribution through capital returns and interest income of households. This sheds a new light on other aspects of CFMs, the primary role of which is to guard against financial crises. The results also indicate that capital outflow liberalization (with lower τ_d) is more favorable to households compared to entrepreneurs, as it only increases the household's capital income. In other words, encouraging overseas investment of domestic households can increase their capital income by improving long-term returns from both domestic and foreign savings.

In all, this study highlights that capital liberalization of gross inflows and outflows can have opposite effects on the capital income ratio in the long term, which offers important policy implications such as a separate management of gross inflows and outflows. The results should,

[73] On the contrary, Liu et al. (2020) show that "in the steady state, liberalizing capital inflows or outflows would raise the households' share of income and thus reduce inequality" (p. 33).

however, be taken with caution as the current model excludes other possible channels such as wage premium for high skilled workers. Nevertheless, the long-term effect of CFMs on income inequality described in this study opens new possibilities to evaluate CFMs and understand the relationship between capital flow liberalization and inequality.

Chapter 3. CAPITAL FLOW MANAGEMENT AND MONETARY POLICY SHOCKS[74]

3.1 INTRODUCTION

In the aftermath of the Global Financial Crisis (GFC), capital flow management policies have been widely employed in emerging market economies (EMEs) to mitigate the impact of external shocks.[75] Accordingly, many empirical studies have been undertaken to assess the effectiveness of these policies. Although mixed, the results generally suggest that capital flow management measures (CFMs) lower EMEs exposure to external shocks (Baba and Kokenyne, 2011; Ahmed and Zlate, 2014; Forbes et al., 2015; Akinci and Olmstead-Rumsey, 2018). Similarly, Erten, Korinek and Ocampo (2021) suggest that recent estimations show “a tightening in capital controls reduces financial fragility indicators such as bank leverage, bank credit, and exposure to portfolio liabilities” (p. 76).[76]

In a similar vein, we try to answer two questions with this paper: 1) how effective are CFMs in curbing the international capital flows’ cycles, and 2) is there a meaningful difference between the effect of CFMs on gross flows and that on net flows? The second question is motivated by the growing interest of the literature on the differential role of gross capital flows in policy design and macroeconomic outcomes. Based on recent literature (e.g., Forbes and Warnock, 2012; Broner et

[74] This chapter is based on co-authored work with Camilo Granados.
[75] According to the IMF 2019 Taxonomy of Capital Flow Management Measures (2019), 36 economies have introduced capital flow management policies since 2000. See Appendix A for the list of economies and Appendix B for the time trends of the implementations.
[76] On the other hand, empirical studies using annual data sources such as Magud et al. (2018) and Reinhart and Smith (2002) often find no significant evidence that capital controls are effective in reducing capital flows. One can argue against these studies that the introduction of capital controls during a specific month may not be captured by annual data. See Erten et al. (2021).

al., 2013; Cavallo, 2019), overseas investment of domestic agents (i.e., gross outflows) increased significantly in EMEs since the 2000s, indicating the need to distinguish gross outflows from gross inflows. This trend can be also found in the selected economies as shown in Figure 3.1.[77] On the other hand, another relevant feature, that is also visible in Figure 1, is that the movements in gross outflows and inflows tend to move in opposite directions (have a negative covariance), which is translated in a lower variance of the resulting net flows and could lead to underestimating the role and effects of policies targeting this latter variable. We examine whether the characteristics abstracted from analyses based on net flows become relevant when we focus separately on each type of gross flows.

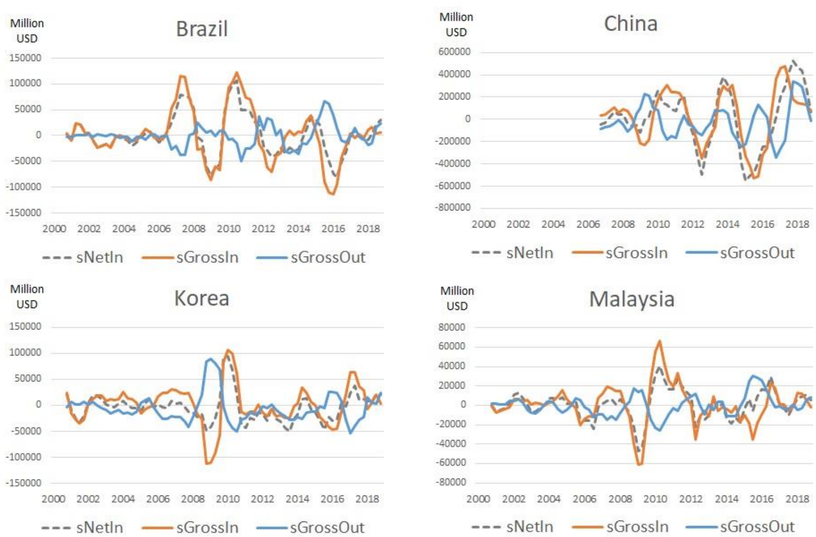


Figure 3.1. Net and Gross Capital Flows in Brazil, China, Korea and Malaysia

To address these questions, we construct a quarterly panel dataset for 32 economies that have employed CFMs during 2000-2018, and assess, based on local projections (Jordà, 2005; Coman

[77] The details of how capital flows are constructed are presented in the data description section.

and Lloyd, 2019), whether CFMs can offset the effects of US monetary shocks on both net and gross flows. We focus on the effect of US monetary policy shocks on the capital flows and compare how these are different in the presence of CFMs. We find that CFMs do mitigate the impact of the shock on capital flows; these offsetting effects are more clearly shown with gross inflows and outflows, whereas they are somewhat ambiguous with net flows. The directions of CFMs' mitigating effects are largely similar in most local projection estimations. The results are robust to other alternative specifications, for example, with different control variables or different length of lagged terms.

These results add further evidence to the empirical literature on CFMs. Broadly speaking, we contribute to the literature on the policies' effectiveness vis-à-vis external shocks. In particular, our result complements the research on the impact of US monetary policy shocks on EMEs, which tend to be more vulnerable relative to advanced economies (e.g., Kalemli-Özcan, 2019). The spillovers from the US monetary shocks into EMEs has drawn much attention after the GFC. Rey (2015), for example, notes that countries with both fixed and flexible exchange rate regimes are affected by the global financial cycle and calls this phenomenon a *dilemma* or an *irreconcilable duo* between monetary policy independence and international capital flows. In other words, EMEs can have independent monetary policies only when they also manage the international flows with CFMs (among other additional tools).

Our results also support the findings of recent studies that CFMs effectively guard against financial turmoil and that countries with tighter measures are less affected by external shocks. Coman and Llyod (2022) use the dataset constructed by Cerutti et al. (2018) to find that prudential policies in EMEs can offset negative spillovers from the US monetary policy, suggesting that such policies can help EMEs maintain their monetary policy autonomy in the face of the global financial cycle. They also find that specific prudential policies such as loan-to-value (LTV) ratio limits and reserve requirements are the most effective tools to reduce the spillover effects on EMEs. In a similar vein, Ahmed and Zlate (2014) estimate, based on a sample for the period 2002-2013, that capital controls introduced after 2009 have significantly discouraged net capital inflows to EMEs in terms of both total and portfolio capital flows. Finally, Akinci and Olmstead-Rumsey (2018) conclude, based on an index of macroprudential policy in 57 economies for the period 2000-2013, that tighter macroprudential measures are associated with lower growth in bank credits.

Our results not only align with these studies, but also consider the special role of gross capital flows on intermediating the effects of global shocks on EMEs. In that sense, it builds on the literature emphasizing the distinction between gross capital inflows and outflows, such as Cavallo et el. (2017) and Davis and van Wincoop (2018). The former authors, for example, argue that sudden stops in net capital inflows can be prevented if a repatriation of domestic investors' overseas investment can offset a reduction in foreign lending to the domestic economy. Similarly, the IMF (2013) points out that EMEs can be resilient against global financial cycle when they are able to mitigate the impact of foreign gross inflows with domestic gross outflows. We contribute to these findings by examining whether the effectiveness of CFMs against external shocks differ by type of capital flows (net and gross).

The remainder of this paper is organized as follows. Section 2 explains the panel dataset. Section 3 describes the local projection methodology and baseline results with LP-OLS and LP-IV specifications. Section 4 presents robustness checks, followed by the conclusion in Section 5.

3.2 DATA DESCRIPTION

We construct a quarterly panel dataset with 32 economies that implemented CFMs during 2000-2018 according to the IMF 2019 Taxonomy of CFMs. The sample economies are Brazil, China, India, Indonesia, Korea and Russia, among others.[78] Our specifications use the net capital inflows, gross inflows and gross outflows as dependent variables.[79] All types of capital flows are calculated using the IMF balance of payment (BoP) dataset based on Cavallo et al. (2017). Following Forbes and Warnock (2012), capital flows are smoothed out by aggregating series for four quarters (past three quarters and the current quarter), and then taking year-over-year differences. We account for the size of each economy by considering the ratio to GDP for each type of capital flow.

For independent variables, we use measures of US monetary shocks that represent a major source of international financial shocks to most economies. For the LP-OLS specification, the US monetary policy shocks are simply measured with the federal funds rates collected from the Federal Reserve Economic Data (FRED) developed by the Federal Reserve Bank of St. Louis. For the LP-IV specification, we use surprises in 3-month ahead federal funds future rates to estimate the US monetary shocks following the method proposed by Gertler and Karadi (2015).

We construct CFM dummy variables by collecting the data from the IMF 2019 Taxonomy of CFMs.[80] We indicate as 1 if any kind of CFM is used during the period t. If not, the variable

---

[78] Initially, 36 economies that introduced CFMs since 2000 are considered. However, four economies are excluded in the dataset since there was very limited data for three economies (CEMAC, Cyprus and Greece), and Seychelles did not use any CFMs until 2019. Therefore, the quarterly panel dataset for 32 economies in the periods from 2000 to 2018 is constructed for this study. See Appendix A for the full list of economies.

[79] Following Cavallo et al. (2015, 2017) and Cavallo (2019), we measure gross capital inflows by the sum of net incurrence of liabilities, and measure gross capital outflows by the negative sum of net acquisition of assets. These series of liabilities and assets include direct investment, portfolio investment, financial derivatives and other investments (excluding reserve assets). Since gross outflows are computed with a negative sign, net capital inflows are defined as the *sum* of gross inflows and gross outflows. In our dataset, for example, when domestic agents sell their foreign assets and repatriate funds into the home country by 10, reducing the size of their foreign asset acquisitions during the period from 100 to 90, it implies that the value of gross capital outflows changes from -100 to -90, which raises net capital inflows.

[80] We provide the time trends of CFMs' implementation in Appendix B.

takes the value of 0. For example, Brazil introduced CFMs by imposing a tax on external loans in January 2008, while Peru placed a reserve requirement on foreign credit lines in February 2010. Thus, CFM dummies for these periods in both countries are ones.[81]

There are two types of control variables in this study. First, the change in the Chicago Board Options Exchange Volatility Index (VIX) and US output growth rates are considered as global control variables. Second, some variables are used as country-specific control variables. For example, we collect the Industrial production (IP) indexes from the World Bank Global Economic Monitor (WB GEM) database. We also include the consumer price index (CPI), nominal foreign exchange rate relative to US dollar that we take from the IMF IFS database, and finally, we consider the domestic interest rates (3-month government bond rates) which are collected from Bloomberg.[82]

3.3 Empirical Framework

3.3.1 *Local Projection (LP) Method*

The methodological framework of this study follows a lag-augmented local projection (LP) approach along the lines of papers such as Coman and Lloyd (2019) or Richter, Schularick and Shim (2019) that build on the projection method outlined by Jordà (2005).[83] The method is being increasingly applied in empirical studies, as it is found to be more robust to misspecification than

[81] See the IMF 2019 Taxonomy of CFMs for details.
[82] See Appendix C for the summary of variables used.
[83] Coman and Llyod (2019), for example, focus on macro-prudential policies, differentiating them from capital flow management. We use a different set of capital flow management measures (CFMs) from the IMF 2019 Taxonomy of CFMs. Also, we used different dependent variables. Instead of using total and bank credits of 29 EMEs from the BIS database, we use capital flows calculated from the IMF BoP database for 32 economies. Choice of variables also differ from those in Coman and Llyod. For example, we include additional global controls such as exchange rate depreciation rate and domestic interest rates. Time dummies are also added before, during, and after the GFC.

the traditional VAR method (Haug and Smith, 2012; Montiel Olea and Plagborg-Møller, 2021). According to Montiel Olea and Plagborg-Møller (2021), “local projection inference robustly handles two issues that commonly arise in applications: highly persistent data and the estimation of impulse responses at long horizons” (p. 1789).

While LP-IV is used as the benchmark specification, we choose to show both LP-OLS and LP-IV specifications in this study as the correction-step for endogeneity of the latter can be insightful in understanding the nuances behind the interaction between the CFMs and the global shocks when affecting the capital flows. Most existing LP-OLS specifications show that gross capital inflows increase when the US policy rates are raised, which does not align with our expectation that higher US interest rates reduce global investors’ appetite for domestic markets.[84] With that in mind, we recognize the potential endogeneity between the US monetary policy and the macroeconomic variables including capital inflows, as done in other studies in the literature (e.g., Kalemli-Özcan, 2019; Coman and Llyod, 2019). Endogeneity is a feature we want to remove from our estimates; for this, we perform an LP-IV estimation where we create a monetary policy shock for US along the lines of Gertler and Karadi (2015).

3.3.2 *Specifications*

For LP-IV estimation, we use a two-stage IV regression along the lines of Kalemli-Özcan (2019) and Jordà, Schularick and Taylor (2020). In the first stage, we use the three-month-ahead Fed futures rate as the instrument, and focus on the differences in future rates using a one-day window

[84] Kalemli-Özcan (2019) describes the notion as follows: “In popular discourse, when the center country – most often the U.S. – runs a contractionary monetary policy, policy rate differentials across the world ($i_{country} - i_{US}$) contract, affecting short-term and possibly long-term market interest rates. Global investors re-balance their portfolio by shifting capital from low interest rate countries to the high interest rate center” (p. 1).

around the FOMC announcement dates (for both scheduled and unscheduled FOMC meetings and conference calls), thereby extending the policy shock series until December 2018.[85] We identify the US monetary policy shocks and obtain the fitted values ($\widehat{USMP}_t$) from a first-stage regression of Fed rates on the futures rates surprises.

In the second stage, we consider the impact of a US monetary shock in quarter t ($\widehat{USMP}_t$), CFMs implemented in economy i ($\text{CFM}_{i,t}$) and their interaction ($\widehat{USMP}_t * \text{CFM}_{i,t}$) on capital flows (as a share of GDP) in the economy i at quarter t+h ($\text{y}_{i,t+h}$).[86] For h = 0,1, …, H (=8),

$$y_{i,t+h} - y_{i,t-1} = \alpha^h + \beta_1^h * \widehat{USMP}_t + \beta_2^h * CFM_{i,t} + \beta_3^h * \left(\widehat{USMP}_t * CFM_{i,t}\right)$$
$$+\gamma^h * IndividualControl_t + \delta^h * GlobalControl_t$$
$$+\eta^h * \Sigma\, Lag_{i,t-j} + \theta^h * GFCdummy_t + FE_i^h + \varepsilon_{i,t+h} \qquad (3.1)$$

where t and h denote quarter and horizon.

GlobalControl_t is a vector that contains the change in VIX and US growth rate, which reflect global economic and financial conditions. $\text{IndividualControl}_{i,t}$ represents the economy-specific control variables, including the growth rate, inflation rate, exchange rate depreciation rate, and domestic interest rate. As a proxy for domestic interest rates, we use government bond rates with maturity of three months for consistency with the quarterly dataset. We include these controls because domestic conditions can affect the capital flows for reasons apart from international markets features. By incorporating the exchange rate depreciation rate and domestic interest rates, we can better focus on the effect of external US monetary shocks and CFMs. To note, there is a

[85] Gertler and Karadi (2015) compute a similar estimate but focus on a 30-minute window around the announcement. Here we focus on the daily window in an attempt to capture the policy surprise with more readily available data that can be obtained in a standard Bloomberg terminal. We find that the correlation between the two time-series (from this paper and Gertler and Karadi's work) is 0.673 during the overlapping periods (February 2000 to June 2012).
[86] Alternatively, we can lag the right-hand-side policy terms (USMP and CFM) to control for endogeneity, namely by removing sources of simultaneity.

loss of observations in our dataset due to data restrictions on domestic interest rates. The results without using domestic interest rates as controls are provided in the section on robustness checks.

Lagged terms for most of the variables for the previous J periods are included as well (in $\Sigma\, Lag_{i,t-j}$). In that vector we include independent variables (US monetary shocks, CFM dummy, and interaction term), economy-specific and global controls, and dependent variables.[87] We set the number of lags as four ($J = 4$) to capture past effects up to one year.[88] GFC time dummy variables are added to capture the possible structural changes in the international financial markets.[89] Fixed effects (FE_i^h) are included to capture potential confounding factors specific to each economy. Similar to Coman and Lloyd (2019), our estimation equation does not include time fixed effects, as the US monetary shocks variable is common to all countries in the sample.

α, β_1, β_2, β_3, γ, δ, η, θ and ε are coefficients and error term in the second-stage regression, respectively. Here, the β_1 measures the effect of a US monetary shock in quarter t on capital flows at quarter t+h. Thus, $\hat{\beta}_1$ for each horizon h is the estimated impulse response to a US monetary shock when CFMs are not implemented (CFM = 0), and $\hat{\beta}_1 + \hat{\beta}_3$ represents the impulse response when CFMs are implemented (CFM = 1). The differences between the two responses correspond to the interaction term $\hat{\beta}_3$.

For LP-OLS specifications, all variables except the US monetary shock ($USMP_t$) are the same to the second stage of LP-IV specification in Equation (1). For h = 0,1, …, H (=8),

[87] The lag terms for dependent variables (capital flows) in the right-hand-side start from two-period prior term as the left-hand-side of the estimating equation already includes one-period prior term for capital flows.

[88] There appears to be different choices in the number of lags in the empirical studies using lag-augmented LP method. The results derived with a bigger number for lag terms ($J = 8$) are provided in the following sections.

[89] The duration of the GFC is from Jan 2008 to Jun 2009 based on NBER recession indicator. The results derived without using GFC dummies are provided in the following sections.

$$y_{i,t+h} - y_{i,t-1} = \alpha^h + \beta_1^h * USMP_t + \beta_2^h * CFM_{i,t} + \beta_3^h * (USMP_t * CFM_{i,t})$$
$$+\gamma^h * IndividualControl_t + \delta^h * GlobalControl_t$$
$$+\eta^h * \Sigma\, Lag_{i,t-j} + \theta^h * GFCdummy_t + FE_i^h + \varepsilon_{i,t+h} \quad (3.2)$$

where t and h denote quarter and horizon, respectively.

3.3.3 *Empirical Results*

We present the impulse response functions (IRFs) of net and gross capital flows on US monetary shocks based on the local projection estimates in both LP-OLS and LP-IV specifications. The resulting IRFs for two years (H=8), depicting the percentual change in the capital flows after a 1%p increase in US monetary policy shock are shown in Figure 3.2 and Figure 3.3. The solid lines are IRFs when CFMs are *not* implemented, and the dashed lines are IRFs when CFMs are implemented. The left panel shows IRFs where net capital flows are included as a dependent variable, whereas the center and right panels are the cases where the dependent variables are gross capital inflows and outflows, respectively. For example, the solid line on the left panel in Figure 3.2 indicates that a 1%p increase in the Fed rates is associated with approximately 20%p increase in net capital flows as a share of GDP after a year (4 quarters) when CFMs are not implemented.

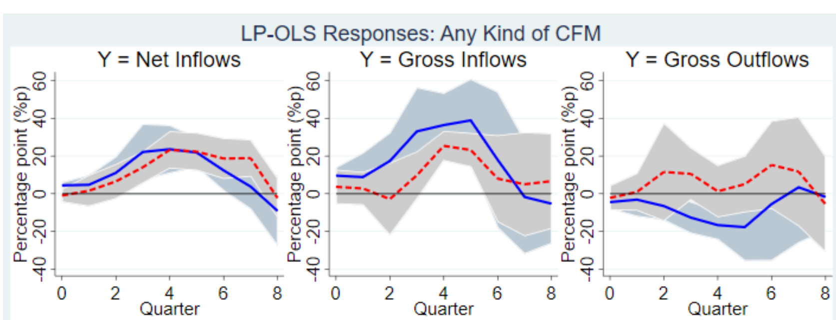


Figure 3.2. LP-OLS IRFs to an Increase of 1%p in the US MP Shock

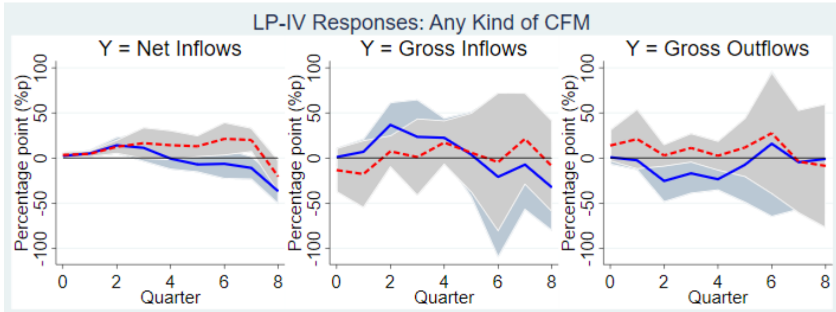


Figure 3.3. LP-IV IRFs to an Increase of 1%p in the US MP Shock

Without considering the 90% confidence bands for IRFs, basic implications can be drawn initially by using the direction and magnitude of IRFs. As presented by the solid lines in the center and right panels in Figure 3.2 with LP-OLS specification, both gross inflows and outflows increase in response to US monetary shocks when CFMs are not used.[90] In other words, both foreign and domestic agents increase their overseas investment when the Fed rates are raised. As noted earlier, the direction of gross inflows does not match our expected results. We expect higher US policy rates to cause foreign agents to reduce investment in domestic markets with relatively low interest rates and adjust their portfolio to other countries—including the US—with relatively high interest rates. A possible explanation for this inconsistency is the fact that a recovery in the US and global economy is typically followed by an increase in the Fed rates caused by concerns of inflation. Therefore, in the period of global economic recovery, both gross inflows and outflows can increase due to optimistic behaviors of domestic and foreign investors, while gross inflows are partly offset by higher Fed rates.

This can be interpreted as the endogeneity between the US monetary policy shocks and the macroeconomics variables. In this study, we tackle this issue by using an instrument variable for

---

[90] To note, the sign of gross outflows is defined to be negative in case of its increase by the convention of empirical studies. Thus, net flows are calculated as the sum of gross inflows and outflows in this study.

the US monetary policy following Gertler and Karadi (2015) in line with other existing studies (e.g., Kalemli-Özcan, 2019; Coman and Llyod, 2019). With the LP-IV specification, the magnitude of gross inflows in the center panel in Figure 3.3 becomes less than that in the LP-OLS specification, although the direction is still positive for the first year after the shock. The improved results indicate that the instrument helps partially to correct the endogeneity issue.[91]

Since the changes in investment volume are greater for foreigners (i.e., gross inflows) than domestic agents (i.e., gross outflows), LP-OLS specification shows that net inflows increase as illustrated in the left panel of Figure 3.2. This is also similar to LP-IV specification for the first year, as shown in Figure 3.3, although the magnitude becomes small compared to LP-OLS. Net inflows are slightly below zero from the second year as the shock fades away. On the other hand, the dashed lines denote the IRFs when CFMs are implemented. First, the dashed lines in the center panel of Figure 3.2 indicate that gross inflows increase in lesser volumes when CFMs are used, thereby generating a weaker response of the flows to the monetary shock. This can be interpreted as a mitigating effect of the CFMs on gross inflows. We also see the mitigating effect for gross inflows for the first year (Figure 3.3).[92] In the second year, gross inflows increase but move close to zero, which still reduces the fluctuations of gross inflows. Since the negative sign of gross inflows means that foreign investors tend to leave the domestic market, CFMs help mitigate this movement of foreign investors, smoothing out the effect on gross inflows towards zero.

Second, the results show that there exists a mitigating effect on gross outflows as well (right panels in Figure 3.2 and Figure 3.3). The mitigation takes place immediately after the shock,

[91] This study can be further developed by using different sets of instrument variables for the US monetary shocks in line with existing research (e.g., Bu et al., 2021; Miranda-Agrippino, 2016).

[92] It is also worth noting that the sign of gross inflows is negative for the first two quarters. This means when there is an increase in the US monetary policy shock, in the presence of CFMs, foreign investors reduce the net purchase of domestic assets as the higher US interest rates make domestic markets less attractive in the short-term. This is consistent with the generic notion. Thus, it shows the benefit of using LP-IV rather than LP-OLS specification.

indicating that CFMs strongly affect domestic agents' behaviors. The magnitude of the mitigating effect is smaller but still clearly shown in the LP-IV estimates. Lastly, the effect on net capital flows seems less clear in both estimations (left panels in Figure 3.2 and Figure 3.3). The CFMs seem to have no mitigating effect on net inflows for the first year, while they slightly increase the net inflows in the second year. This is difficult to interpret since the mitigating effect is somewhat offset for net inflows as gross inflows and outflows cancel out each other.

We can see these results in a more pronounced way when we focus on the IRFs based on the interaction term only. These refer to $\hat{\beta}_3$, shown in Figure 3.4 and Figure 3.5, and represent the change in the effect to monetary shocks after an implementation of the CFM.

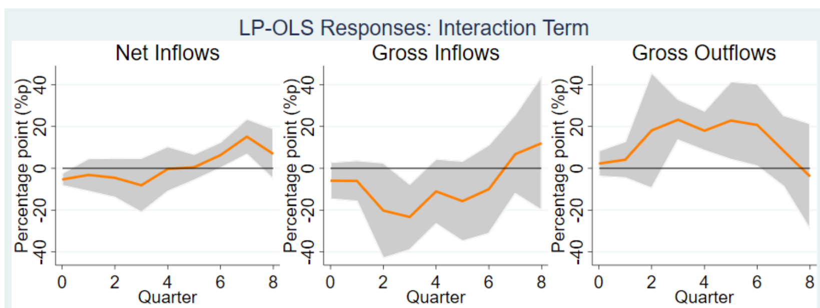


Figure 3.4. LP-OLS IRFs (Coefficient of Interaction Term)

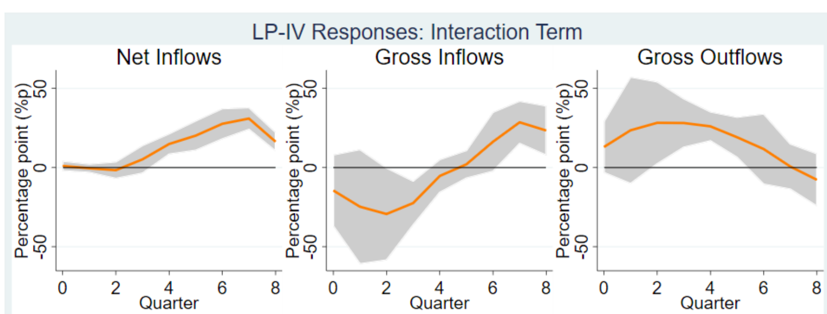


Figure 3.5. LP-IV IRFs (Coefficient of Interaction Term)

Negative interaction coefficients for the first year in the center panels (for gross inflows) in Figure 3.4 and Figure 3.5 imply that the CFMs reduce the response of gross capital inflows to the US monetary shocks. Similarly, positive interaction coefficients in the right panels (for gross outflows) in Figure 3.4 and Figure 3.5 show that CFMs reduce the response of the gross outflows to US monetary shocks. Since gross inflows and outflows offset each other in the net flows, interaction coefficients for the first year in the left panels (for net inflows) are only slightly lower than or close to the zero lines. In the second year, the coefficients are positive due to the greater mitigation effect on gross inflows compared to that on gross outflows.

The overall results show how the mitigating effect of CFMs are present and visible only when gross flows are considered; conversely, they are somewhat hidden when determined by the magnitude between two offsetting effects as in the case of net flows. Thus, looking only at net inflows measures could lead to the mistake of assuming that there is no such mitigation effects or concealing the underlying forces on each type of gross flow. Importantly, the fact that the CFMs' mitigating effects can vary according to the type of flows may explain why their effectiveness on net flows is not clearly established in the literature.

One caveat to mention is that these results are supported by limited statistical evidence as the effects confidence intervals for both types of flows can overlap for several periods, in particular for the OLS specification. In fact, this is another feature in which the LP-IV estimates are a better, or at least a more insightful result to examine. With 90% confidence bands for IRFs, it is hard to argue that CFMs mitigate US monetary shocks in both net and gross flows, since confidence bands overlap in most periods especially with LP-OLS specification.

There are some limitations to this empirical study. First, there still can be other sources of endogeneity: the implementations of both CFMs and US monetary shocks may be correlated to other economic variables that reflect country-specific features such as output growth. The potential endogeneity from US monetary policy shocks is widely known in many studies (e.g., Romer and Romer, 2004; Gertler and Karadi, 2015; Bu et al., 2021) and partly addressed in this study with the LP-IV specifications. However, it is challenging to find a valid instrument to address the endogeneity issue for the CFM implementation (Erten et al., 2021). As an alternative way, using lag terms as control variables can partially solve this issue, and this is the reason why we consider the lagged terms for CFM dummy variables as part of the "lag-augmented" approach (e.g., Coman and Lloyd, 2019; Kalemli-Özcan, 2019).[93]

Second, the intensity and direction of CFMs are not captured; the data only considers the presence of CFMs. This is not only due to limitation of data, but also the difficulty of aggregating the intensity of different kinds of CFMs even for the same country. According to Batini and Durand (2021), a simple indexing as zero or one without capturing the intensity could in fact ensure objectivity, since there may be a risk of subjectivity in scoring the intensity of CFMs which take various forms across countries. Extensions with various indexes of CFMs reflecting their intensity remain as potential areas of further research.

3.4 ROBUSTNESS CHECK

3.4.1 *Alternative Specifications*

As a robustness check, we examine alternative results with several variant specifications. The first alternative specification does not include domestic interest rates as country-specific control variables due to data limitations. Based on the premise that the monetary policy response of

[93] Specifically, we use $CFM_{i,t-1}$ instead of $CFM_{i,t}$ as main regressors. See next section.

domestic countries to that of the US can be summarized in the interest rate differential, one would say that including the domestic rates as a control is proper. However, there is a substantial data loss of observations when this variable is included. By excluding domestic interest rates, we can increase the number of observations from 348 to 1,190 and the number of economies considered from 11 to 18.[94] Thus, in the first alternative specification we re-estimate our baseline equation but with the domestic interest rates variable abstracted from. The estimating equations look identical as shown in Equations (1) and (2) except the component of individual controls. In this specification, global controls still include output growth rate, inflation rate and exchange rate depreciation rate as country-specific controls.

The result of this first alternative specification is illustrated in Figure 3.6 and Figure 3.7, and the outcomes are consistent with the results in Section 3, i.e., we also obtain the mitigating effects of the CFMs on the impacts of foreign monetary policy shocks. Interestingly, the results with LP-OLS and LP-IV are quite similar in terms of directions of mitigating effects as shown in the bottom panels in Figure 3.6 and Figure 3.7. Also, the directions of gross inflows in LP-IV estimation are clearly negative with and without CFMs after the first quarter of the shock, while the direction of gross inflows in LP-OLS estimation is still positive. This may indicate that the endogeneity issue is cured using instrument variables at least in this alternative specification. Since this specification excluding domestic interest rates uses a larger number of data observations, further study by enhancing the dataset will be needed.

[94] We provide the list of 18 economies in this alternative specification in Appendix A.

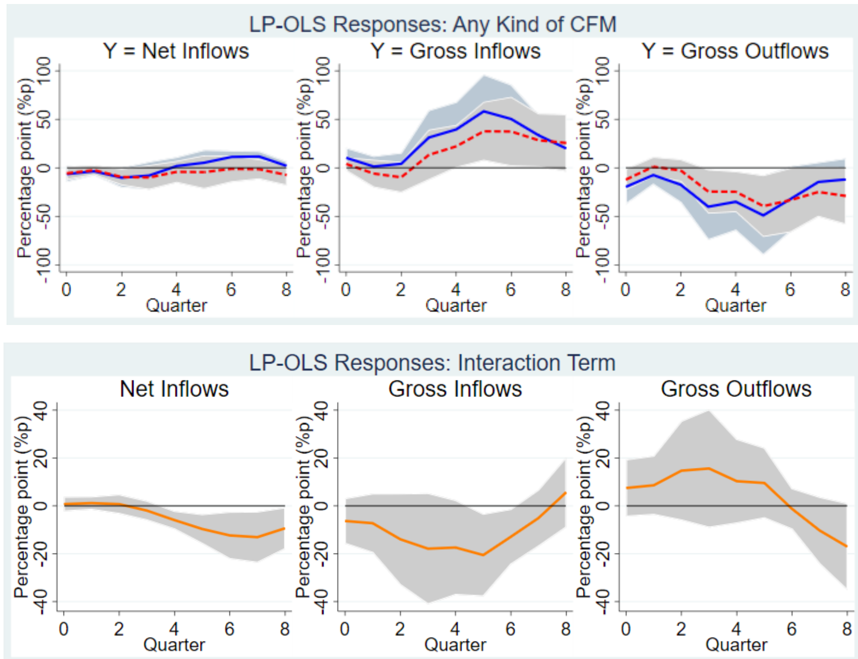


Figure 3.6. LP-OLS IRFs (Excluding Domestic Interest Rates)

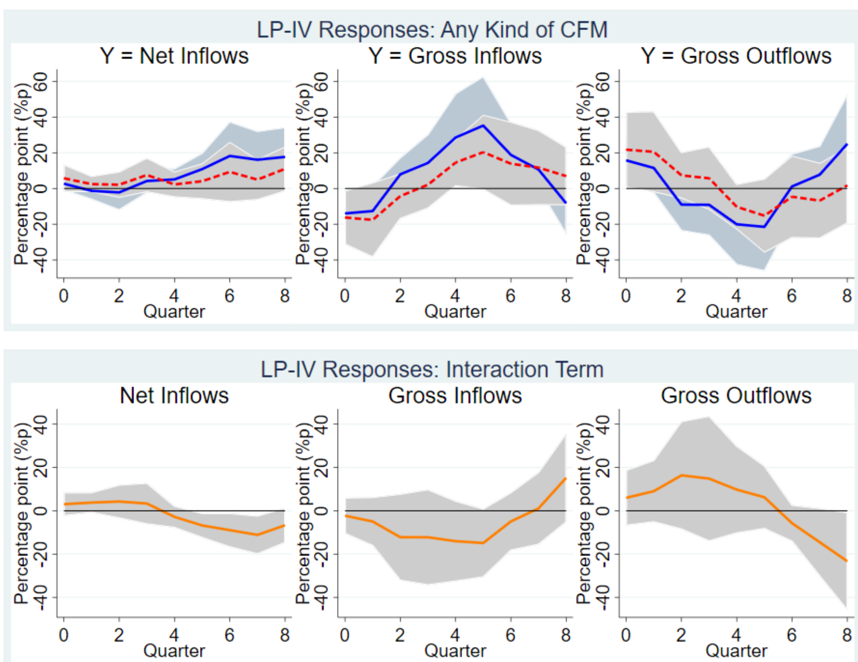


Figure 3.7. LP-IV IRFs (Excluding Domestic Interest Rates)

Specifically, we can see the mitigating effects are present with the alternative specifications in both LP-OLS and LP-IV. Although the magnitude of the effect is smaller compared to the LP-OLS results in Figure 3.2, both gross inflows and outflows are still dampened in the presence of CFMs. Since the impact on gross inflows and outflows also offset each other, the mitigation effect of the CFMs on the responses is not seen clearly in the first year after the foreign policy shock (the left panel in Figure 3.6 and Figure 3.7). Another thing to note is that the direction of net capital flows is different from the baseline results in Section 3, while those of gross inflows and outflows are quite similar. This also adds to the evidence that the effectiveness of CFMs on capital flows is more difficult to predict when using net rather than gross flows.

In the second alternative specification, we consider a model with no GFC dummy variables. In the baseline specifications in Section 3, the time dummies are incorporated to consider possible structural breaks during and after the GFC. As shown in Figure 3.8 and Figure 3.9, the results are similar when the GFC potential structural changes are abstracted from. We also find the mitigating effects of CFMs on gross inflows and outflows. In particular, the gross outflows with implementing CFMs clearly show the opposite direction as those without CFMs in the specification. In the presence of CFMs, we can expect that domestic agents actively sell their overseas investment to the extent that the gross outflows are returning to home countries. This may be consistent with the fact that there was a large retrenchment during the GFC (e.g., Broner et al., 2013). As the shocks fade away after approximately two years, the effect of CFMs also shrinks in LP-OLS and even reverts in LP-IV (but still mitigating towards zeroes) as depicted in the upper-right panels of Figure 3.8 and Figure 3.9.

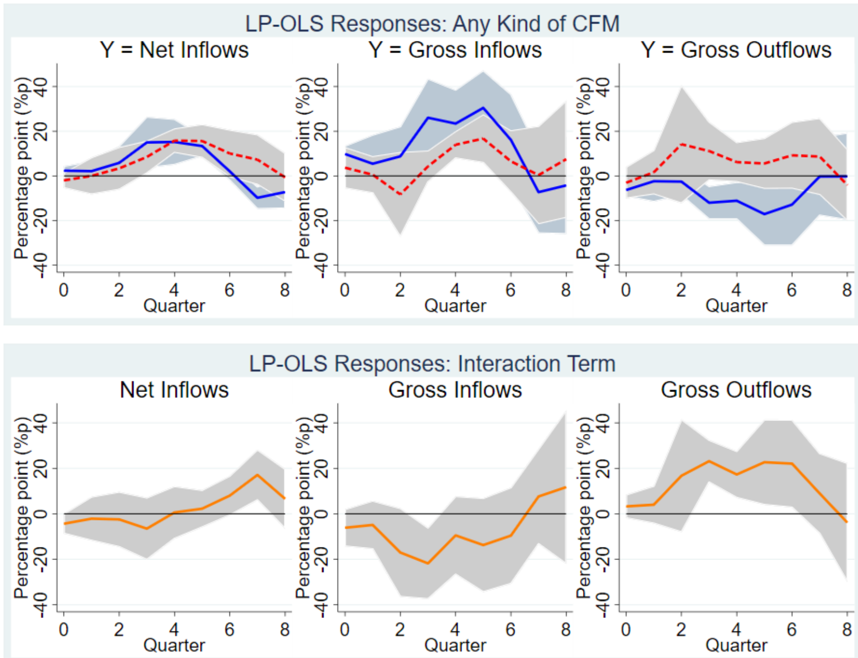


Figure 3.8. LP-OLS IRFs (without Time Dummy)

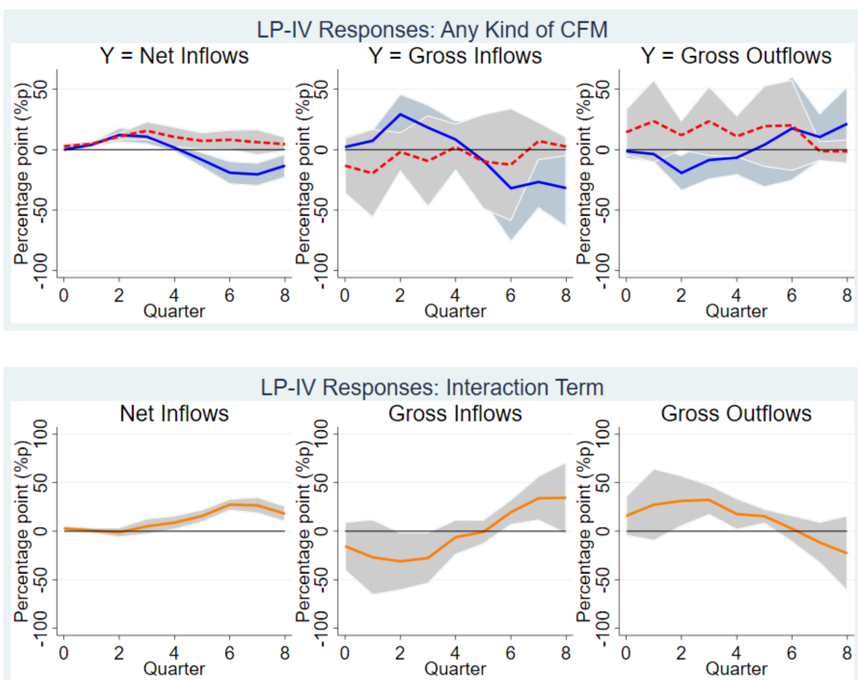


Figure 3.9. LP-IV IRFs (without Time Dummy)

In the third alternative specification, we change the number of periods in the lagged controls. The estimating equations are the same as Equations (1) and (2) except the length of lagged terms are 8 (two years) instead of 4 (one year). Setting longer periods of lagged terms as controls may help better capture the contemporaneous change of capital flows by interested independent variables. However, there is no golden rule about the most appropriate length for lagged terms in literature. We confirm that the baseline results do not change when we use more lagged control variables as shown in Figure 3.10 and Figure 3.11.[95] Especially, the LP-IV results in the baseline and the alternative specifications are closely aligned in terms of both direction and magnitude. LP-OLS specifications also show similar results in terms of direction.[96]

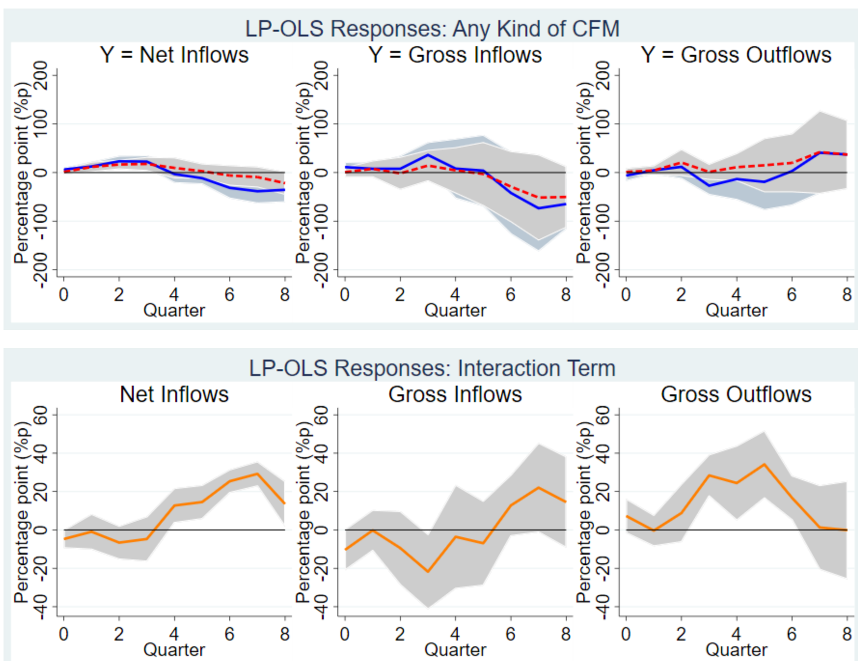


Figure 3.10. LP-OLS IRFs (with Two-Year Lagged Terms)

[95] We could see similar results when using 6 quarters for lagged terms ($J = 6$) as well.
[96] The magnitudes are also consistent between two specifications in the baseline and alternative specifications. The vertical axes are presented with different scales in Figure 3.2 and Figure 3.10.

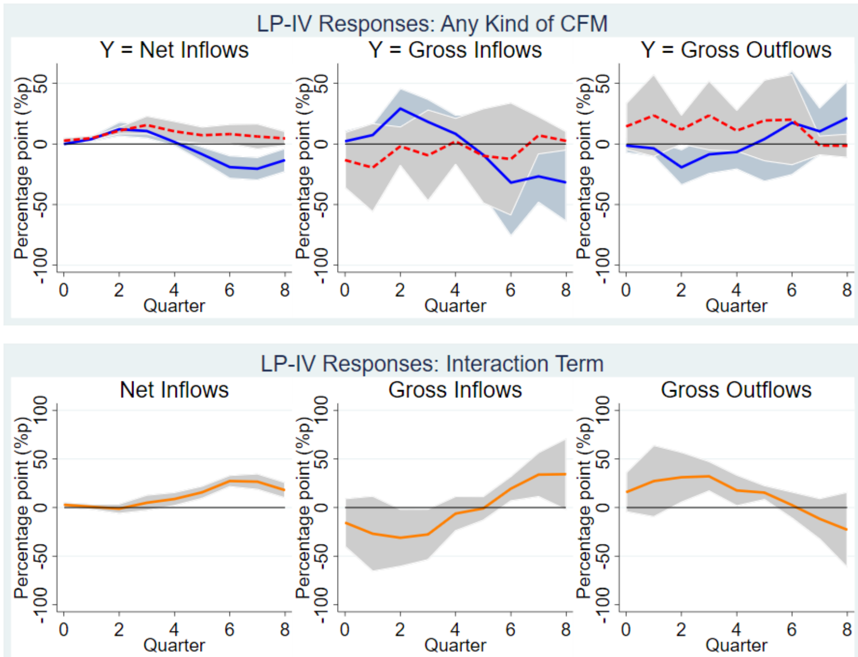


Figure 3.11. LP-IV IRFs (with Two-Year Lagged Terms)

Lastly, we use the lagged terms for CFMs dummies as main regressors in the fourth alternative specification. More specifically, we change $CFM_{i,t}$ to $CFM_{i,t-1}$ in Equations (1) and (2).[97] As noted earlier, this is due to possible endogeneity arising from CFM implementation and US monetary policy since both may be correlated to common global macroeconomic conditions. Instead of using instrument variables which are known to be difficult to find, one possible alternative way to tackle this issue is using the lagged variables by excluding contemporaneous CFMs dummies.[98] As a result, our focus is on previous implementations of CFMs, which causes a partial loss of the effect of current policies. The results under these setups show that the implications are very close to the baseline results in Section 3 as shown in Figure 3.12 and Figure 3.13. The similarity can be attributed to the fact that the CFM implementation does not change

[97] The periods of lagged terms in control variables for CFM dummies only are adjusted from t-j to t-1-j accordingly to avoid duplication in this alternative specification.
[98] Finding and using proper instrument variables can be an extension of this study.

frequently. This argument may be modified when we reflect the intensity of CFMs, which would be another area of further research.

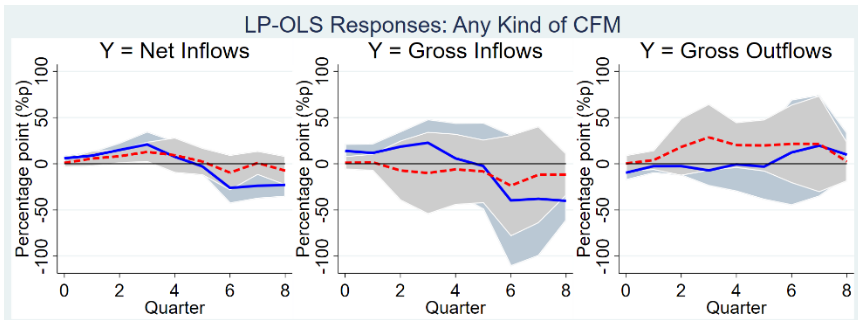


Figure 3.12. LP-OLS IRFs (with Lagged CFM Dummy)

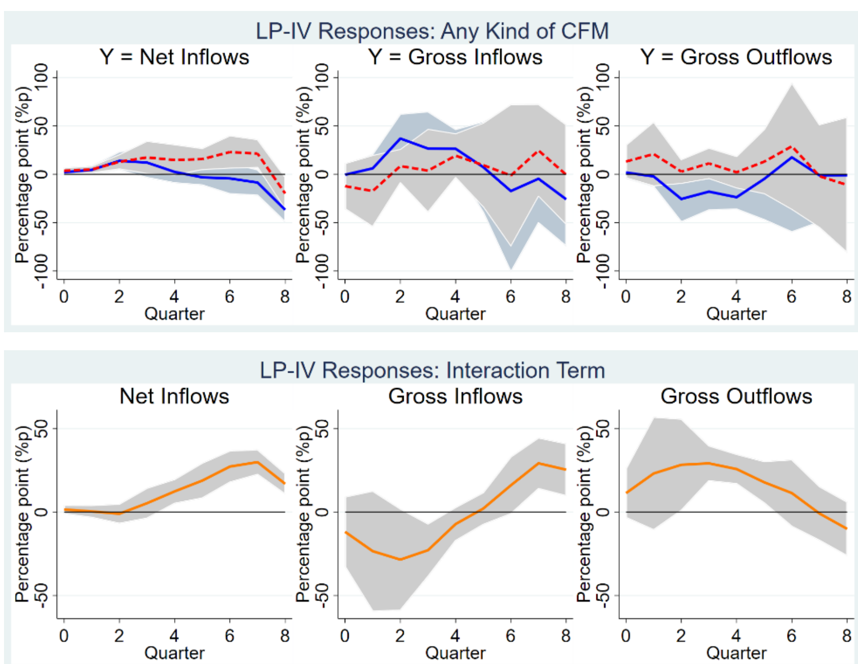


Figure 3.13. LP-IV IRFs (with Lagged CFM Dummy)

3.4.2 *Effects by Types of CFMs*

We further investigate the effects of different types of CFMs. In particular, we exploit the data from the IMF 2019 Taxonomy of CFMs, which disaggregate CFMs into several sub-categories.[99] The major distinction is between CFMs on capital inflows and CFMs on capital outflows. According to the IMF (2019), the data contains some details about CFMs including "whether they are designed to limit capital inflows and/or outflows" (p. 2). Here, unlike before where any type of CFMs was pooled into the same variable, we replace the policy dummy with specific types of CFMs (e.g., CFMs on inflows only) in Equations (1) and (2). This new specification is meant to capture the effect of each type of CFMs on capital flows in the event of foreign monetary shocks. One benefit of such disaggregation is that we can compare the results with our prior expectations for each type of CFMs. In general, we can expect that CFMs on inflows to affect the foreign investors' behavior and reduce gross inflows, while CFMs on outflows will reduce domestic investor's overseas investment (gross outflows). The results are largely consistent with our expectations, but not perfectly so, as described below.

The results from using CFMs on inflows in both LP-OLS and LP-IV specifications are shown in Figure 3.14 and Figure 3.15. We can see that the mitigating effects are still present on both gross inflows and outflows, similar to the baseline results in Figure 3.2 and Figure 3.3.[100] The mitigating effect on gross inflows are consistent with our expectation as CFMs on inflows directly target inflows. We do not expect that such effect exists for gross outflows considering the aim of the policy. However, the right panels of Figure 3.2 and Figure 3.3 both indicate that domestic

---

[99] The classification is based on the IMF's Institutional View on Capital Flows in Practice (2018). Examples of CFMs on inflows are taxes, reserve requirements and stamp duties on nonresident property transactions. Examples of CFMs on outflows include restrictions on financial institutions' overseas investment and surrender requirement of export proceeds. See IMF (2018) for more details.

[100] The similarity may originate from characteristics of economies in this specification. In other words, the economies more frequently use CFMs on Inflows than CFMs on Outflows. See Figure B.2 in Appendix B.

investors reduce the amount of overseas investment with the implementation of CFMs on inflows. This can be assumed as a limitation of this study, leaving an open question to be answered in future work.[101] Another thing to note is that CFMs on inflows will increase gross inflows in the later periods after 6 quarters in LP-OLS specification and from the second year in LP-IV specification. Although this confirms the mitigating effect during these periods, it is not consistent with the prior expectations as the purpose of the policy is to limit inflows.

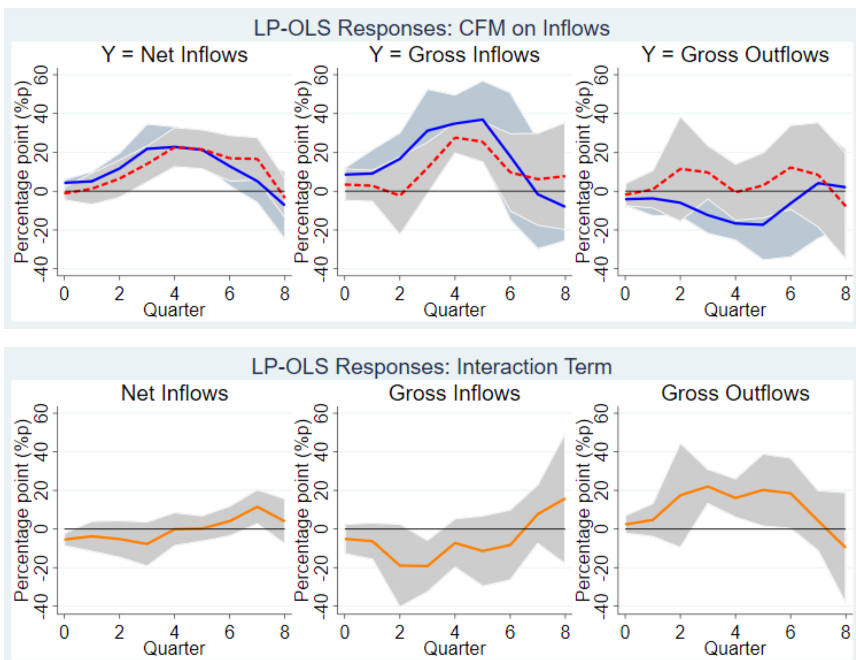


Figure 3.14. LP-OLS IRFs (with CFMs on Inflows)

[101] Alternative results with specifications that exclude domestic interest rates with more data observation show the mitigation effects are clearly reduced (see Appendix D for Figure D.1 and Figure D.2). We can investigate this further by increasing data size and reflecting the intensity of CFMs.

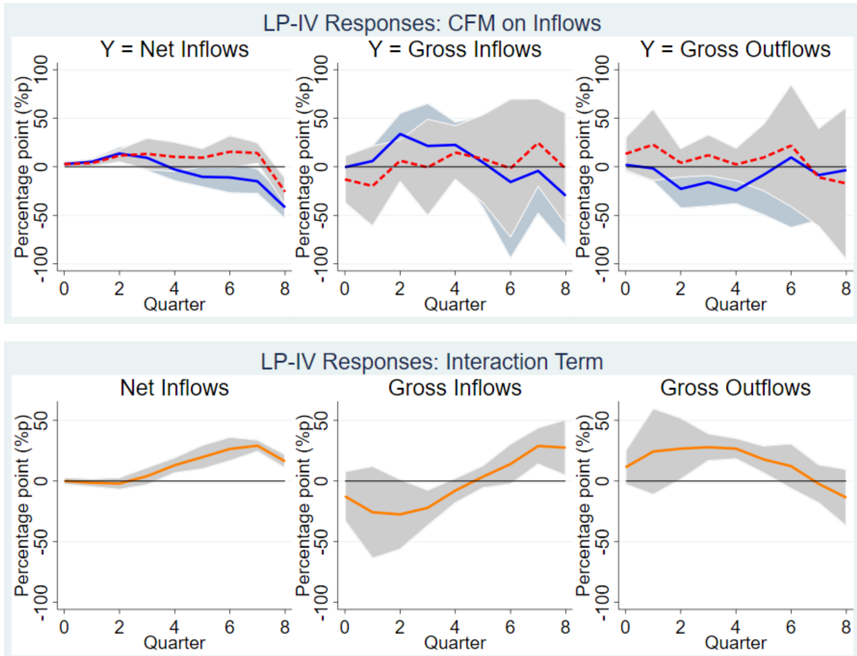


Figure 3.15. LP-IV IRFs (with CFMs on Inflows)

In both LP-OLS and LP-IV specifications, we can also see the mitigating effects on both gross inflows and outflows. As CFMs on outflows target outflows, the mitigating effect is more clearly seen with gross outflows compared to gross inflows. The results are largely consistent with our expectations. More specifically, we can expect a reduction of gross outflows; thus, the dashed lines should be placed above the solid lines in the upper-right panels in Figure 3.16 and Figure 3.17. The results from two quarters after the shocks are as expected.[102] The results with each type of CFMs are also robust to alternative specifications including four cases with i) no domestic interest rates, ii) no time dummy, iii) the longer period of lagged terms (8 instead of 4 quarters) and iv) the lagged CFMs.[103]

[102] For the first two quarters after the shocks, positive signs for solid lines in the upper-right panels in Figure 3.16 and Figure 3.17 imply that domestic investors tend to repatriate their overseas investment. As CFMs on outflows do not directly affect the behaviors, we cannot clearly see the mitigation effects in those periods.
[103] The results of alternative LP-OLS and LP-IV specifications are presented in Appendix D.

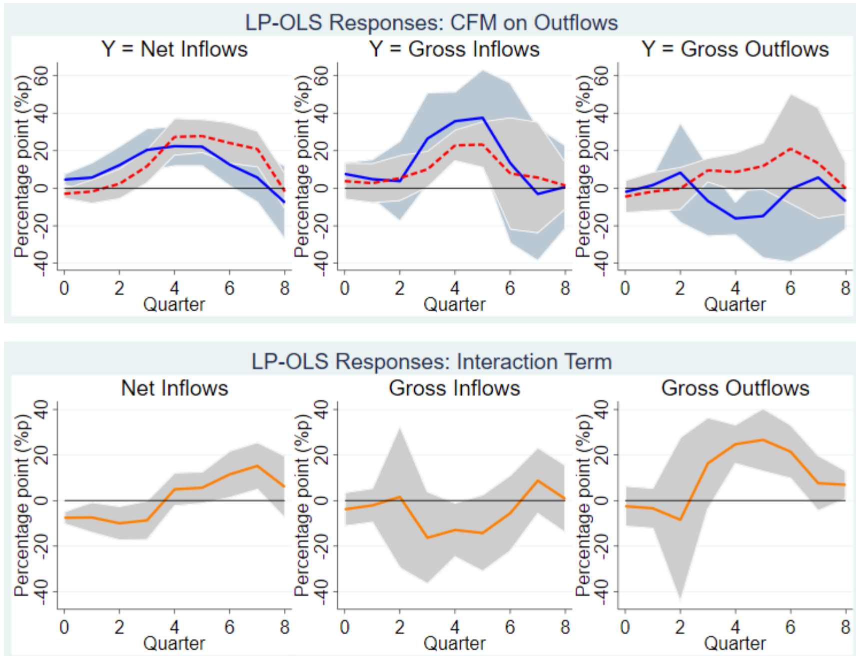


Figure 3.16. LP-OLS IRFs (with CFMs on Outflows)

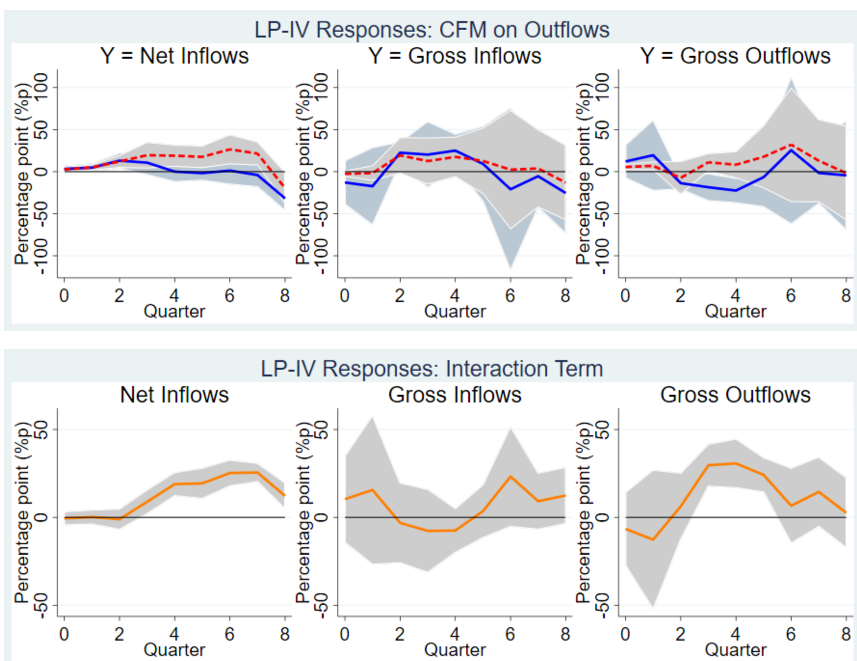


Figure 3.17. LP-IV IRFs (with CFMs on Outflows)

3.5 CONCLUSION

We assess the effectiveness of CFMs against major external shocks—namely, US monetary policy shocks—with an emphasis on the effects on gross capital flows relative to those on net flows. We focus on the case of CFMs applied in EMEs that have employed these policies during most of the last two decades. Our results, based on local projection estimations, suggest that CFMs are effective in mitigating the effect of US monetary shocks on these countries, and moreover, the impact of these policies can differ by types of capital flow. In fact, we are able to arrive to the latter conclusion by making the former distinction in our estimations (i.e., checking gross inflows and outflows separately), which is the feature we found relevant given the recent volume of gross outflows in EMEs.

In contrast to our main results, we find that the mitigating effect of CFMs on the impact of foreign policy shocks is not clear when analyzing net capital flows exclusively. We obtain evidence that the CFMs affect the sensitivity to international monetary shocks of both gross inflows and outflows. As a result, given the negative correlation between inflows and outflows in the last years, the expected effect on the net flows is rather fuzzy, i.e., a monetary shock can affect the net flows positively or negatively depending on whether it affects by more either side of the flows. Two potential lessons arise from this: First, the lack of consensus on the literature regarding the effect of CFMs may be explained by the offsetting effects of these policies on the different types of flows; and second, policymakers aiming to mitigate the effect of foreign shocks can be more effective by targeting different (or only some) types of flows with their regulations.

Considering these implications when designing policy or reacting to global policy innovations is paramount as prescriptions based only on net flows can lead to systematic policy mistakes. Instead, we propose that each global shock and its associated policy response be evaluated in the light of the effect it may have on each part of the flows (gross inflows and outflows) and the actual part of the net flows that the policymakers prioritize to target. On the other hand, it should be mentioned that the current data limitations do not make possible to fully analyze the effect of CFMs of different intensity. An analysis that controls for this, subject to future data developments, that perhaps, also allow for stronger identification strategies (on the side of CFMs) represent a promising venue for future explorations on this topic.

BIBLIOGRAPHY

Chapter 1

Batini, N., & Durand, L. (2021). Facing the Global Financial Cycle: What Role for Policy? *IMF Working Paper*, *34*. https://www.imf.org/-/media/Files/Publications/WP/2021/English/wpiea2021034-print-pdf.ashx

Benigno, G., Chen, H., Otrok, C., Rebucci, A., & Young, E. R. (2013). Financial crises and macro-prudential policies. *Journal of International Economics*, *89*(2), 453–470. https://doi.org/10.1016/j.jinteco.2012.06.002

Bianchi, J. (2011). Overborrowing and systemic externalities in the business cycle. *American Economic Review*, *101*(7), 3400–3426. https://doi.org/10.1257/aer.101.7.3400

Bianchi, J., & Mendoza, E. G. (2018). Optimal Time-Consistent Macroprudential Policy. *Journal of Political Economy*, *126*(2), 588–634. https://doi.org/10.1086/696280

Broner, F., Didier, T., Erce, A., & Schmukler, S. L. (2011). Gross Capital Flows: Dynamics and Crises. *The World Bank Policy Research Working Paper*, *5768*. https://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-5768

Caballero, Ricardo, J., & Simsek, A. (2020). A Model of Fickle Capital Flows and Retrenchment. *Journal of Political Economy*, *128*(6), 2288–2328. https://doi.org/10.1086/705719

Cavallo, E., Izquierdo, A., & León-Díaz, J. J. (2017). Domestic Antidotes to Sudden Stops. *IDB Working Paper*, *851*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3103801

Davis, J. S., & Van Wincoop, E. (2018). Globalization and the increasing correlation between capital inflows and outflows. *Journal of Monetary Economics*, *100*, 83–100. https://doi.org/10.101

Erten, B., Korinek, A., & Ocampo, J. (2019). Capital Controls: Theory and Evidence. *NBER Working Papers*, *w26447*. https://ssrn.com/abstract=3492877

Forbes, K. J., & Warnock, F. E. (2012). Capital flow waves: Surges, stops, flight, and retrenchment. *Journal of International Economics*, *88*(2), 235–251. https://doi.org/10.1016/j.jinteco.2012.03.006

Fornaro, L. (2015). Financial crises and exchange rate policy. *Journal of International Economics*, *95*(2), 202–215. https://doi.org/10.1016/j.jinteco.2014.11.009

International Monetary Fund. (2012). The Liberalization and Management of Capital Flows: An Institutional View. https://www.imf.org/external/np/pp/eng/2012/111412.pdf

International Monetary Fund. (2013). The Yin and Yang of Capital Flow Management: Balancing Capital Inflows with Capital Outflows. *World Economic Outlook*, *2*(4), 113–132. https://www.imf.org/~/media/Websites/IMF/imported-flagship-issues/external/pubs/ft/weo/2013/02/pdf/_c4pdf.ashx

International Monetary Fund. (2018). The IMF's Institutional View on Capital Flows in Practice. https://www.imf.org/external/np/g20/pdf/2018/073018.pdf

Jeanne, O., & Korinek, A. (2010). Excessive Volatility in Capital Flows: A Pigouvian Taxation Approach. *American Economic Review*, *100*(2), 403–407. https://doi.org/10.1257/aer.100.2.403

Jeanne, O., & Korinek, A. (2010b). Managing credit booms and busts: A Pigouvian taxation approach. *NBER Working Papers*, *w16377*. https://doi.org/10.1016/j.jmoneco.2018.12.005

Jeanne, O., & Korinek, A. (2019). Managing credit booms and busts: A Pigouvian taxation approach. *Journal of Monetary Economics*, *107*, 2–17. https://doi.org/10.1016/j.jmoneco.2018.12.005

Jeanne, O., & Sandri, D. (2020). Global Financial Cycle and Liquidity Management. *NBER Working Papers*, *w27901*. https://doi.org/10.3386/w27901

Justiniano, A., & Preston, B. (2010). Can structural small open-economy models account for the influence of foreign disturbances?. *Journal of International Economics, 81(1)*, 61-74.

Lubik, T. (2007). Non-stationarity and instability in small open-economy models even when they are 'closed'. *FRB Richmond Economic Quarterly, 93(4)*, 393-412.

Rebucci, A., & Ma, C. (2019). Capital Controls: A Survey of the New Literature. *NBER Working Papers, w26558*. https://doi.org/10.2139/ssrn.3495987

Chapter 2

Agnello, L., Mallick, S. K., & Sousa, R. M. (2012). Financial Reforms and Income Inequality. *Economics Letters*, 116(3), 583–587. https://doi.org/10.1016/j.econlet.2012.06.005

Amadi, A. A., & Bergin, P. R. (2008). Understanding international portfolio diversification and turnover rates. *Journal of International Financial Markets*, Institutions and Money, 18(2), 191–206. https://doi.org/10.1016/j.intfin.2006.09.003

Baldacci, E., De Mello, L., & Inchauste, G. (2002). Financial Crises, Poverty, and Income Distribution. *Macroeconomic Policies and Poverty Reduction*, 269.

Benigno, G., Fornaro, L., & Wolf, M. (2020). The Global Financial Resource Curse. *FRB of New York Staff Report No. 915.* https://ssrn.com/abstract=3541304

Bodea, C., Houle, C., & Kim, H. (2021). Do Financial Crises Increase Income Inequality? *World Development*, 147. https://doi.org/10.1016/j.worlddev.2021.105635

Bordo, M. D., & Meissner, C. M. (2012). Does Inequality Lead to a Financial Crisis? *Journal of International Money and Finance*, *31*(8), 2147–2161. https://doi.org/10.1016/j.jimonfin.2012.05.006

Broner, F., Didier, T., Erce, A., & Schmukler, S. L. (2011). Gross Capital Flows: Dynamics and Crises. *The World Bank Policy Research Working Paper, 5768*. https://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-5768

Bumann, S., & Lensink, R. (2016). Capital Account Liberalization and Income Inequality. *Journal of International Money and Finance*, *61*, 143–162. https://doi.org/10.1016/j.jimonfin.2015.10.004

Caballero, R. J., Farhi, E., & Gourinchas, P. O. (2008). An equilibrium model of global imbalances and low interest rates. American Economic Review, 98(1), 358–393. https://doi.org/10.1257/aer.98.1.358

Cavallo, E., Izquierdo, A., & León-Díaz, J. J. (2017). Domestic Antidotes to Sudden Stops. *IDB Working Paper*, *851*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3103801

Chatterjee, S., & Naknoi, K. (2007). The Marginal Product of Capital, Capital Flows and Convergence. *Purdue University Economics Working Papers*, *1202*, Purdue University, Department of Economics.

Chatterjee, S., & Naknoi, K. (2010). The Marginal Product of Capital, Capital Flows, and Convergence. *American Economic Review*, *100*(2), 73-77.

Constantinides, G. M. (1986). Capital Market Equilibrium with Transaction Costs. *Journal of Political Economy (Vol. 94, Issue 4)*. https://www.jstor.org/stable/1833205

Cúrdia, V., & Woodford, M. (2016). Credit Frictions and Optimal Monetary Policy. *Journal of Monetary Economics*, 84, 30–65. https://doi.org/10.1016/j.jmoneco.2016.10.003

de Haan, J., & Sturm, J. E. (2017). Finance and Income Inequality: A Review and New Evidence. *European Journal of Political Economy*, 50, 171–195. https://doi.org/10.1016/j.ejpoleco.2017.04.007

Delis, M. D., Hasan, I., & Kazakis, P. (2014). Bank Regulations and Income Inequality: Empirical Evidence. *Review of Finance*, 18(5), 1811–1846. https://doi.org/10.1093/rof/rft039

Forbes, K. J., & Warnock, F. E. (2012). Capital flow waves: Surges, stops, flight, and retrenchment. *Journal of International Economics*, *88*(2), 235–251. https://doi.org/10.1016/j.jinteco.2012.03.006

Frost, J., & van Stralen, R. (2018). Macroprudential Policy and Income Inequality. *Journal of International Money and Finance*, *85*, 278–290. https://doi.org/10.1016/j.jimonfin.2017.11.010

Furceri, D., Loungani, P. & Ostry, J. D. (2019). The Aggregate and Distributional Effects of Financial Globalization: Evidence from Macro and Sectoral Data. *Journal of Money, Credit and Banking*, *51*(S1), 163–198. https://doi.org/10.1111/jmcb.12668

Furceri, D., & Loungani, P. (2018). The Distributional Effects of Capital Account Liberalization. *Journal of Development Economics*, *130*, 127–144. https://doi.org/10.1016/j.jdeveco.2017.09.007

Georgescu, O. M., & Martin, D. V. (2021). Do Macroprudential Measures Increase Inequality? Evidence from the Euro Area Household Survey. *ECB Working Paper Series*, *2567*. http://dx.doi.org/10.2139/ssrn.3870018

Korinek, A., & Sandri, D. (2016). Capital Controls or Macroprudential Regulation? *Journal of International Economics*, *99*, S27–S42. https://doi.org/10.1016/j.jinteco.2016.02.001

Liu, Z., Spiegel, M. M., & Zhang, J. (2020). Capital Controls and Income Inequality. *Federal Reserve Bank of San Francisco, Working Paper Series*, 01–51. https://doi.org/10.24148/wp2020-14

Mendoza, E. G., Quadrini, V., & Ríos-Rull, J.-V. (2009). Financial Integration, Financial Development, and Global Imbalances. *Journal of Political Economy (Vol. 117, Issue 3).* https://www.journals.uchicago.edu/doi/full/10.1086/599706

Rowland, P. F. (1999). Transaction costs and international portfolio diversification. *Journal of International Economics*, 49(1), 145–170. https://doi.org/10.1016/S0022-1996(98)00059-2

Uppal, R. (1993). A General Equilibrium Model of International Portfolio Choice. *Journal of Finance (Vol. 48, Issue 2).* https://doi.org/10.1111/j.1540-6261.1993.tb04726.x

Villalvazo, S. (2021). Inequality and Asset Prices during Sudden Stops. *Working Paper*. https://96415c6f-104e-4735-949f-5ee021a6e80c.filesusr.com/ugd/18e8a4_194855b4c0534bc39995181f1d634258.pdf

Chapter 3

Ahmed, S., & Zlate, A. (2014). Capital flows to emerging market economies: A brave new world? *Journal of International Money and Finance*, *48*, 221-248.

Akinci, O., & Olmstead-Rumsey, J. (2018). How effective are macroprudential policies? An empirical investigation. *Journal of Financial Intermediation*, *33*, 33-57.

Baba, C., & Kokenyne, A. (2011). Effectiveness of Capital Controls in Selected Emerging Markets in the 2000's. International Monetary Fund.

Batini, N., & Durand, L. (2021). Facing the Global Financial Cycle: What Role for Policy. International Monetary Fund.

Broner, F., Didier, T., Erce, A., & Schmukler, S. L. (2013). Gross capital flows: Dynamics and crises. *Journal of Monetary Economics*, *60*(1), 113-133.

Bu, C., Rogers, J., & Wu, W. (2021). A unified measure of Fed monetary policy shocks. *Journal of Monetary Economics*, *118*, 331-349. https://doi.org/10.1016/j.jmoneco.2020.11.002

Cavallo, E., Izquierdo, A., & León-Díaz, J. J. (2017). Domestic Antidotes to Sudden Stops. *IDB Working Paper*, *851*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3103801

Cavallo, E., Powell, A., Pedemonte, M., & Tavella, P. (2015). A new taxonomy of Sudden Stops: Which Sudden Stops should countries be most concerned about? *Journal of International Money and Finance*, *51*, 47-70.

Cavallo, E. A. (2019). International Capital Flow Reversals (Sudden Stops). *Oxford Research Encyclopedia of Economics and Finance*.

Cerutti, E., Correa, R., Fiorentino, E., & Segalla, E. (2018). Changes in prudential policy instruments-a new cross-country database. *48th issue (March 2017) of the International Journal of Central Banking*.

Coman, A., & Lloyd, S. (2019). In the Face of Spillovers: Prudential Policies in Emerging Economies. *Bank of England Working Paper*, *828*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3460538

Coman, A., & Lloyd, S. P. (2022). In the face of spillovers: Prudential policies in emerging economies. *Journal of International Money and Finance*, *122*. https://doi.org/10.1016/j.jimonfin.2021.102554

Davis, J. S., & Van Wincoop, E. (2018). Globalization and the increasing correlation between capital inflows and outflows. *Journal of Monetary Economics*, *100*, 83-100. https://doi.org/10.1016/j.jmoneco.2018.07.009

Erten, B., Korinek, A., & Ocampo, J. A. (2021). Capital controls: Theory and evidence. *Journal of Economic Literature*, *59(1), 45-89*. https://doi.org/10.1257/jel.20191457

Forbes, K., Fratzscher, M., & Straub, R. (2015). Capital-flow management measures: What are they good for? *Journal of International Economics*, *96*, S76-S97.

Forbes, K. J., & Warnock, F. E. (2012). Capital flow waves: Surges, stops, flight, and retrenchment. *Journal of International Economics*, *88*(2), 235-251. https://doi.org/10.1016/j.jinteco.2012.03.006

Gertler, M., & Karadi, P. (2015). Monetary Policy Surprises, Credit Costs, and Economic Activity. *American Economic Journal: Macroeconomics*, *7*(1), 44-76. https://doi.org/10.1257/mac.20130329

Haug, A. A., & Smith, C. (2012). Local linear impulse responses for a small open economy. *Oxford Bulletin of Economics and Statistics*, *74*(3), 470-492.

International Monetary Fund (2013). The Yin and Yang of Capital Flow Management: Balancing Capital Inflows with Capital Outflows. *World Economic Outlook*, *2*(4), 113-132. https://www.imf.org/~/media/Websites/IMF/imported-flagship-issues/external/pubs/ft/weo/2013/02/pdf/_c4pdf.ashx

International Monetary Fund (2018). The IMF's Institutional View on Capital Flows in Practice. https://www.imf.org/external/np/g20/pdf/2018/073018.pdf

International Monetary Fund (2019). IMF 2019 Taxonomy of Capital Flow Management Measures. https://www.imf.org/en/~/media/1699259C6D1246119C1A43AC544973B6.ashx

Jordà, Ò. (2005). Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review*, *95*(1), 161-182. https://doi.org/10.1257/0002828053828518

Jordà, Ò., Schularick, M., & Taylor, A. M. (2020). The effects of quasi-random monetary experiments. *Journal of Monetary Economics*, *112*, *22-40*. https://doi.org/10.1016/j.jmoneco.2019.01.021

Kalemli-Özcan, Ș. (2019). U.S. Monetary Policy and International Risk Spillovers. *NBER Working Papers*, *w26297*. http://www.nber.org/papers/w26297

Miranda-Agrippino, S. (2016) Unsurprising Shocks: Information, Premia, and the Monetary Transmission. *Bank of England Working Paper No. 626*. http://dx.doi.org/10.2139/ssrn.2865585

Plagborg-Møller, M., & Montiel-Olea, J. (2020). Local Projection Inference is Simpler and More Robust Than You Think. *Econometrica, 89(4), 1789-1823*. https://doi.org/10.3982/ECTA18756

Rey, H. (2015). Dilemma not trilemma: the global financial cycle and monetary policy independence (No. w21162). National Bureau of Economic Research.

Richter, B., Schularick, M., & Shim, I. (2019). The costs of macroprudential policy. *Journal of International Economics, 118, 263-282*. https://doi.org/10.1016/j.jinteco.2018.11.011

Romer, C. D., & Romer, D. H. (2004). A New Measure of Monetary Shocks: Derivation and Implications. *American Economic Review*, *94*(4), 1055-1084. https://doi.org/10.1257/0002828042002651

APPENDIX 1.A: DERIVATION WITH ASYMMETRY PARAMETER

Budget Constraints and Collateral Constraint

$$c_0 + \gamma_1 Q_0 = d_1^i + (1-\theta_1)P_0 \qquad \text{(where } \gamma_1 Q_0 = d_1^o\text{)} \qquad (1.A.1)$$

$$c_1 + d_1^i = e + d_2^i + (\theta_1 - \theta_2)P_1 + (\gamma_1 - \gamma_2)Q_1 \qquad \text{(where } \gamma_2 Q_1 = d_2^o\text{)} \qquad (1.A.2)$$

$$c_2 + d_2^i = \theta_2 y + \gamma_2 Q_2 \qquad (1.A.3)$$

$$d_2^i \leq \theta_1 P_1 + \boldsymbol{\kappa}\gamma_1 Q_1 \qquad (1.A.4)$$

Competitive Equilibrium (Laissez-faire)

Taking net worth $m_1 (\equiv e - d_1^i + \gamma_1 Q_1 \equiv m_1^i + \gamma_1 Q_1)$ as given, the domestic agent solves for the period-1 equilibrium first:

$$V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u(c_1) + c_2 + \lambda_{ce}\left(\theta_1 P_1 + \boldsymbol{\kappa}\gamma_1 Q_1 - d_2^i\right), \text{ or}$$

$$V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u\left(e - d_1^i + d_2^i + (\theta_1 - \theta_2)P_1 + (\gamma_1 - \gamma_2)Q_1\right) + \theta_2 y + \gamma_2 Q_2 - d_2^i$$
$$+\lambda_{ce}\left(\theta_1 P_1 + \boldsymbol{\kappa}\gamma_1 Q_1 - d_2^i\right). \qquad (1.A.5)$$

By substituting $d_2^i = \theta_1 P_1 + \boldsymbol{\kappa}\gamma_1 Q_1$, the budget constraint in period 1 becomes as follows:

$$c_1 = m_1^i + \theta_1 P_1 + \boldsymbol{\kappa}\gamma_1 Q_1 + (\theta_1 - \theta_2)P_1 + (\gamma_1 - \gamma_2)Q_1 \text{ (where } \gamma_2 Q_1 = d_2^o\text{)},$$

$$c_1 = m_1^i + (2\theta_1 - \theta_2)P_1 + ((1+\boldsymbol{\kappa})\gamma_1 - \gamma_2)Q_1 \qquad \text{(where } m_1^i \equiv e - d_1^i\text{), or}$$

$$c_1 = m_1 + (2\theta_1 - \theta_2)P_1 + (\boldsymbol{\kappa}\gamma_1 - \gamma_2)Q_1 \qquad \text{(where } m_1 \equiv m_1^i + \gamma_1 Q_1\text{)}. \; (1.A.6)$$

If I assume $\theta_t = 1$ in equilibrium, the equations above can be re-written by substituting domestic and foreign asset pricing equations:

$$c_1 = m_1^i + \frac{y + ((1+\boldsymbol{\kappa})\gamma_1 - \gamma_2)Q_2}{u\prime(c_1)} \quad \text{or} \quad c_1 = m_1 + \frac{y + (\boldsymbol{\kappa}\gamma_1 - \gamma_2)Q_2}{u\prime(c_1)}. \qquad (1.A.7)$$

One thing to note here is that if I assume that $\boldsymbol{\kappa}\gamma_1 = \gamma_2$, the second equation in (A.7) presents the same formula as Jeanne and Korinek (2010)'s study as below:

$$c_1 = m_1^i + \frac{y + \gamma_1 Q_2}{u\prime(c_1)} \quad \text{or} \quad c_1 = m_1 + \frac{y}{u\prime(c_1)}. \qquad (1.A.8)$$

In period 0, with anticipating the period-1 equilibrium, the representative domestic agent solves period-0 maximization problem as below:

$$\mathcal{L}_{ce} = \max_{d_1^i, \gamma_1, \theta_1} u(c_0) + E_0 V_{ce}(m_1)$$

$$\text{where } V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u(c_1) + c_2 + \lambda_{lf}\left(\theta_1 \overline{P_1}, + \boldsymbol{\kappa}\gamma_1 \overline{Q_1} - d_2^i\right),$$

$$\mathcal{L}_{ce} = \max_{d_1^i, \gamma_1 \theta_1} u\left(d_1^i + (1 - \theta_1)P_0 - \gamma_1 Q_0\right)$$

$$+ E_0\left[u(c_1) + \theta_2 y + \gamma_2 Q_2 - d_2^i + \lambda_{ce}\left(\theta_1 \overline{P_1} + \boldsymbol{\kappa}\gamma_1 \overline{Q_1} - d_2^i\right)\right]$$

where $c_1 = m_1^i + (2\theta_1 - \theta_2)\overline{P_1} + ((1+\boldsymbol{\kappa})\gamma_1 - \gamma_2)\overline{Q_1}$ (where $m_1^i \equiv e - d_1^i$), or

$$c_1 = m_1 + (2\theta_1 - \theta_2)\overline{P_1} + (\boldsymbol{\kappa}\gamma_1 - \gamma_2)\overline{Q_1} \text{ (where } m_1 \equiv m_1^i + \gamma_1 Q_1). \qquad (1.A.9)$$

The FOC with respect to d_1^i gives $u'(c_0) = E_0[u'(c_1)]$, and this equation can determine period-0 equilibrium borrowing, d_1^i. Since the left-hand-side decreases and the right-hand-side increases in d_1^i, a unique solution can be derived. The FOCs for θ_1 and γ_1 provide asset pricing equations.[104]

---

[104] $P_0 = E_0\left[\left\{(2u'(c_1) + \lambda_{lf}\right\}\overline{P_1}\right]/u'(c_0)$, $Q_0 = E_0\left[\left\{(1+\boldsymbol{\kappa})u'(c_1) + \boldsymbol{\kappa}\lambda_{lf}\right\}\overline{Q_1}\right]/u'(c_0)$

Social Planner Allocation and Pigouvian Tax

I can write the same reduced form for period-1 equilibrium consumption and asset prices as increasing functions of net worth, $c(m_1), P(m_1)$ and $Q(m_1)$.[105] Anticipating this period-1 equilibrium, the social planner solves period-0 maximization problem as below:

$$\mathcal{L}_{sp} = \max_{d_1^i, \gamma_1, \theta_1} u(c_0) + E_0 V_{sp}(m_1)$$

where $V_{sp}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u\big(c(m_1)\big) + c_2 + \lambda_{sp}\big(\theta_1 P(m_1) + \boldsymbol{\kappa}\gamma_1 Q(m_1) - d_2^i\big)$,

$P(m_1) = y/u'(c_1)$, and $Q(m_1) = \mathrm{Q}_2/u'(c_1)$, $c_1 = c(m_1)$.

Note that first derivatives with respect to d_1^i are $-P'(m_1)$, $-Q'(m_1)$, and $-c'(m_1)$.

$$\mathcal{L}_{sp} = \max_{d_1^i, \gamma_1 \theta_1} u\big(d_1^i + (1-\theta_1)\mathrm{P}_0 - \gamma_1 \mathrm{Q}_0\big)$$

$$+E_0\left[u\big(c(m_1)\big) + \theta_2 y + \gamma_2 \mathrm{Q}_2 - d_2^i + \lambda_{sp}\left(\frac{\theta_1 y + \boldsymbol{\kappa}\gamma_1 \mathrm{Q}_2}{u'(c_1)} - d_2^i\right)\right]$$

where $c_1 = m_1^i + (2\theta_1 - \theta_2)\overline{\mathrm{P}_1} + ((1+\boldsymbol{\kappa})\gamma_1 - \gamma_2)\overline{\mathrm{Q}_1}$ (where $m_1^i \equiv e - d_1^i$), or

$$c_1 = m_1 + (2\theta_1 - \theta_2)\overline{\mathrm{P}_1} + (\boldsymbol{\kappa}\gamma_1 - \gamma_2)\overline{\mathrm{Q}_1} \quad \text{(where } m_1 \equiv m_1^i + \gamma_1 \mathrm{Q}_1\text{)} \qquad (1.A.10)$$

by internalizing $P(m_1) = y/u'(c_1)$ and $Q(m_1) = \mathrm{Q}_2/u'(c_1)$. The FOC for d_1^i gives $u'(c_0) = E_0\big[u'(c_1) + \lambda_{sp}\{\theta_1 P'(m_1) + \boldsymbol{\kappa}\gamma_1 Q'(m_1)\}\big]$.

The social planner, who internalizes the impact of borrowing on asset prices in the collateral constraints, will decide the optimal level of borrowing using following FOC for d_1^i: $u'(c_0) = E_0\big[u'(c_1) + \lambda_{sp}\{\theta_1 P'(m_1) + \boldsymbol{\kappa}\gamma_1 Q'(m_1)\}\big]$. Focusing on a constrained equilibrium with binding collateral constraint ($\lambda_{sp} > 0$), it can be inferred that in the case of large κ (> 1), the social planner will make the agents consume and borrow *even less* in period 0 than laissez-faire decision in the benchmark model (κ = 1).

[105] Note that net worth $m_1(\equiv e - d_1^i + \gamma_1 \mathrm{Q}_1 \equiv m_1^i + \gamma_1 \mathrm{Q}_1)$ in period 1 does not depend on the size of κ.

The externalities can be corrected by Pigouvian taxation on borrowing. The optimal level of borrowing (gross capital inflows) can be implemented in a decentralized economy with a tax rate τ_1^i on period-0 borrowing d_1^i and the tax is rebated in a lump-sum fashion. The budget constraints in periods 0 and 1 are now modified as follows:

$$c_0 + \gamma_1 \mathrm{Q}_0 = (1-\tau_1^i)d_1^i + (1-\theta_1)\mathrm{P}_0 \tag{1.A.11}$$

$$c_1 + d_1^i = e + d_2^i + (\theta_1 - \theta_2)\mathrm{P}_1 + (\gamma_1 - \gamma_2)\mathrm{Q}_1 + Transfer. \tag{1.A.12}$$

Anticipating the same period-1 equilibrium (since the lump-sum transfer does not change the results), the representative domestic agent under the Pigouvian tax solves period-0 maximization problem again in period 0:

$$\mathcal{L}_{ce} = \max_{d_1^i, \gamma_1, \theta_1} u\big((1-\tau_1^i)d_1^i + (1-\theta_1)\mathrm{P}_0 - \gamma_1 \mathrm{Q}_0\big) + E_0 V_{ce}(m_1)$$

$$\text{where } V_{ce}(m_1) = \max_{d_2^i, \gamma_2, \theta_2} u(c_1) + c_2 + \lambda_{ce}\big(\theta_1 \overline{P_1}, + \boldsymbol{\kappa}\gamma_1 \overline{\mathrm{Q}_1} - d_2^i\big). \tag{1.A.13}$$

The FOC with respect to d_1^i gives $u'(c_0) = E_0[u'(c_1)]/(1-\tau_1^i)$. The optimal tax rate can be obtained by equating two FOCs for d_1^i under laissez-faire with tax and social planner's allocation: $u'(c_0) = E_0[u'(c_1)]/(1-\tau_1^i) = E_0\big[u'(c_1) + \lambda_{sp}\{\theta_1 P'(m_1) + \boldsymbol{\kappa}\gamma_1 Q'(m_1)\}\big]$. This yields optimal tax rate as:

$$\tau_1^{i,*} = \frac{E_0\big[\lambda_{sp}\{\theta_1 P\prime(m_1) + \boldsymbol{\kappa}\gamma_1 Q\prime(m_1)\}\big]}{E_0\big[u\prime(c_1) + \lambda_{sp}\{\theta_1 P\prime(m_1) + \boldsymbol{\kappa}\gamma_1 Q\prime(m_1)\}\big]}. \tag{1.A.14}$$

The results are also consistent with the model of Jeanne and Korinek (2010).

APPENDIX 1.B: NUMERICAL ILLUSTRATION

I basically follow the methodology and parameter values by Jeanne and Korinek (2010) in order to compare the results with their study that use net flows.

Assumptions

I use log utility functions for periods 0 and 1, so that lifetime utility of representative agents in Equation (1) becomes: $U = \log(c_0) + \log(c_1) + c_2$. The endowment shock in period 1 is assumed to be uniformly distributed in $[\bar{e} - \varepsilon, \bar{e} + \varepsilon]$. I assume $\theta_t = 1$ and $\gamma_1 = \gamma_2$ in equilibrium. The domestic agent holds its endowed domestic asset until period 2. Also, the domestic agent invests in foreign assets and re-invest them all in period 1 (and holds them until period 2).

Equation (9), $c_1 = m_1^i + \frac{y + \gamma_1 Q_2}{u\prime(c_1)}$, has a solution $c_1 \geq 0$ if and only if $m_1^i = e - d_1^i \geq 0$. For the lowest realization of e (= $\bar{e} - \varepsilon$), the inequality should also hold. This implies the condition that $\varepsilon < \bar{e} - d_1^i$. To ensure the uniqueness of equilibrium, the following condition should hold: $(y + (2\gamma_1 - \gamma_2)Q_2)\frac{d\left(1/u'(c)\right)}{dc} = y + \gamma_1 Q_2 < 1$. By defining $m_1^{i*}(\equiv 1 - y - \gamma_1 Q_2) > 0$, the equilibrium level of consumption is as follows: $c_1 = \min\left(\frac{m_1^i}{m_1^{i*}}, c^*\right)$. Domestic asset pricing equation ($P_1 = y/u'(c_1)$) implies that $P_1 = yc_1 = y * \min\left(\frac{m_1^i}{m_1^{i*}}, 1\right)$.

I focus on the situation where the economy is constrained with a non-zero probability. If $\bar{e} < 1 + m_1^{i*} + \gamma_1 Q_0 + \varepsilon$, then there is a positive probability that the collateral constraint binds in period 1. The constraint binds if and only if $m_1^i < m_1^{i*}$, or equivalently, $e < m_1^{i*} + d_1^i$. As a result, the calibrations of parameters should satisfy the condition (B.1) so that the economy will not be constrained without uncertainty ($\varepsilon = 0$), but may be constrained for significantly large endowment shocks.

$$1 + m_1^{i*} + \gamma_1 Q_0 < \bar{e} < 1 + m_1^{i*} + \gamma_1 Q_0 + \varepsilon \tag{1.B.1}$$

Competitive Equilibrium

Suppose that the economy is constrained in period 1 with a positive probability. The FOC, $u'(c_0) = E_0[u'(c_1)]$, can determine period-0 equilibrium level of borrowing, d_1^i. This level, denoted as $d_1^{i,ce}$, can be solved by using the uniform distribution of endowment shocks.

$$LHS = u'(c_0) = \frac{1}{c_0} = \frac{1}{d_1^i - \gamma_1 Q_0}$$

$$RHS = E_0[u'(c_1)] = E_0\left[\frac{1}{c_1}\right] = E_0\left[\frac{1}{\min\left(\frac{m_1^i}{m_1^{i*}}, 1\right)}\right] = E_0\left[\frac{1}{\min\left(\frac{e - d_1^i}{m_1^{i*}}, 1\right)}\right]$$

$$= \frac{1}{2\varepsilon}\int_{\bar{e}-\varepsilon}^{+d_1^i} \frac{m_1^{i*}}{e - d_1^i}\, de + \frac{1}{2\varepsilon}\int_{m_1^{i*}+d_1^i}^{\bar{e}+\varepsilon} 1\ de$$

$$= \frac{1}{2\varepsilon}\left[m_1^{i*}\log\left(\frac{m_1^{i*}}{\bar{e} - \varepsilon - d_1^i}\right) + \bar{e} + \varepsilon - m_1^{i*} - d_1^i\right] \tag{1.B.2}$$

Since $c_1 < 1$ in the constrained region and $c_1 = 1$ in the unconstrained region, $E_0[u'(c_1)] > 1$ with a log-utility form (and this is same for strictly concave utility form). This implies $d_1^i < 1 + \gamma_1 Q_0$. Also, $d_1^i > \bar{e} - \varepsilon - m_1^{i*}$ from the assumption that the economy is constrained with a non-zero probability. In the range of $[\bar{e} - \varepsilon - m_1^{i*}, 1 + \gamma_1 Q_0]$, LHS is strictly decreasing and RHS is strictly increasing with d_1^i. ($\frac{\partial RHS}{\partial d_1^i} = \frac{1}{2\varepsilon}\left[\frac{m_1^{i*}}{\bar{e} - \varepsilon - d_1^i} - 1\right]$) This means there is a unique solution d_1^i in this range. The solution can be numerically solved given the parameters m_1^{i*}, $\bar{e}$, ε, and $\gamma_1 Q_0$.

Social Planner Allocation and Pigouvian Tax

From the optimality condition, $u'(c_1) = 1 + \lambda_{ce}$, it can be shown that $\lambda_{ce} = \frac{1}{c_1} - 1 = \left(\frac{m_1^{i*}}{m_1^i} - 1\right)^+$.

From the asset pricing equations for domestic and foreign assets, $P(m_1) = y * \min\left(\frac{m_1^i}{m_1^{i*}}, 1\right)$ and $Q(m_1) = Q_2 * \min\left(\frac{m_1^i}{m_1^{i*}}, 1\right)$, $P'(m_1) = \frac{y}{m_1^{i*}}$ and $Q'(m_1) = \frac{Q_2}{m_1^{i*}}$ in constrained region ($m_1^i < m_1^{i*}$) and $P'(m_1) = Q'(m_1) = 0$ in unconstrained region ($m_1^i > m_1^{i*}$).

Now the period-0 FOC for social planner, $u'(c_0) = E_0\left[u'(c_1) + \lambda_{sp}\{P'(m_1) + \gamma_1 Q'(m_1)\}\right]$ can determine period-0 equilibrium level of borrowing, d_1^i. This level, denoted as $d_1^{i,sp}$, can also be solved using the similar method as competitive equilibrium.

$$LHS = u'(c_0) = \frac{1}{c_0} = \frac{1}{d_1^i - \gamma_1 Q_0}$$

$$RHS = E_0\left[u'(c_1) + \lambda_{sp}\left\{P'^{(m_1)} + \gamma_1 Q'^{(m_1)}\right\}\right]$$

$$= E_0\left[\frac{1}{\min\left(\frac{e-d_1^i}{m_1^{i*}}, 1\right)} + \lambda_{sp}\left\{P'^{(m_1)} + \gamma_1 Q'^{(m_1)}\right\}\right]$$

$$= \frac{1}{2\varepsilon}\int_{\bar{e}-\varepsilon}^{m_1^{i*}+d_1^i}\left(\frac{1}{e-d_1^i} + 1 - \frac{1}{m_1^{i*}}\right) de + \frac{1}{2\varepsilon}\int_{m_1^{i*}+d_1^i}^{\bar{e}+\varepsilon} 1 \; de$$

$$= 1 + \frac{1}{2\varepsilon}\left[\log\left(\frac{m_1^{i*}}{\bar{e}-\varepsilon-d_1^i}\right) - 1 - \frac{d_1^i - \bar{e} + \varepsilon}{m_1^{i*}}\right] \quad (1.B.3)$$

Numerically, I confirm that, in the range of $[\bar{e} - \varepsilon - m_1^{i*}, 1 + \gamma_1 Q_0]$, the borrowing level determined by the social planner is smaller than the borrowing level chosen by private domestic agent. This implies there exists excessive borrowing (overborrowing) in period 0. $d_1^{i,sp}$ satisfies

$$\bar{e} - \varepsilon - m_1^{i*} < d_1^{i,sp} < d_1^{i,ce} < 1 + \gamma_1 Q_0 \quad (1.B.4)$$

The social planner can impose tax on borrowing. From the equation (15), the optimal tax rate on borrowing (gross inflows) satisfies

$$\tau_1^{i,*} = \frac{E_0[\lambda_{sp}\{P'(m_1)+\gamma_1 Q'(m_1)\}]}{E_0[u'(c_1)+\lambda_{sp}\{P'(m_1)+\gamma_1 Q'(m_1)\}]}, \text{ or}$$

$$\frac{1}{1-\tau_1^{i,*}} = \frac{E_0[u\prime(c_1)+\lambda_{sp}\{P\prime(m_1)+\gamma_1 Q\prime(m_1)\}]}{E_0[u\prime(c_1)]} = \frac{1}{(d_1^i-\gamma_1 \mathrm{Q}_0)E_0[u\prime(c_1)]} \quad (1.B.5)$$

From Equation (B.2) evaluated at $d_1^{i.sp}$ and (B.3),

$$E_0[u'(c_1)] = \frac{1}{2\varepsilon}\left[m_1^{i*}\log\left(\frac{m_1^{i*}}{\bar{e}-\varepsilon-d_1^{i,sp}}\right)+\bar{e}+\varepsilon-m_1^{i*}-d_1^{i,sp}\right] = m_1^{i*}\left(\frac{1}{d_1^{i,sp}}-1\right)+1 \quad (1.B.6)$$

This implies

$$\frac{1}{1-\tau_1^{i,*}} = 1+\frac{\tau_1^{i,*}}{1-\tau_1^{i,*}} = \frac{1}{(d_1^i-\gamma_1 \mathrm{Q}_0)} * \frac{1}{m_1^{i*}\left(\frac{1}{d_1^{i,sp}}-1\right)+1} = \frac{1}{\left(1-\frac{\gamma_1 \mathrm{Q}_0}{d_1^{i,sp}}\right)\left(m_1^{i*}+(1-m_1^{i*})d_1^{i,sp}\right)}, \text{ or}$$

$$\tau_1^{i,*} = 1-\left(1-\frac{\gamma_1 \mathrm{Q}_0}{d_1^{i,sp}}\right)\left(m_1^{i*}+(1-m_1^{i*})d_1^{i,sp}\right) \quad (1.B.7)$$

It is also worth noting that when using a different notation for tax rate ($\dot{\tau}$) from Jeanne and Korinek (2010), there exists one-to-one relationship as follows: $1+\dot{\tau} \equiv \frac{1}{1-\tau^i}$.

Calibration

Following Jeanne and Korinek (2010), I also use the same parameter values for the mean of endowment shock ($\bar{e} = 1.3$) and return of domestic asset in period 2 ($y = 0.8$). For the sake of simplicity, I additionally assume that foreign asset price in period 2 is same as the price of foreign asset in period 0 as well as the return for domestic asset ($\mathrm{Q}_2 = \mathrm{Q}_0 = y$). By doing so, I can eliminate the search-for-yield motives of domestic agents. Thus, numerical solutions depend on parameters values y, $\bar{e}$, ε and γ_1. By using the parameter values, for ε between 0 and 0.3 using evenly spaced grid with 50 grid points, I compute the numerical solution for $d_1^{i,ce}$, $d_1^{i,sp}$ and $\tau_1^{i,*}$

I derive the range of parameter value for γ_1 from the condition that ensures the uniqueness of equilibrium, $(\gamma_1 Q_2 < 1 - y)$. This implies that $\gamma_1 Q_2$ is strictly less than 0.2, or γ_1 cannot exceed 0.25 given $y = 0.8$. In the numerical illustration, I estimate $\gamma_1 Q_0$ by using the 10-year average gross capital outflows to GDP ratio in 26 economies across the world that introduced capital flow management.

Table B.1. Parameters Values

Group A (from Jeanne and Korinek, 2010)	Group B (new in this study)
• $\bar{e} = 1.3$ • $y = 0.8$	• $\gamma_1\ (= \gamma_2) = 0.04\ (< 0.25)$ • $Q_2 = Q_0\ (= y) = 0.8$

The estimates for $\gamma_1 (= 0.04)$ is calculated as follows. First, I construct the annual dataset from 2011 to 2020 for 36 economies that introduced capital flow management since 2000 according to IMF 2019 Taxonomy of Capital Flow Management Measures. Then, I calculate the nominal GDP in U.S. dollars by using the nominal GDP in domestic currency and the nominal exchange rates using period average exchange rate in the IMF International Financial Statistics data. To obtain gross capital outflows data, I follow the method by Cavallo et al. (2017). From the IMF Balance of Payment (BoP) data, I sum up net acquisition of financial assets for all components in financial accounts including direct investment, portfolio investment, financial derivatives, and other investment. The values are denominated by US dollars. Due to the lack of data, six economies in

Group 3 of Table B.2 are excluded. The statistics are reported in Table B.2. The medians are 3.0% in Group 1 and 3.2% by adding Group 2.[106] This implies the estimate for γ_1 is 4.0% or 0.04.

Table B.2. Gross Capital Outflows to GDP Ratio

	Economies included	Statistics
Group 1 (26 economies)	Argentina (2.9), Australia (0.5), Barbados (8.4), Belarus (8.4), Bolivia (1.5), Brazil (3.5), Canada (8.3), China, P.R.: Mainland (3.3), Costa Rica (2.5), Ecuador (4.5), Georgia (3.5), India (3.2), Indonesia (1.4), Kazakhstan (5.0), Korea (6.0), Madagascar (2.2), Malaysia (7.8), New Zealand (0.3), Nigeria (2.2), North Macedonia (3.6), Peru (2.0), Russia (3.2), Seychelles (1.7), Sri Lanka (0.4), Ukraine (2.2), Uzbekistan (3.9)	Median = <u>3.0%</u> Average = 3.3% Max = 8.4% Min = 0.3%
Group 1 and 2 (30 economies)	Group 1, China, P.R.: Hong Kong (43.8), China, P.R.: Macao (45.7), Singapore (50.2), Iceland (-10.4)	Median = 3.2% Average = 7.1%
Group 3 (6 economies)	Cyprus, Democratic Republic of Congo, Ghana, Greece, Liberia, CEMAC	-

The numbers inside ( ) indicate 10-year average gross capital outflows to GDP ratio in percentage from 2011 to 2020.

Numerical Illustration

In the numerical illustration using the specific parameters values, I focus on the region where ε is between 0.1 and 0.28. From condition (B.1), for $\varepsilon > \bar{e} - 1 - m_1^{i*} - \gamma_1 Q_0 = 0.1$, the constraint is binding with positive probability, where this study is focused on. The size of borrowing (d_1^i) increases as the size of endowment shock increases, but d_1^i reaches its upper limit set by the condition on borrowing $d_1^i < 1 + \gamma_1 Q_0 = 1.032$. This corresponds to $\varepsilon \cong 0.275$.

I find that given the same endowment shocks with 10% maximum deviation ($\varepsilon \cong 0.13$) from the mean, $\bar{e}$, optimal tax rate on borrowing (gross inflows) is around 2.1%. When I restrict

[106] Using domestic consumption instead of GDP, I find the similar results: the median is 4.0%. In this case, estimates for γ_1 becomes 5% (0.05). This slightly increases optimal tax rates from 2.1% to 2.2% for $\varepsilon \cong 0.13$.

$\gamma_1 = 0$ to exclude the foreign asset channel, the optimal tax rate is only 1.3%, which is the same as Jeanne and Korinek (2010). This shows that, considering gross outflows, the optimal tax rate on gross inflows should be (0.8%p or 57%) higher considering the increased unintended side effect (externalities) of borrowing via foreign asset price channel. If the size of shock is large as $\varepsilon \cong 0.27$, then, the social planner should impose 10.1% tax on borrowing, and this is 1.6%p or 19% higher than the optimal tax rates, 8.5%, which is derived from no foreign investment assumption that corresponds to Jeanne and Korinek (2010)'s study.

The left panel of Figure B.1 shows the probabilities of sudden stops calculated using the uniformly distributed endowment shocks, and the right panel of Figure B.1 illustrates $d_1^{i,ce}$ and $d_1^{i,sp}$ over the range of maximum endowment shock parameter (ε). The difference of optimal level of borrowing in competitive equilibrium and the social planner's allocation implies the size of overborrowing. For example, given the endowment shock, $\varepsilon \cong 0.13$, the social planner can reduce the size of borrowing by imposing 2.1% tax, and this will help alleviate the probability of sudden stops by 3.7%p (from 9.7% to 6.0%).[107]

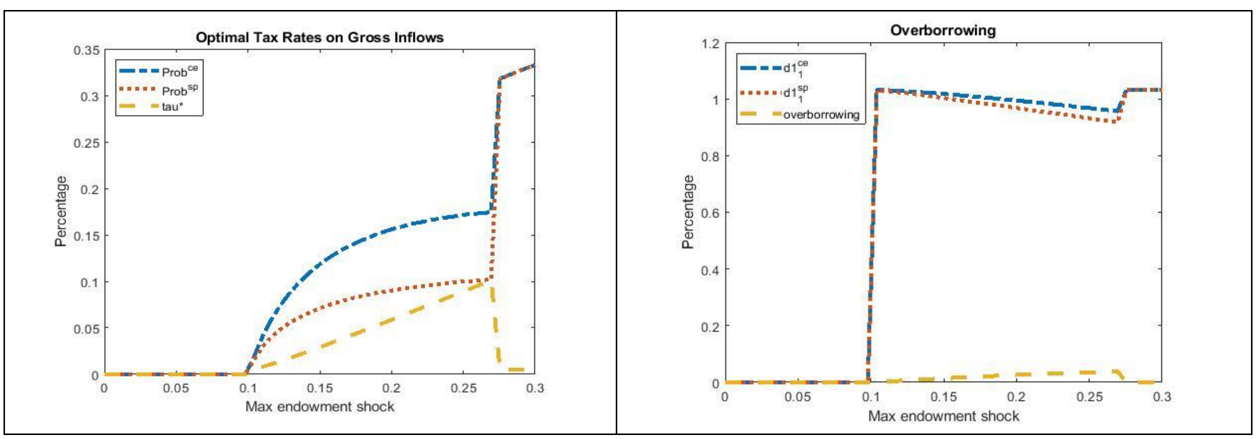


Figure B.1. Optimal Tax Rates on Borrowing ($\gamma_1 = 0.04$)

[107] The probability of sudden stop is calculated using the uniform distribution following Jeanne and Korinek (2010): $Prob^{ce} = \frac{1}{2\varepsilon}\int_{\bar{e}-\varepsilon}^{m_1^{i*}+d_1^i} 1\ de = \frac{1}{2} - \frac{\bar{e}-m_1^{i*}-d_1^{i,ce}}{2\varepsilon}$ and $Prob^{sp} = \frac{1}{2\varepsilon}\int_{\bar{e}-\varepsilon}^{m_1^{i*}+d_1^i} 1\ de = \frac{1}{2} - \frac{\bar{e}-m_1^{i*}-d_1^{i,sp}}{2\varepsilon}$.

APPENDIX 2.A: COMPARISON OF RESULTS/PROPOSITIONS

	Liu et al. (2020)[108] (with risk premium assumption)	**Present study**[109] (with discount assumption)
Domestic lending rate (R_l)	[Proposition IV.1] "In the steady-state equilibrium, the lending rate $R_l(\tau_d, \tau_l)$ decreases with τ_d ($\frac{\partial R_l}{\partial \tau_d} < 0$) and increases with τ_l ($\frac{\partial R_l}{\partial \tau_l} > 0$)."	[Proposition I] In the steady-state equilibrium, the domestic lending rate $R_l(\tau_l)$ increases with τ_l ($\frac{\partial R_l}{\partial \tau_l} > 0$). <u>However, R_l does not depend on τ_d</u> ($\frac{\partial R_l}{\partial \tau_d} = 0$).
Aggregate output (Y)	[Proposition IV.2] "In the steady state equilibrium, aggregate output $Y(\tau_d, \tau_l)$ increases with τ_d ($\frac{\partial Y}{\partial \tau_d} > 0$) and decreases with τ_l ($\frac{\partial Y}{\partial \tau_l} < 0$)."	[Proposition II] In the steady state equilibrium, aggregate output $Y(\tau_l)$ decreases with τ_l ($\frac{\partial Y}{\partial \tau_l} < 0$). <u>However, Y does not depend on τ_d</u> ($\frac{\partial Y}{\partial \tau_d} = 0$).
Domestic deposit rate (R)	"…liberalizing capital outflow controls (decreasing τ_d) raises the domestic deposit rate."	[Proposition III] In the steady-state equilibrium, the deposit rate $R(\tau_d, \tau_l)$ decreases with τ_d ($\frac{\partial R}{\partial \tau_d} < 0$) <u>and increases with τ_l</u> ($\frac{\partial R}{\partial \tau_l} > 0$).
Household's labor income (W_h^l)	"… from Proposition IV.2, the household's labor income increases with τ_d and decreases with τ_l."	From Proposition II, the household's labor income decreases with τ_l, <u>however, does not depend on τ_d</u>.

[108] For comparison, I directly quote the propositions and results from Liu et al. (2020).
[109] The different outcomes from Liu et al. (2020) are underlined.

Household's capital income (W_h^c)	[Proposition IV.3] "In the steady-state equilibrium, the household's capital income W_h^c decreases with τ_l ($\frac{\partial W_h^c}{\partial \tau_l} < 0$)." "Furthermore, if the labor share α in production is sufficiently large, then W_h^c also decreases with τ_d ($\frac{\partial W_h^c}{\partial \tau_d} < 0$)."	[Proposition IV] In the steady-state equilibrium, the household's capital income W_h^c decreases with τ_d ($\frac{\partial W_h^c}{\partial \tau_d} < 0$). However, if the labor share α in production is sufficiently large, then W_h^c increases with τ_l ($\frac{\partial W_h^c}{\partial \tau_l} > 0$).
Entrepreneur's labor income (W_e^l)	"…the entrepreneur's labor income increases with the outflow tax and decreases with the inflow tax, as does the household labor income."	In the steady state, the entrepreneur's labor income decreases with τ_l, however, does not depend on τ_d.
Entrepreneur's capital income (W_e^c)	[Proposition IV.4] "If the labor share α is sufficiently large, then the entrepreneur's capital income W_e^c decreases with τ_d ($\frac{\partial W_e^c}{\partial \tau_d} < 0$) and increases with τ_l ($\frac{\partial W_e^c}{\partial \tau_l} > 0$)."	[Proposition V] If the labor share α is sufficiently large, then the entrepreneur's capital income W_e^c increases with τ_l ($\frac{\partial W_e^c}{\partial \tau_l} > 0$). However, W_e^c does not depend on τ_d ($\frac{\partial W_e^c}{\partial \tau_d} = 0$).
Household's relative capital income (W^c)	[Proposition IV.5] "The household's relative capital income W^c decreases with both τ_d and τ_l ($\frac{\partial W^c}{\partial \tau_d} < 0$ and $\frac{\partial W^c}{\partial \tau_l} < 0$)."	[Proposition VI] The household's relative capital income W^c decreases with τ_d ($\frac{\partial W^c}{\partial \tau_d} < 0$). However, under some conditions of ($\frac{1}{(R-1)}\frac{\partial R}{\partial \tau_l} > \frac{1}{(R_l-1)}\frac{\partial R_l}{\partial \tau_l}$), W^c increases with τ_l ($\frac{\partial W^c}{\partial \tau_l} > 0$).

APPENDIX 2.B: STEADY STATE SOLUTION

This section largely follows the Appendix (Steady State Solution) of Liu et al. (2020).

The entrepreneur's intertemporal optimizing decisions are as below:

$$1 = E_t \beta R_{lt} \frac{\Lambda^o_{e,t+1}}{\Lambda^y_{et}} \tag{2.B.1}$$

$$q^k_t + \frac{\Omega_k}{2}\left(\frac{\mathrm{I}_t}{K^o_t} - \frac{\bar{I}}{\bar{K}^o}\right)^2 - \Omega_k\left(\frac{\mathrm{I}_t}{K^o_t} - \frac{\bar{I}}{\bar{K}^o}\right)\frac{\mathrm{I}_t}{K^o_t} = E_t \beta [q^k_{t+1}(1-\delta) + r^k_{t+1}] \frac{\Lambda^o_{e,t+1}}{\Lambda^y_{et}} \tag{2.B.2}$$

$$1 + \Omega_k\left(\frac{\mathrm{I}_t}{K^o_t} - \frac{\bar{I}}{\bar{K}^o}\right) = E_t \beta [q^k_{t+1}(1-\delta) + r^k_{t+1}] \frac{\Lambda^o_{e,t+1}}{\Lambda^y_{et}} \tag{2.B.3}$$

where $\Lambda^y_{et} = \frac{1}{C^y_{et}}$ and $\Lambda^o_{et} = \frac{1}{C^o_{et}}$ are the Lagrangian multipliers.

Equation (B.1) – (B.3) imply that, in the steady state, the entrepreneur's return to capital equals the domestic lending rate:

$1 - \delta + r^k = R_l$, or equivalently,

$$r^k = R_l - 1 + \delta = \frac{R^*}{(1-\tau_l)} - 1 + \delta. \tag{2.B.4}$$

Entrepreneur's labor income share is constant as below:

$$\frac{W^l_e}{Y} = \alpha(1-\theta). \tag{2.B.5}$$

Define $\frac{N_e}{Y}$ as the ratio of the entrepreneur's net worth to output:

$$\frac{N_e}{Y} \equiv \frac{K}{Y} - \frac{B}{Y} - \frac{B^l_f}{Y}. \tag{2.B.6}$$

From the entrepreneur's budget constraint,

$$\frac{C^y_e}{Y} = \alpha(1-\theta) - \frac{N_e}{Y}, \tag{2.B.7}$$

$$\frac{C^o_e}{Y} = R_l \frac{N_e}{Y}. \tag{2.B.8}$$

By substituting into the entrepreneur's optimal borrowing condition in Equation (B.1),

$$1 = \beta R_l \frac{\alpha(1-\theta)-\frac{N_e}{Y}}{R_l \frac{N_e}{Y}}, \text{ or}$$

$$\frac{N_e}{Y} = \frac{\beta\alpha(1-\theta)}{1+\beta}. \tag{2.B.9}$$

The entrepreneur's capital income is as follows:

$$\frac{W_e^c}{Y} = (R_l - 1)\frac{N_e}{Y} = (R_l - 1)\frac{\beta\alpha(1-\theta)}{1+\beta} = \left(\frac{R^*}{1-\tau_l} - 1\right)\frac{\beta\alpha(1-\theta)}{1+\beta}. \tag{2.B.10}$$

Then, I can express $\frac{B}{Y}$ as a function of the deposit rate R.

$$\frac{B}{Y} = \left(\frac{\frac{R_l}{R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}} = \left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}}. \tag{2.B.11}$$

Now I can solve for $\frac{K}{Y}$.

$$\frac{K}{Y} = \frac{1-\alpha}{r^k} = \frac{1-\alpha}{R_l-1+\delta} = \frac{1-\alpha}{\frac{R^*}{1-\tau_l}-1+\delta}. \tag{2.B.12}$$

From equation (B.9), (B.11) and (B.12), I can derive $\frac{B_f^l}{Y}$ by substituting into Equation (B.6).

$$\frac{N_e}{Y} \equiv f(R,\tau_d,\tau_l) = \frac{1-\alpha}{\frac{R^*}{1-\tau_l}-1+\delta} - \left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}} - \frac{B_f^l}{Y} = \frac{\beta\alpha(1-\theta)}{1+\beta}, \text{ or}$$

$$\frac{B_f^l}{Y} = \frac{1-\alpha}{\frac{R^*}{1-\tau_l}-1+\delta} - \left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}} - \frac{\beta\alpha(1-\theta)}{1+\beta}. \tag{2.B.13}$$

Lastly, I can solve for Y by using Equation (15): $r_t^k \mathrm{K}_{t-1} = (1-\alpha)\mathrm{Y}_t$ as follows:

$$Y = \left(\frac{K}{Y}\right)^{\frac{1-\alpha}{\alpha}} = \left(\frac{1-\alpha}{r^k}\right)^{\frac{1-\alpha}{\alpha}} = \left(\frac{1-\alpha}{R_l-1+\delta}\right)^{\frac{1-\alpha}{\alpha}} = \left(\frac{1-\alpha}{\frac{R^*}{1-\tau_l}-1+\delta}\right)^{\frac{1-\alpha}{\alpha}}. \tag{2.B.14}$$

Now I can solve for the domestic deposit rate R. Recall The household's intertemporal optimizing decisions.

$$1 = E_t \beta R_t \frac{\Lambda^o_{h,t+1}}{\Lambda^y_{ht}} \tag{2.B.15}$$

where $\Lambda^y_{ht} = \frac{1}{C^y_{ht}}$ and $\Lambda^o_{ht} = \frac{1}{C^o_{ht}}$ are the Lagrangian multipliers.

$$R_t = (1-\tau_d) R^*_t \Psi\left(\frac{B^d_{ft}}{Y_t}\right) \tag{2.B.16}$$

where $\Psi\left(\frac{B^d_{ft}}{Y_t}\right) = exp\left[\Psi_d\left(\kappa_d - \frac{B^d_{ft}}{Y_t}\right)\right]$.

Household's labor income share is constant as below:

$$\frac{W^l_h}{Y} = \alpha\theta. \tag{2.B.17}$$

Define $\frac{S_h}{Y}$ as the ratio of the household's total saving to output:

$$\frac{S_h}{Y} \equiv \frac{D}{Y} + \frac{B^d_f}{Y}. \tag{2.B.18}$$

From the household's budget constraint,

$$\frac{C^y_h}{Y} = \alpha\theta - \frac{S_h}{Y} \tag{2.B.19}$$

$$\frac{C^o_h}{Y} = R\frac{S_h}{Y}. \tag{2.B.20}$$

I substitute the above expressions into the household's optimal saving condition in Equation (B.15). Then, I can explicitly solve for the ratio of the household's total saving to output:

$$\frac{S_h}{Y} = \frac{\beta\alpha\theta}{1+\beta}. \tag{2.B.21}$$

Now, I can express $\frac{D}{Y}$ and $\frac{B^d_{ft}}{Y_t}$ as functions of of the deposit rate R. Recall Equation (B.11) that expresses $\frac{B}{Y}$ as a function of R. Then, I use the bank's binding budget constraint in Equation (18): $R_{lt}B_t = R_t D_t$.

$$\frac{D}{Y} = \frac{R_l}{R}\frac{B}{Y} = \frac{R_l}{R}\left(\frac{\frac{R_l}{R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}} = \frac{R^*}{(1-\tau_l)R}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}}. \tag{2.B.22}$$

Then, I solve for $\frac{B_f^d}{Y_t}$ by using Equation (5) and (7) as follows:

$$R_t = (1-\tau_d)R_t^* exp\left[\Psi_d\left(\kappa_d - \frac{B_{ft}^d}{Y_t}\right)\right], \text{ or}$$

$$\frac{B_f^d}{Y_t} = \kappa_d - \frac{1}{\Psi_d} ln\left(\frac{R}{(1-\tau_d)R^*}\right). \quad (2.B.23)$$

Finally, I can use the expressions in Equation (B.18), (B.21), (B.22) and (B.23) to solve for R as a function of parameters (e.g., τ_d and τ_l):

$$\frac{S_h}{Y} \equiv \frac{D}{Y} + \frac{B_f^d}{Y} = \frac{R^*}{(1-\tau_l)R}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}} + \kappa_d - \frac{1}{\Psi_d} ln\left(\frac{R}{(1-\tau_d)R^*}\right) = \frac{\beta\alpha\theta}{1+\beta}. \quad (2.B.24)$$

APPENDIX 2.C: PROOFS OF PROPOSITIONS

This part is based on the Appendix (Proof for Proposition IV.1,3,4 and 5) of Liu et al. (2020).

Proof of Proposition III. (Related to R, Domestic deposit rate)

The function $f(R(\tau_d,\tau_l),\tau_d,\tau_l)$ is given by equation (B24) as follows:

$$f(R(\tau_d,\tau_l),\tau_d,\tau_l) = \frac{R^*}{(1-\tau_l)R}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}} + \kappa_d - \frac{1}{\Psi_d} ln\left(\frac{R}{(1-\tau_d)R^*}\right) = \frac{\beta\alpha\theta}{1+\beta}. \quad (2.C.1)$$

Since $\frac{\beta\alpha\theta}{1+\beta}$ is constant, the first derivates of $f(\cdot)$ with respect to τ_d and τ_l both equal zeros.

$$\frac{\partial f}{\partial\tau_d} = f_1\frac{\partial R}{\partial\tau_d} + f_2 = 0 \quad (2.C.2)$$

$$\frac{\partial f}{\partial\tau_l} = f_1\frac{\partial R}{\partial\tau_l} + f_3 = 0. \quad (2.C.3)$$

where $f_1 < 0$, $f_2 < 0$, $f_3 > 0$ as follows:

$$f_1 = \frac{\partial f}{\partial R} = \frac{R^*}{(1-\tau_l)}\frac{-1}{R^2}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}}$$

$$+\frac{R^*}{(1-\tau_l)R}\frac{1}{\eta-1}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}-1}\frac{1}{\xi\eta}\frac{R^*}{(1-\tau_l)}\frac{-1}{R^2} - \frac{1}{\Psi_d}\frac{1}{R}$$

$$= -\frac{1}{R}\left[\frac{R^*}{(1-\tau_l)R}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}}\left\{1+\frac{1}{\eta-1}\frac{R^*}{(R^*-(1-\tau_l)R)}\right\} + \frac{1}{\Psi_d}\right] < 0 \quad (2.C.4)$$

$$f_2 = \frac{\partial f}{\partial\tau_d} = -\frac{1}{\Psi_d}\frac{1}{\frac{R}{(1-\tau_d)R^*}}\frac{1}{(1-\tau_d)^2}\frac{R}{R^*} = -\frac{1}{\Psi_d(1-\tau_d)} < 0 \quad (2.C.5)$$

$$f_3 = \frac{\partial f}{\partial\tau_l} = \frac{+1}{(1-\tau_l)^2}\frac{R^*}{R}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}}$$

$$+\frac{R^*}{(1-\tau_l)R}\frac{1}{\eta-1}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}-1}\frac{1}{\xi\eta}\frac{+1}{(1-\tau_l)^2}\frac{R^*}{R}$$

$$=\frac{1}{(1-\tau_l)^2}\frac{R^*}{R}\left(\frac{\frac{R^*}{(1-\tau_l)R}-1}{\xi\eta}\right)^{\frac{1}{\eta-1}}\left[1+\frac{1}{\eta-1}\frac{R^*}{(R^*-(1-\tau_l)R)}\right]>0. \tag{2.C.6}$$

Finally, I can check the sign of the first derivatives of $R(\cdot)$ as follows:

$$\frac{\partial R}{\partial \tau_d}=-\frac{f_2}{f_1}<0 \tag{2.C.7}$$

$$\frac{\partial R}{\partial \tau_l}=-\frac{f_3}{f_1}>0.\square \tag{2.C.8}$$

Proof of Proposition IV. (Related to W_h^c, Household's capital income)

The representative household's capital income is a function of τ_d and τ_l as below:

$$W_h^c \equiv W_h^c(\tau_d,\tau_l)=(R-1)\left(D+B_f^d\right)=[R(\tau_d,\tau_l)-1]\frac{\beta\alpha\theta}{1+\beta}\mathrm{Y}(\tau_l) \tag{2.C.9}$$

Then, the first derivatives of the household's capital income with respect to τ_d and τ_l are as follows:

$$\frac{\partial W_h^c}{\partial \tau_d}=\frac{\partial R(\tau_d,\tau_l)}{\partial \tau_d}\frac{\beta\alpha\theta}{1+\beta}\mathrm{Y}(\tau_l)<0 \tag{2.C.10}$$

$$\frac{\partial W_h^c}{\partial \tau_l}=\frac{\beta\alpha\theta}{1+\beta}\left\{\frac{\partial R(\tau_d,\tau_l)}{\partial \tau_l}\mathrm{Y}(\tau_l)+[R(\tau_d,\tau_l)-1]\frac{\partial \mathrm{Y}(\tau_l)}{\partial \tau_l}\right\} \tag{2.C.11}$$

where $\frac{\partial R}{\partial \tau_l}=-\frac{f_3}{f_1}>0$ and $\frac{\partial Y}{\partial \tau_l}=-\frac{(1-\alpha)}{\alpha}\frac{Y}{R_l-1+\delta}\frac{R_l}{(1-\tau_l)}<0.$

If labor income share α is large enough so that $\alpha>\frac{1}{1+\frac{\partial R}{\partial \tau_l}(1-\tau_l)\frac{R_l-1+\delta}{R_l(R-1)}}$, then

$$\frac{\partial W_h^c}{\partial \tau_l}=\frac{\beta\alpha\theta}{1+\beta}\frac{\mathrm{Y}(\tau_l)}{(1-\tau_l)}\left\{\frac{\partial R}{\partial \tau_l}(1-\tau_l)-\frac{1-\alpha}{\alpha}[R(\tau_d,\tau_l)-1]\frac{R_l}{R_l-1+\delta}\right\}>0.\ \square \tag{2.C.12}$$

Proof of Proposition V. (Related to W_e^c, Entrepreneur's capital income)

The representative entrepreneur's capital income is a function of τ_l as below:

$$W_e^c \equiv (R_l - 1)(K - B_e) = (R_l - 1)\frac{\beta\alpha(1-\theta)}{1+\beta}\mathrm{Y}(\tau_l)$$

$$= \left(\frac{R^*}{1-\tau_l} - 1\right)\frac{\beta\alpha(1-\theta)}{1+\beta}\left(\frac{1-\alpha}{\frac{R^*}{1-\tau_l}-1+\delta}\right)^{\frac{1-\alpha}{\alpha}}. \tag{2.C.13}$$

Since W_e^c does not depend on τ_d, the first derivative of the entrepreneur's capital income with respect to τ_d is zero.

$$\frac{\partial W_e^c}{\partial \tau_d} = 0. \tag{2.C.14}$$

Now, the first derivative of the entrepreneur's capital income with respect to τ_l is as follows:

$$\frac{\partial W_e^c}{\partial \tau_l} = \frac{\beta\alpha(1-\theta)}{1+\beta}\left\{\frac{\partial R_l}{\partial \tau_l}\left(\frac{1-\alpha}{R_l - 1 + \delta}\right)^{\frac{1-\alpha}{\alpha}} + (R_l - 1)\frac{\partial}{\partial \tau_l}\left[\left(\frac{1-\alpha}{R_l - 1 + \delta}\right)^{\frac{1-\alpha}{\alpha}}\right]\right\}$$

$$= \frac{\beta\alpha(1-\theta)}{1+\beta}\left\{\frac{\partial R_l}{\partial \tau_l}Y + (R_l - 1)\frac{\partial Y}{\partial \tau_l}\right\} \tag{2.C.15}$$

where $\frac{\partial R_l}{\partial \tau_l} > 0$ and $\frac{\partial Y}{\partial \tau_l} = \frac{\partial Y}{\partial R_l}\frac{\partial R_l}{\partial \tau_l} = \frac{-(1-\alpha)}{\alpha}\frac{Y}{R_l-1+\delta}\frac{R_l}{(1-\tau_l)} < 0.$

If the labor share α is large enough so that $\alpha > \frac{(R_l-1)}{2(R_l-1)+\delta}$, then the entrepreneur's capital income is an increasing function of τ_l:

$$\frac{\partial W_e^c}{\partial \tau_l} = \frac{\beta\alpha(1-\theta)}{1+\beta}\mathrm{Y}(\tau_l)\frac{R_l}{(1-\tau_l)}\left\{1 - \frac{(1-\alpha)}{\alpha}\frac{(R_l-1)}{R_l-1+\delta}\right\} > 0. \tag{2.C.16}$$

Proof of Proposition VI. (Related to income inequality)

The household's relative capital income (i.e., capital income ratio) is described as below:

$$W^c(\tau_d,\tau_l) \equiv \frac{W_h^c}{W_e^c} = \frac{[R-1]\frac{\beta\alpha\theta}{1+\beta}Y}{(R_l-1)\frac{\beta\alpha(1-\theta)}{1+\beta}Y} = \frac{\theta}{(1-\theta)}\frac{[R-1]}{(R_l-1)} = \frac{\theta}{(1-\theta)}\frac{[R(\tau_d,\tau_l)-1]}{\left(\frac{R^*}{1-\tau_l}-1\right)} \tag{2.C.17}$$

where $R_l(\tau_l)$ solves for R_l as a function of τ_l, given by Proposition I, and $R(\tau_d,\tau_l)$ solves for the R as a function of τ_d and τ_l, given by Proposition III. The first derivative of the household's relative capital income with respect to τ_d is expressed by:

$$\frac{\partial W^c}{\partial \tau_d} = \frac{\theta}{(1-\theta)}\frac{\partial}{\partial \tau_d}\left\{\frac{[R(\tau_d,\tau_l)-1]}{(R_l(\tau_l)-1)}\right\} = \frac{\theta}{(1-\theta)}\frac{1}{(R_l(\tau_l)-1)}\frac{\partial}{\partial \tau_d}\{[R(\tau_d,\tau_l)-1]\}$$
$$= \frac{\theta}{(1-\theta)}\frac{1}{(R_l(\tau_l)-1)}\frac{\partial R}{\partial \tau_d} < 0 \tag{2.C.18}$$

where $R_l = \frac{R^*}{1-\tau_l}$ and $\frac{\partial R}{\partial \tau_d} = -\frac{f_2}{f_1} < 0$.

Now, the first derivative of the household's relative capital income with respect to τ_l is given by:

$$\frac{\partial W^c}{\partial \tau_l} = \frac{\theta}{(1-\theta)}\frac{\partial}{\partial \tau_l}\left\{\frac{[R(\tau_d,\tau_l)-1]}{(R_l(\tau_l)-1)}\right\}$$
$$= \frac{\theta}{(1-\theta)}\left\{\frac{\partial R}{\partial \tau_l}\frac{1}{(R_l-1)} + [R(\tau_d,\tau_l)-1]\frac{-1}{(R_l-1)^2}\frac{\partial R_l}{\partial \tau_l}\right\}$$
$$= \frac{\theta}{(1-\theta)}\frac{1}{(R_l-1)}\left\{\frac{\partial R}{\partial \tau_l} - \frac{(R-1)}{(R_l-1)}\frac{\partial R_l}{\partial \tau_l}\right\}$$
$$\left(\text{where } \frac{\partial R}{\partial \tau_l} = -\frac{f_3}{f_1} > 0 \text{ and } \frac{\partial R_l}{\partial \tau_l} = \frac{R^*}{(1-\tau_l)^2} = \frac{R^*}{(1-\tau_l)(1-\tau_l)} = \frac{R_l}{(1-\tau_l)} > 0\right)$$
$$= \frac{\theta}{(1-\theta)}\frac{(R-1)}{(R_l-1)}\left\{\frac{1}{(R-1)}\frac{\partial R}{\partial \tau_l} - \frac{1}{(R_l-1)}\frac{\partial R_l}{\partial \tau_l}\right\} > 0. \tag{2.C.19}$$

if and only if, $\frac{\partial R}{\partial \tau_l} > \frac{(R-1)}{(R_l-1)}\frac{\partial R_l}{\partial \tau_l}$ or $\frac{1}{(R-1)}\frac{\partial R}{\partial \tau_l} > \frac{1}{(R_l-1)}\frac{\partial R_l}{\partial \tau_l}$. □

APPENDIX 2.D: CALIBRATION PARAMETERS

	Parameters	Descriptions	Values
(A) Liu et al. (2020)[110]	β	Household discount rate	0.665
	δ	Capital depreciation rate	0.651
	Ω_k	Scale of capital adjustment cost	5
	R^*	Foreign interest rate	1.480
	Γ	Transfer from old to young	0.53
	α	Labor income share	0.5
	θ	Household labor income share	0.67
	Φ_b	Elasticity of risk premium on external debt	3
	κ_f	Steady-state ratio of external debt to output	0.04
	ξ	Scale of intermediation cost	0.57
	η	Elasticity of intermediation cost	1.6
	ω	Pareto weight on household welfare	0.5
	τ_d	Tax rate on foreign asset	1.64%
	τ_l	Tax rate on foreign debt	10.17%
(B) Present study	Ψ_d	Elasticity of discount on overseas investment	3
	κ_d	Steady-state overseas investment to output ratio	0.04

[110] See Table 1 in Liu et al. (2020, p. 19) for details.

APPENDIX 3.A: LIST OF ECONOMIES

Table A.1. Economy List – IMF 2019 Taxonomy of CFMs

Argentina	Australia	Barbados	Belarus	Bolivia	Brazil
Canada	CEMAC	China	Costa Rica	Cyprus	Dem. Rep. Congo
Ecuador	Georgia	Ghana	Greece	Hong Kong SAR China	Iceland
India	Indonesia	Kazakhstan	Korea	Liberia	Macao SAR China
Madagascar	Malaysia	New Zealand	Nigeria	North Macedonia	Peru
Russia	Seychelles	Singapore	Sri Lanka	Ukraine	Uzbekistan

Table A.2. Economy List in the Dataset

List of economies included in the dataset after dropping missing observations			
	Before dropping missing observation	(A): If include all controls	(B): If exclude 'domestic interest rates' from (A)
Number of economies	32*	11	18
List of economies	Argentina, Australia, Barbados, Belarus, Bolivia, Brazil, Canada, China, CostaRica, DemocraticRepublicofCongo, Ecuador, Georgia, Ghana, HongKongSARChina, Iceland, India, Indonesia, Kazakhstan, Korea, Liberia, MacaoSARChina, Madagascar, Malaysia, NewZealand, Nigeria, NorthMacedonia, Peru, Russia, Singapore, SriLanka, Ukraine, Uzbekistan	Brazil, China, HongKongSARChina, India, Indonesia, Korea, Malaysia, Peru, Russia, Singapore	Bolivia, Brazil, China, CostaRica, Ecuador, HongKongSARChina, Iceland, India, Indonesia, Kazakhstan, Korea, Malaysia, NorthMacedonia, Peru, Russia, Singapore, SriLanka, Ukraine
Number of observation	2,432	348	1,190

* 4 economies are deleted from 36 economies that introduced CFMs since 2000, because they have very limited data (CEMAC, Cyprus and Greece) or no CFM used during the periods of 2000-2018 (Seychelles).

APPENDIX 3.B: TIME TRENDS OF CFMS IMPLEMENTATION

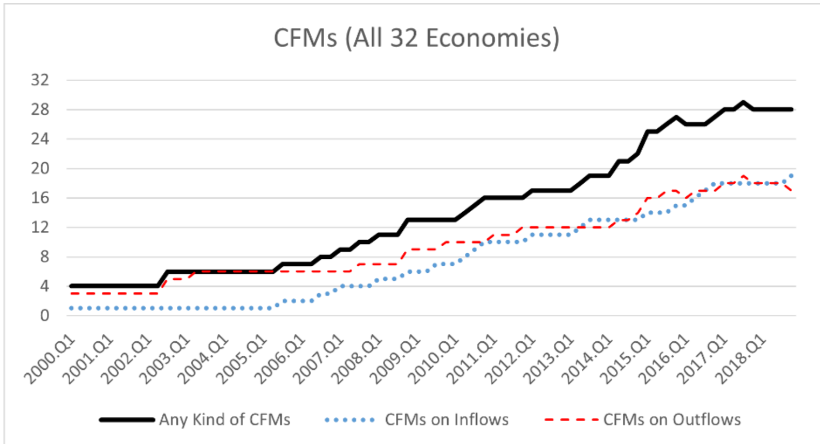


Figure B.1. Time Trends of CFMs[111] (32 Economies[112])

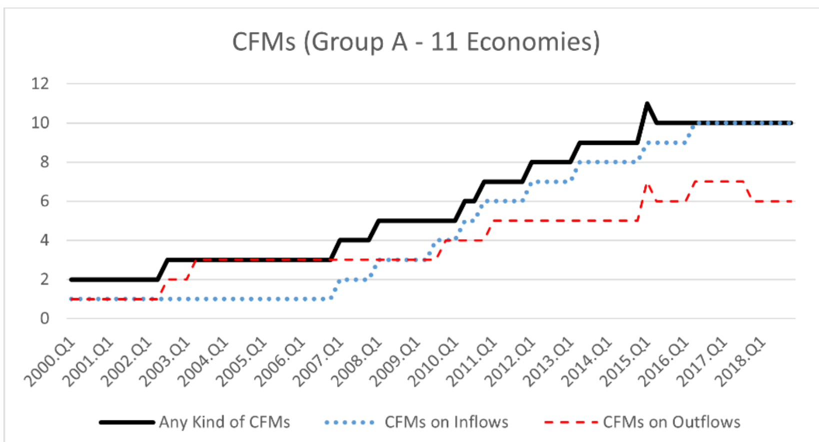
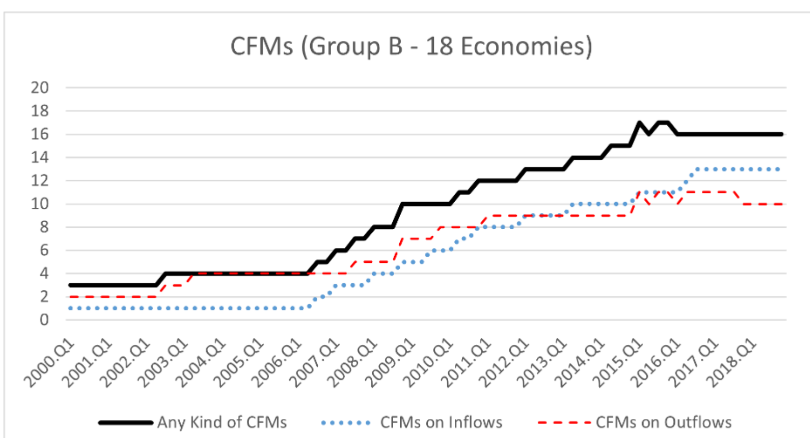


Figure B.2. Time Trends of CFMs (Group A - 11 Economies)



[111] The data is collected from the IMF 2019 Taxonomy of CFMs (2019).
[112] See Table A.2. in Appendix A for the list of economies.

Figure B.3. Time Trends of CFMs (Group B - 18 Economies)

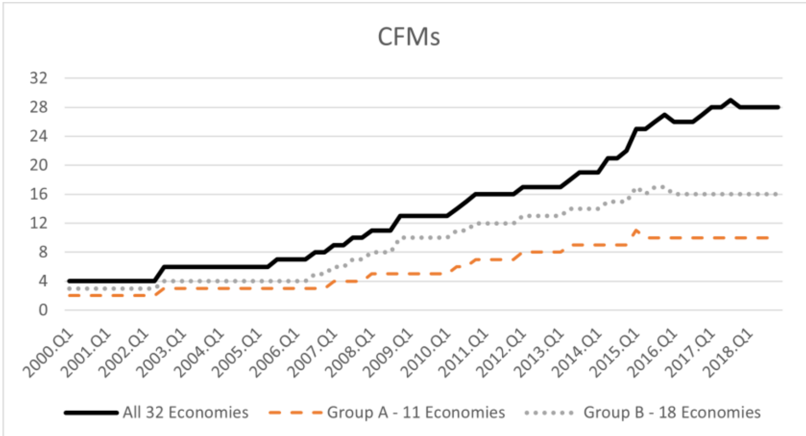


Figure B.4. Time Trends of CFMs (Any Kind of CFMs)

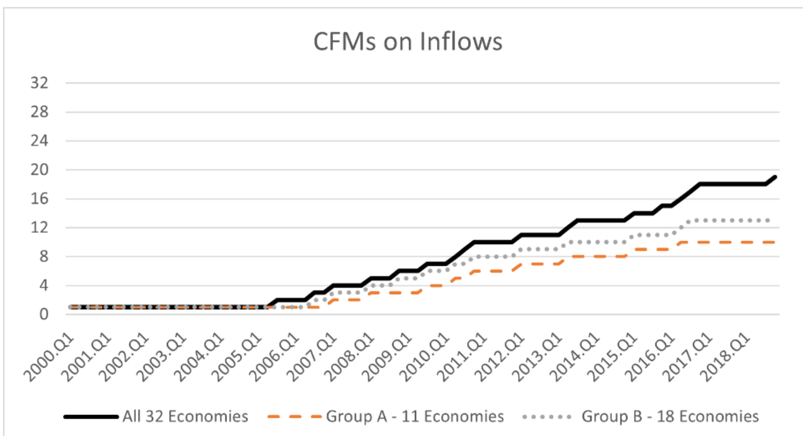


Figure B.5. Time Trends of CFMs on Inflows

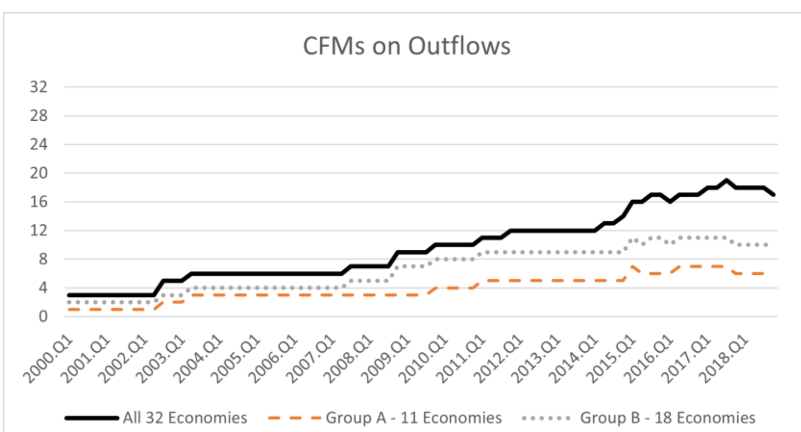


Figure B.6. Time Trends of CFMs on Outflows

APPENDIX 3.C: DATA DESCRIPTION AND SOURCES

Name	Description	Sources
Dependent variables		
Capital Flows		
Net (in)flows, Gross inflows and Gross outflows	Methodology by Cavallo and Izquierdo (2017). They smoothed time series following Forbes and Warnock (2012) by aggregating series for 4 quarters (past three and current quarters), and then taking year-over-year differences. To consider the size of economy, capital flows to GDP ratio is used.	IMF IFS (BoP, BPM6) (downloaded on 5/11/2020)
Explanatory variables		
CFM dummy	1 if any kind of CFM is used during the period. Otherwise, 0.	IMF 2019 Taxonomy of CFMs
US Monetary Policy Rates	Effective Federal Funds Rate	FRED (downloaded on 2/18/2020)
Instrument	3-month-ahead Federal Funds Futures Rate	Bloomberg (downloaded on 2/20/2020)
Global control variables		
VIX	The Chicago Board Options Exchange S&P 500 Volatility Index	GFDFinaeon (downloaded on 1/16/2020)
US Growth Rates	Industrial production (seasonally adjusted, constant USD)	WB GEM, downloaded 1/6/2020)
Country-specific control variables		
Output Growth Rates	Industrial production (seasonally adjusted, constant USD)	WB GEM, downloaded 1/6/2020)
Inflation	Consumer Price Index (2010 = 100)	IMF IFS (downloaded on 3/26/2020)
Exchange Rates	Nominal exchange rate (Price of 1 USD in terms of local currency, Average period)	IMF IFS (downloaded on 3/26/2020)
Domestic MP Rates	Domestic interest rates (3-month government bond rates) (as proxies)	Bloomberg
Others		
GFC dummy	Before/during/after the Global Financial Crisis (2008Q1-2009Q2)	FRED (NBER recession indicator)

APPENDIX 3.D: RESULTS WITH ADDITIONAL ALTERNATIVE SPECIFICATIONS

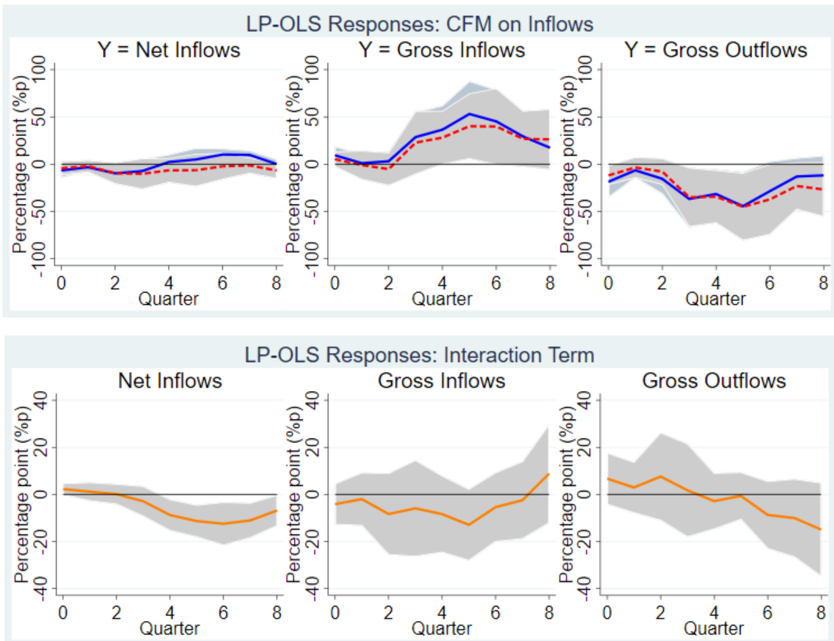


Figure D.1. LP-OLS IRFs to an Increase of 1%p in US MP Shock (with CFMs on Inflows and Excluding Domestic Interest Rates)

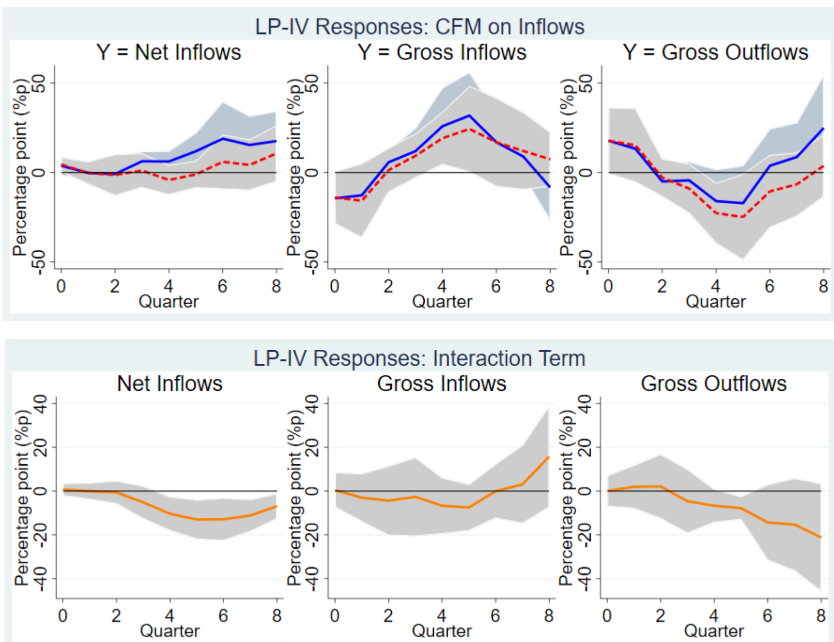


Figure D.2. LP-IV IRFs to an Increase of 1%p in US MP Shock (with CFMs on Inflows and Excluding Domestic Interest Rates)

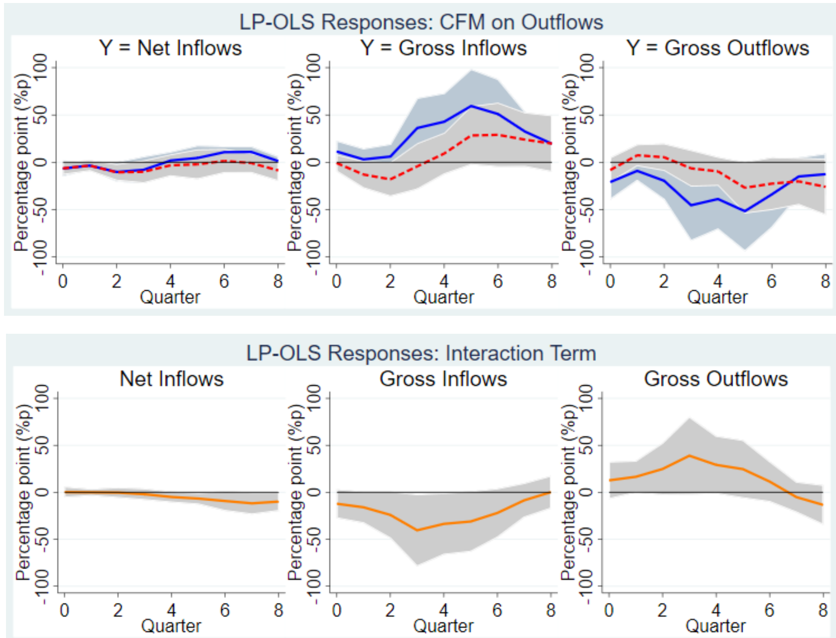


Figure D.3. LP-OLS IRFs to an Increase of 1%p in US MP Shock (with CFMs on Outflows and Excluding Domestic Interest Rates)

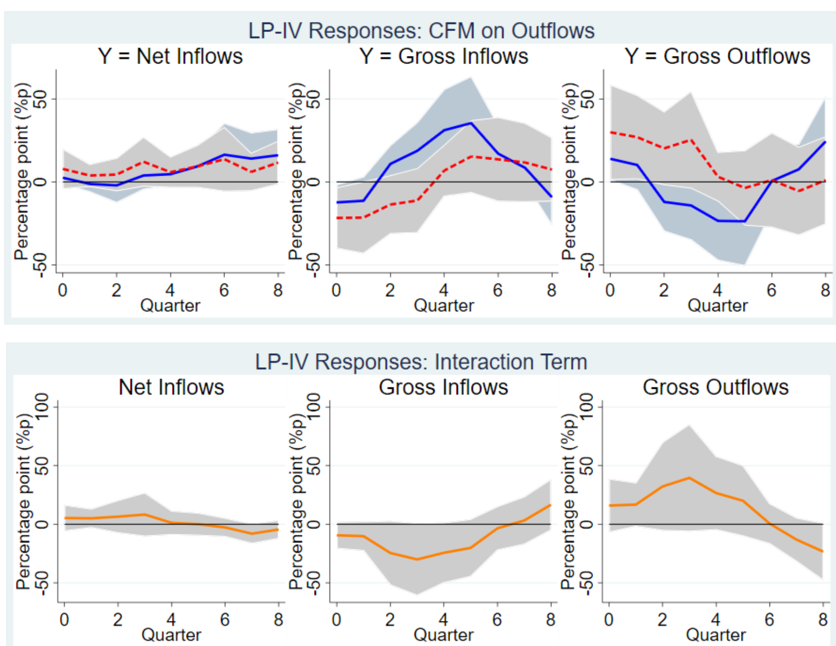


Figure D.4. LP-IV IRFs to an Increase of 1%p in US MP Shock (with CFMs on Outflows and Excluding Domestic Interest Rates)

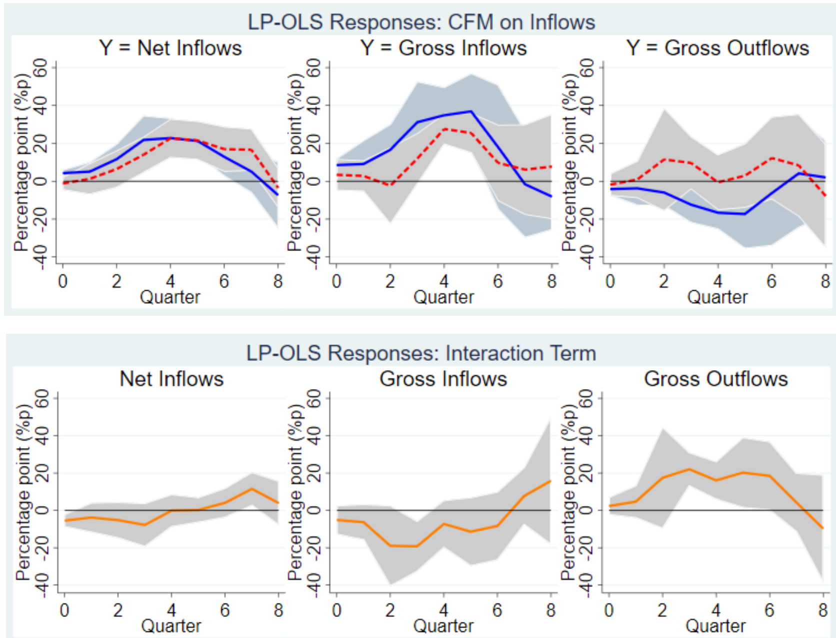


Figure D.5. LP-OLS IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Inflows and without Time Dummy)

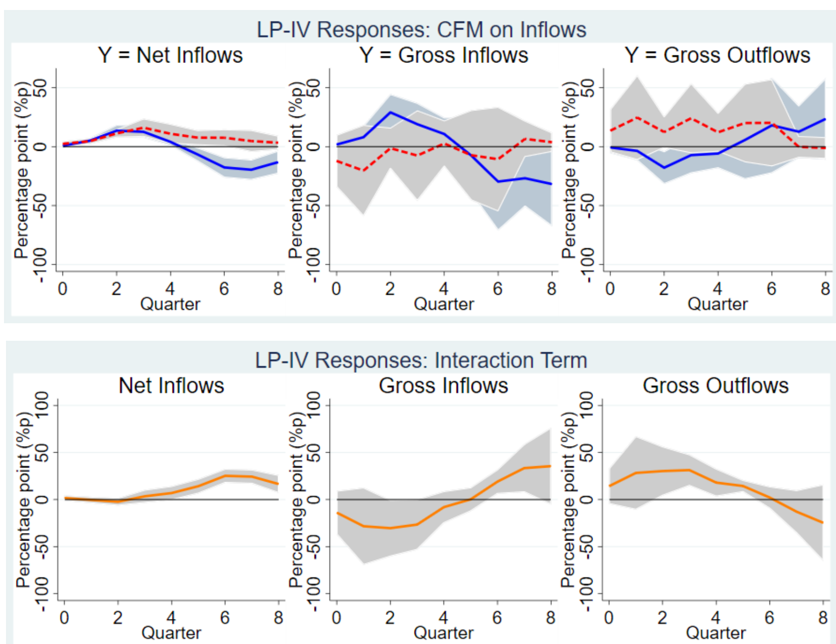


Figure D.6. LP-IV IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Inflows and without Time Dummy)

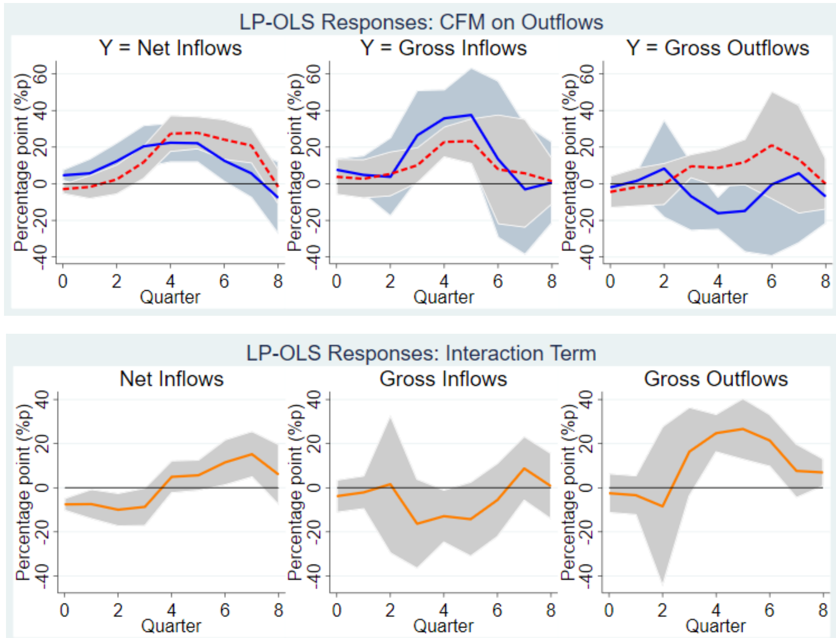


Figure D.7. LP-OLS IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Outflows and wihtout Time Dummy)

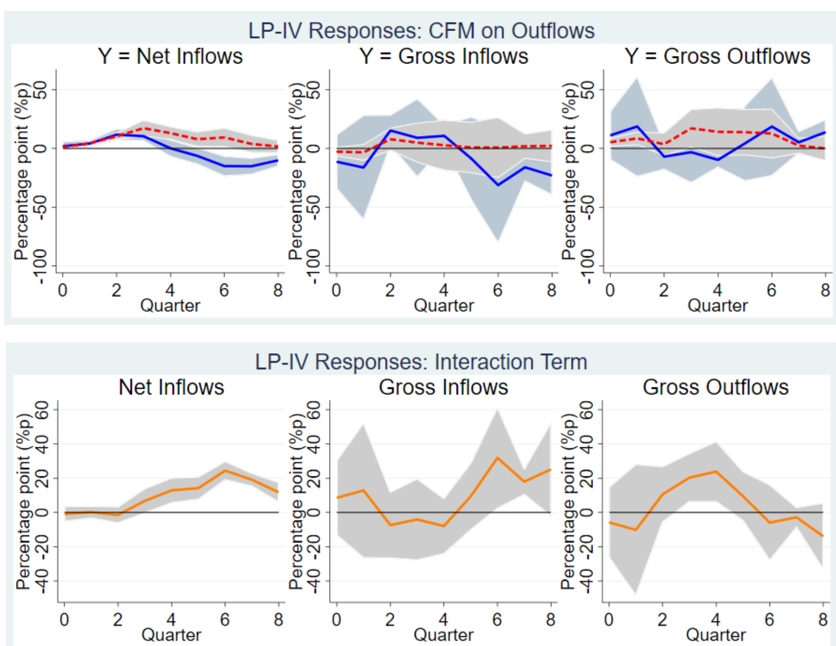


Figure D.8. LP-IV IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Outflows and without Time Dummy)

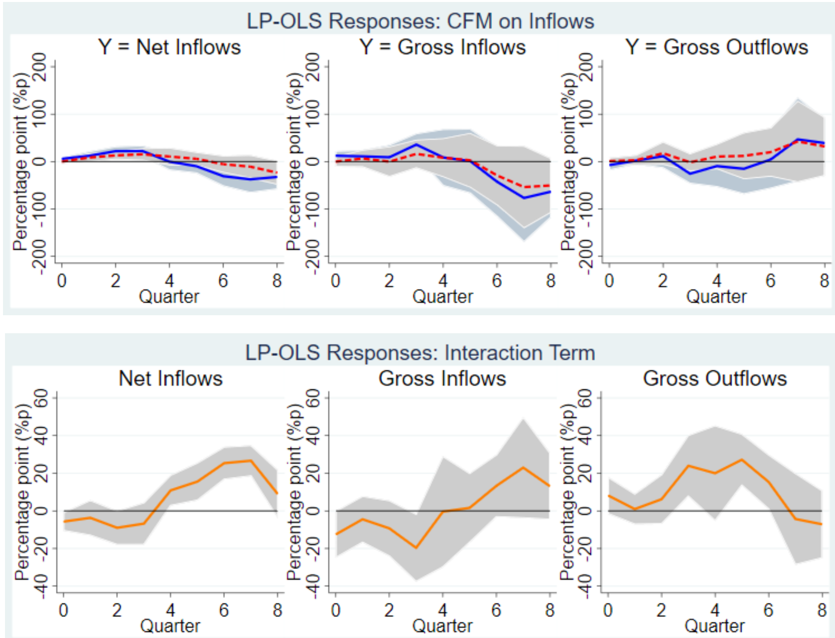


Figure D.9. LP-OLS IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Inflows and Two-Year Lagged Terms)

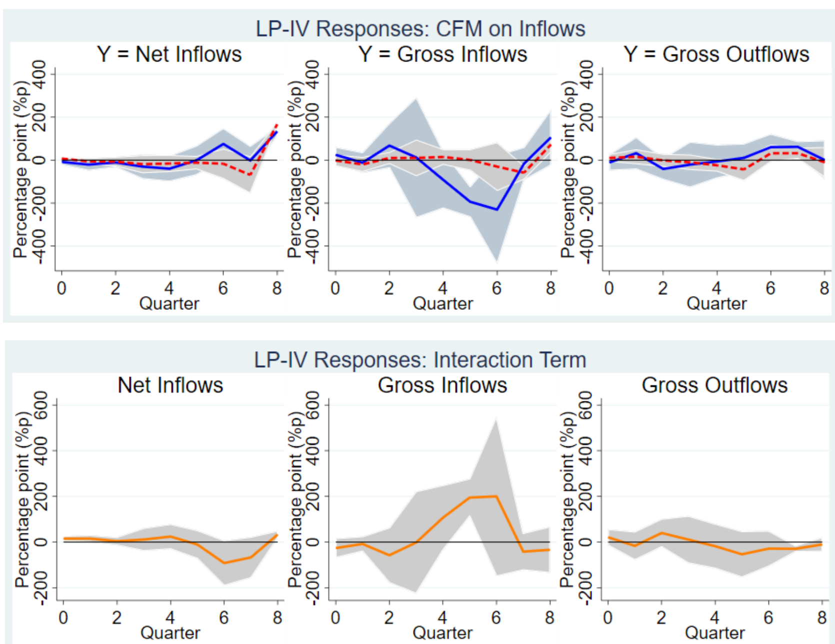


Figure D.10. LP-IV IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Inflows and Two-Year Lagged Terms)

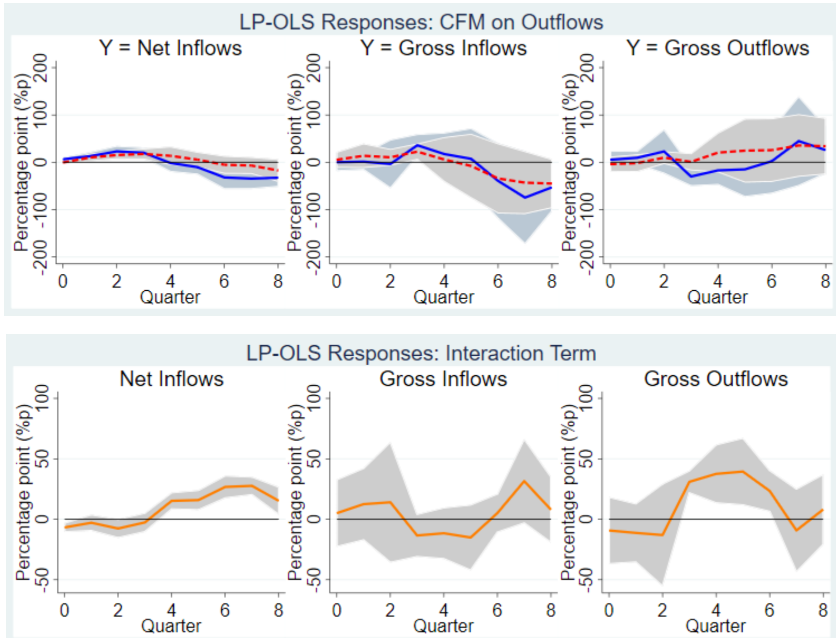


Figure D.11. LP-OLS IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Outflows and Two-Year Lagged Terms)

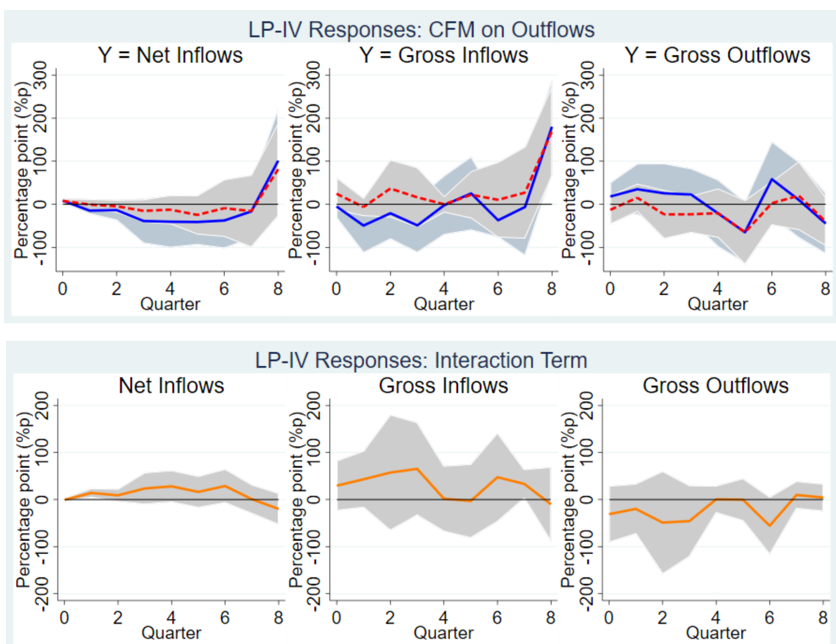


Figure D.12. LP-IV IRFs to an Increase of 1%p in US MP Shock

(with CFMs on Outflows and Two-Year Lagged Terms)

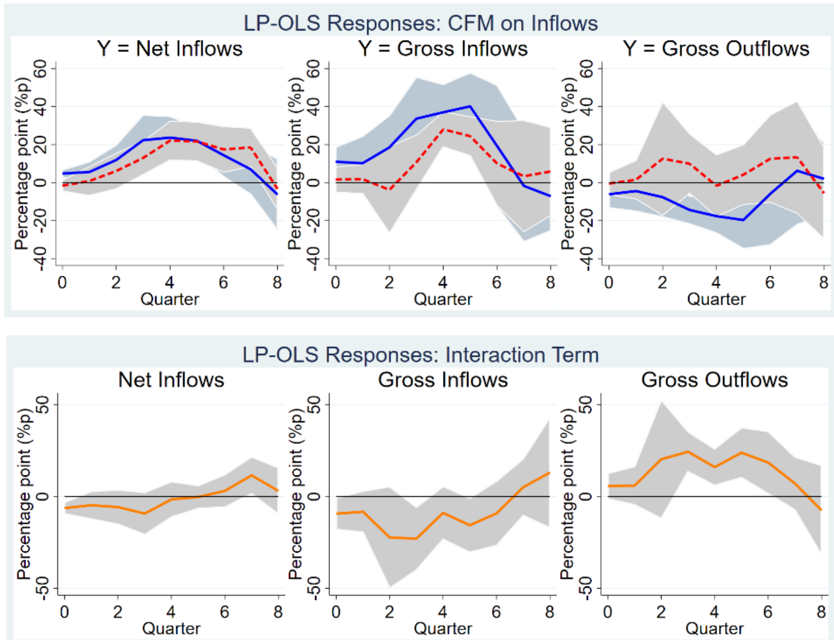


Figure D.13. LP-OLS IRFs to an Increase of 1%p in US MP Shock

(with Lagged CFM Dummy on Inflows)

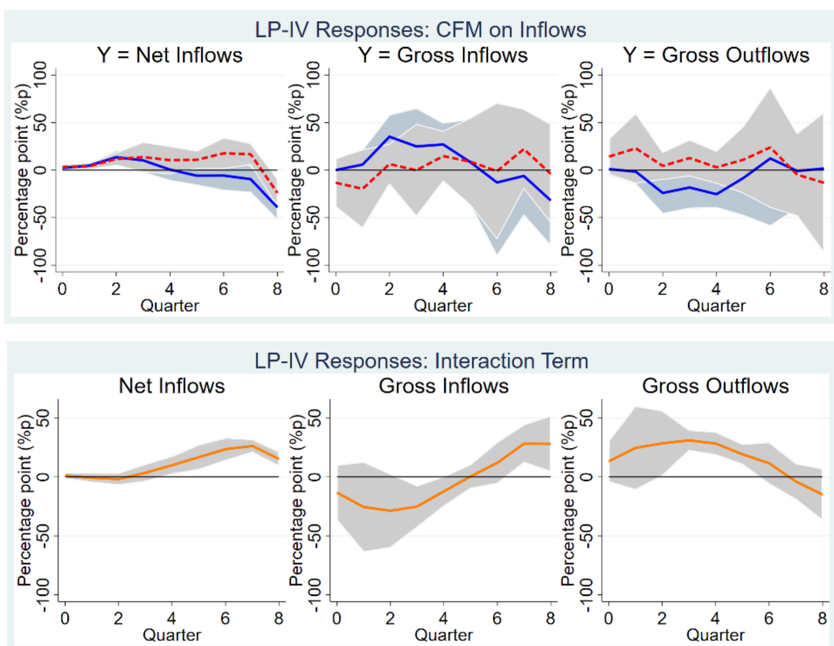


Figure D.14. LP-IV IRFs to an Increase of 1%p in US MP Shock

(with Lagged CFM Dummy on Inflows)

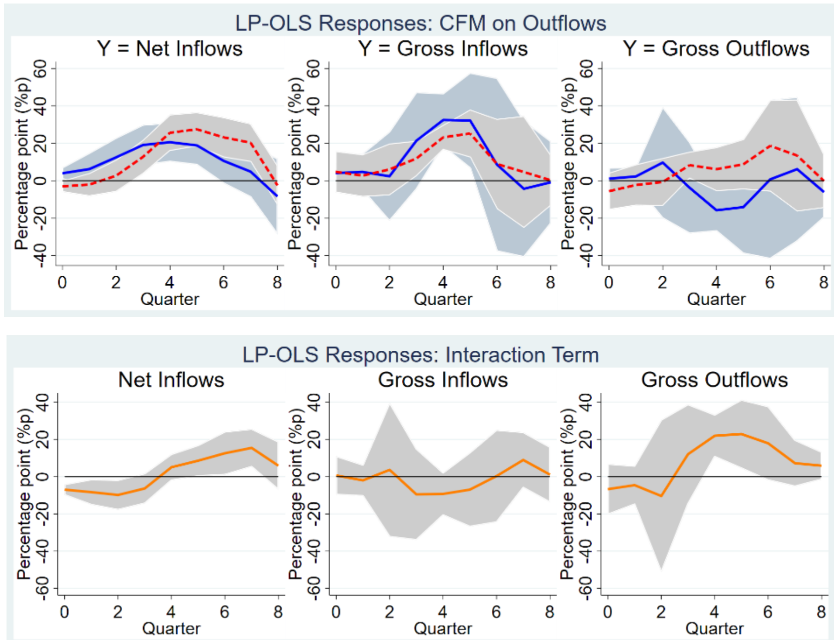


Figure D.15. LP- IRFs to an Increase of 1%p in US MP Shock

(with Lagged CFM dummy on Outflows)

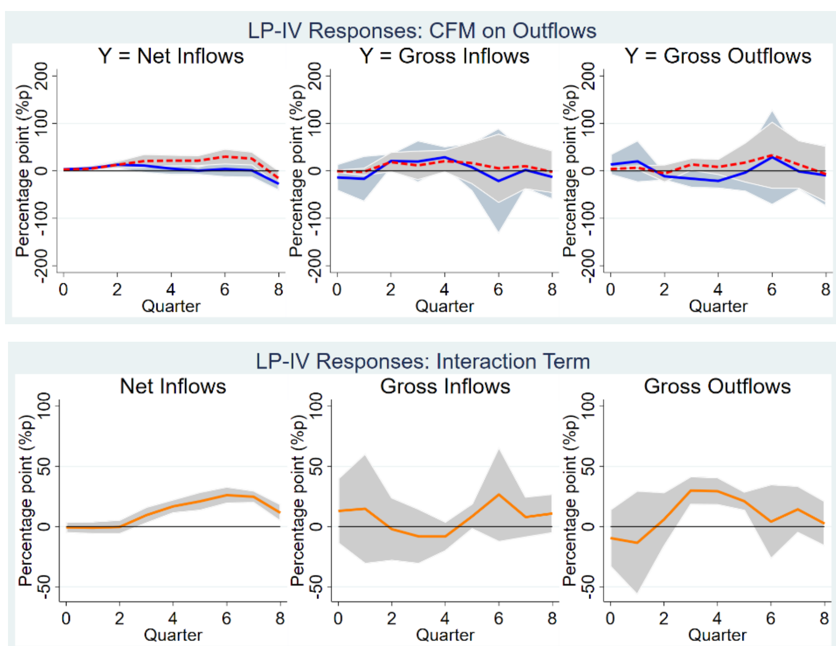


Figure D.16. LP-IV IRFs to an Increase of 1%p in US MP Shock

(with Lagged CFM Dummy on Outflows)