New Foundations for International Macroeconomic Policy*

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July 2026

Abstract

The Mundell-Fleming IS-LM framework has guided generations of economists on international macroeconomic policy, including on the benefits of exchange rate flexibility. But countries have experienced new problems such as "taper tantrums" and "sudden stops," and the international finance literature on optimal policy has advanced. The scene is set for an updated approach. We propose a new tractable framework that both generates the forms of macroeconomic destabilization that countries worry about and provides normative policy advice. The policy prescriptions depend on the particulars of the shock, the frictions, and the policy instruments. Consequently, this framework can be applied to advanced economies, emerging markets, and developing economies. In addition, the framework illustrates connections between different strands of the international finance literature, some of which have been evolving in parallel up to this point.

JEL classification codes: E58, F38, F41, G28

Keywords: integrated policy framework, monetary policy, foreign exchange intervention, capital controls, macroprudential policies

*This paper contributes to the work on the Integrated Policy Framework (IPF) at the IMF. We thank Emine Boz, Giovanni Dell'Ariccia, Pierre-Olivier Gourinchas, Francisco Roch and Filiz Unsal for their helpful inputs. The views expressed in this paper are those of the authors and should not be attributed to the IMF, its Executive Board, or its management. Contact emails: SBasu2@imf.org, gopinath@harvard.edu.

1 Introduction

The Mundell-Fleming IS-LM framework has guided generations of economists over the past 60 years on international macroeconomic policy, including on the benefits of exchange rate flexibility. The IS-LM framework assumes that the key friction is price stickiness and that countries address shocks by relying on *standard* tools, i.e., monetary and fiscal policy in either a floating or a fixed exchange rate regime. But many emerging markets and developing economies (EMDEs), and also several advanced economies (AEs), have adopted policy frameworks which include *additional* tools such as sterilized foreign exchange (FX) intervention, capital controls, and domestic macroprudential measures.

Policymakers often link the necessity of these additional tools to the interaction of external shocks with key financial market frictions. Figure 1 shows some examples of such shocks and their effects. Panel a shows volatility in oil prices, which affect oil exporters and importers. Panel b shows U.S. monetary policy tightening and loosening episodes, which affect global borrowing conditions. Panel c shows the 2013 "taper tantrum", in which a U.S. monetary policy announcement led to a spike in uncovered interest parity (UIP) premia on EMDEs' *local* currency debt. Panel d shows the incidence of "sudden stops", i.e., more severe events where a reversal of net capital inflows (especially *foreign* currency debt inflows) causes a collapse in GDP growth.

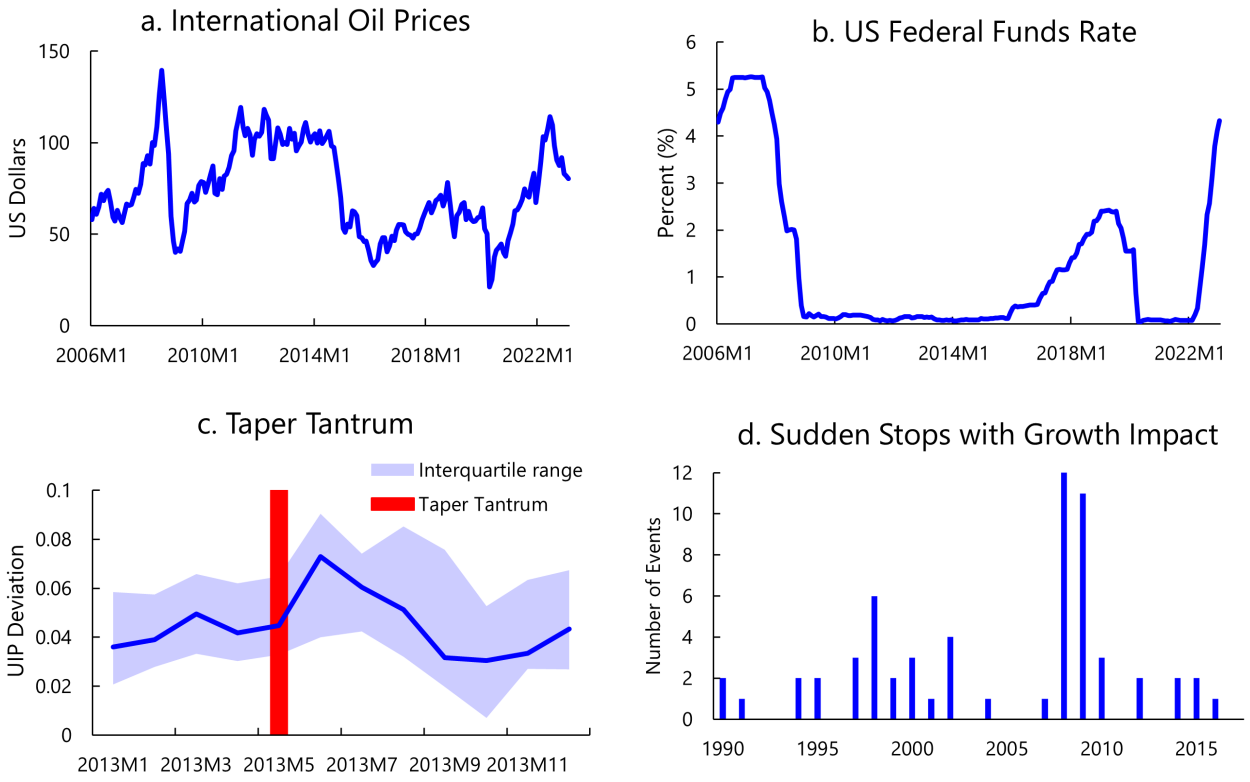
Designing policy responses requires an assessment of the effect of each shock and the appropriateness of the available tools. Specifically, we need to answer:

- Can standard policy tools achieve desirable outcomes?
- Can additional tools improve outcomes? If so, how can they be used?

The Mundell-Fleming approach is not best placed to answer such questions. The reason is that it does not feature the requisite combination of two elements: first, a normative structure that can provide advice on which shocks to accommodate and which to resist; and second, the financial frictions which can generate premium spikes, sudden stops, and domestic credit crunches. As a result, it is unclear whether the approach's policy advice remains valid. Does exchange rate flexibility remain beneficial in circumstances where large depreciations may interact with currency mismatches to amplify sudden stops? Which kinds of additional tools could be used in normal times to allow countries to reap the benefits of exchange rate flexibility after shocks strike?

While several separate literatures in international finance provide careful treatments of different frictions that are relevant for open economies, each literature typically considers a single friction and complements monetary policy with one additional tool. This is unlike how policy is deployed and does not address whether tools that address one friction may mitigate or worsen a separate friction.

Figure 1: Examples of External Shocks



Sources: a. Refinitiv Datastream. b. FRED, Federal Reserve Bank of St. Louis. c. Das, Gopinath, and Kalemli-Özcan (2021). d. Basu, Perrelli, and Xin (2023).

Moreover, the powerful appeal of the Mundell-Fleming framework derives from its simplicity, including in illustrating the economy's response to varied shocks. It is therefore no surprise that it remains the leading pedagogical framework in international undergraduate textbooks.

The contribution of this paper is to introduce a framework that is kept as simple as possible (*but no simpler!*) so that it can be useful for policymakers in central banks and finance ministries, advanced students, and the wider economics profession alike. It builds on and simplifies the model in Basu et al. (2025). This framework can generate the forms of macroeconomic destabilization that countries are worried about, and it can provide normative answers to the questions above by showing how each policy tool can improve or worsen welfare along different dimensions. It does so by building on market frictions and normative policy approaches proposed by recent papers at the forefront of the international finance literature. The rationale for the policymaker to intervene will be based on externalities that are not internalized by the private sector.

We use the framework to illustrate possible policy responses to the four shocks shown in figure

1. For each shock, readers can follow our reasoning on a purely graphical dimension, or they can use the provided algebra to dig deeper. Readers can draw the diagram differently for each country, depending not just on its exchange rate regime (as in the Mundell-Fleming approach), but also on the combination of frictions and the set of available policy tools that are relevant. Correspondingly, our framework can show how shocks and policy tools have different effects in different countries, and how the policy mix can be tailored to each country.

This framework shifts the lens through which optimal policy is viewed. Here are some examples of how our framework can shed light on policy discussions in small open economies:

- The optimal policy response depends on whether the shock is "fundamental" or "non-fundamental." A fundamental shock, such as an increase in U.S. monetary policy rates, changes the optimal level of macroeconomic variables even in the absence of financial frictions. A non-fundamental shock, such as a noise-trader outflow shock, does not change the optimal level of macroeconomic variables in the absence of financial frictions, but does so in the presence of financial frictions. The IS-LM model recommends similar policies to handle the U.S. monetary tightening shock and the noise-trader outflow shock, because they both have a similar impact on the exchange rate. However, our framework emphasizes that different policies may be called for. In response to the U.S. monetary tightening shock, standard policy tools—monetary policy and exchange rate flexibility—can be sufficient. However, in response to the noise-trader shock, the policymaker can use additional tools such as sterilized FX intervention and capital controls to insulate the economy from the shock.

- The optimal response of different instruments depends on the tools available. Our framework can generate a contractionary depreciation, breaking from the IS-LM framework. The contractionary depreciation occurs if much of the external debt is in foreign currency. In this case, a depreciation causes the external constraint to get substantially tighter and reduce imports, which in turn reduces home output. As a result, exchange rate flexibility is not sufficient to cushion the economy from the sudden stop. Instead, for some countries, ex post exchange flexibility may only be welfare-improving if supported by an ex ante capital inflow tax and/or ex ante macroprudential regulation on external debt—tools whose impacts are not typically considered in the IS-LM framework.

- The optimal response depends on the specific combination of shocks and frictions. Some kinds of frictions generate a material case for additional tools after some shocks but not others. For

example, monetary policy and exchange rate flexibility can be sufficient after fundamental export income shocks even in countries with "shallow" foreign exchange markets that give rise to a local currency premia externality. On the other hand, the interaction of the friction with noise-trader shocks can generate the case for additional tools.

The flexibility of the framework permits its application to a range of new shocks, such as tariffs and a variety of financial disruptions. For each shock, our framework predicts that the policy mix depends on how fundamental the shock is, the tools available, and the combination of frictions in the country in question.

2 The Framework Without Financial Frictions

In this section, we introduce the first step of our approach. We construct our framework for a country where the only friction is price stickiness and there are no financial frictions. The resulting diagram serves as a visual illustration of the simple intertemporal New Keynesian framework, with monetary policy that is set either to stabilize the home output gap (in a floating exchange rate regime) or to implement a peg (in a fixed exchange rate regime).[1]

The framework illustrates the welfare impacts of policymakers' decisions, and how shocks affect these decisions. As a result, it can provide normative advice on whether policymakers should stabilize macroeconomic variables or facilitate their adjustment to shocks.

To ensure that the framework is useful for readers at a variety of technical levels, we convert all our equations into curves on the diagram coupled with textual bullet points that summarize how the curves shift in response to shocks and policy tools. That way, when we explore possible policy mixes to handle different shocks in the next section, readers can opt to follow our reasoning on a purely graphical dimension (by seeing what happens when the curves shift), or they can use the algebra to dig deeper (by building on our system of equations).

2.1 Model Overview

The approach described here is based on the model in Basu et al. (2025), for the special case where all the financial frictions in that model are turned off.

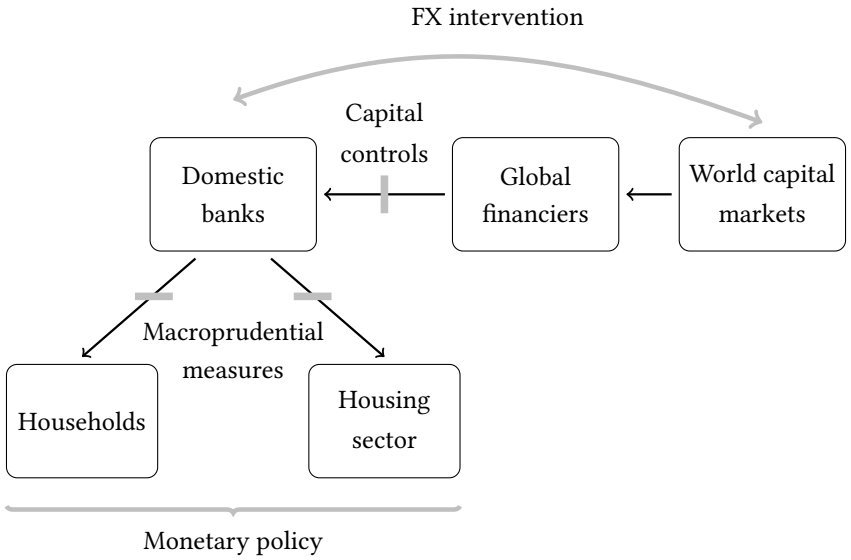
Our framework includes micro-foundations for expenditure-switching, based on optimizing households who consume several goods. Price stickiness generates a role for exchange rate flexibility. We

[1] In case you are eager for a preview of the complete diagram for this section, it is depicted in figure 7 below.

choose assumptions which extend the "dominant currency paradigm"[2]:

- Imports and exports of produced tradable goods have sticky prices that are set in dollars.
- The domestically-sold part of home-produced tradable goods has sticky local currency prices.
- Nontradable housing services have flexible local currency rents.
- Exports of commodity endowments have flexible dollar prices.

Figure 2: Structure of the Financial Market



Given these assumptions, an exchange rate depreciation increases the relative price of imports to home goods, causing households to switch expenditure from imports to home goods. However, exports do not change, because their price relative to other countries' exports (which also have sticky dollar prices) does not change.

As is standard in the New Keynesian framework, the price stickiness friction generates an aggregate demand externality. Specifically, aggregate demand determines output when prices are sticky, and private agents do not internalize the impact of their consumption decisions on that aggregate demand. Consequently, there may be too little or too much activity from the perspective of the policymaker. This externality can be addressed using policy tools.

Financial intermediation follows the structure shown in figure 2. Global financiers channel funds from world capital markets to domestic banks, who lend these funds to the domestic private sector. Here we assume that there are no frictions in this process.

[2]This paradigm, in which the dominant currency used to price both imports and exports, seems to be a good approximation for most EMDEs and some AEs. Different pricing assumptions would change some of the curves in the diagram, but the overall conceptual approach would remain valid. In this paper, we take the U.S. dollar to be the dominant currency.

As shown in the figure, FX intervention can be used to circumvent the financial intermediaries, capital controls can be applied at the border (in the form of taxes on capital inflows), and domestic macroprudential measures can be applied on financial transactions between domestic agents (in the form of taxes on their debt). Monetary policy sets the policy rate, which then determines the exchange rate. We do not include fiscal policy for now.

We assume that there are three periods (0, 1, and 2) and shocks strike in period 1, after which there is no further uncertainty. The policy tools can be used either "ex ante" (in period 0, before shocks strike) or "ex post" (in periods 1 and 2, after shocks strike) or both. The diagram will show the ex post values of macroeconomic variables, and it will include a simple system of equations which can be analyzed to show the impact of shocks and ex post policies. Ex ante policies turn out to be unnecessary in this version of the framework.

2.2 Construction of the Framework

The framework features four interlinked panels. In this sense, its spirit stays close to the IS-LM framework, which includes ancillary panels plotting the economic forces behind each of the IS and LM curves.

Next, we explain the four panels one by one. At the start of the discussion for each panel, we include (in inverted commas and italics) a one-phrase description of the panel, which nods to the specific literature the panel most relates to. Then we identify in numbered equations each curve on the panel and how it is determined.[3]

Panel A. Imports

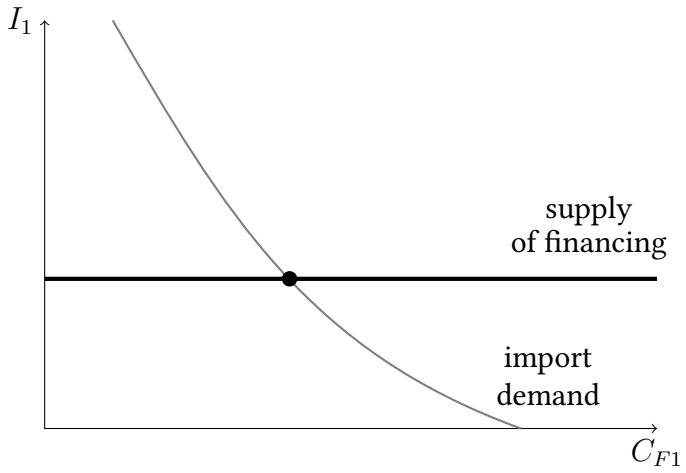
"Intertemporal theory of the current account"

Panel A is shown in figure 3. It presents the optimal consumption of imports C_{F1} in period 1 (F for "foreign" goods) from the policymaker's perspective, i.e., the level which maximizes economy-wide welfare. The decision follows an intertemporal optimization process. The consumption of imports worsens the trade balance and causes an increase in external debt.[4] Accordingly, the optimal level of imports depends on I_1, the dollar value of the gross interest rate on external financing between periods 1 and 2. This rate averages and converts into dollars the rates on the economy's dollar and local currency external debts. The policymaker should use its tools to induce households to consume

[3] Some of the numbers are not sequential, because we are leaving space for equations that will be added in section 4.2.

[4] The dominant currency paradigm simplifies matters by ensuring that imports and the trade balance move one for one in opposite directions, because exchange rate movements do not alter exports.

Figure 3: Panel A. Imports



the optimal level of imports.

The variables plotted, C_{F1} and I_1, are chosen to ensure that the welfare-relevant variables in the intertemporal optimization are clearly illustrated. We will optimize the consumption of home goods separately in panel C below. Notice that I_1 is generally different to the monetary policy rate, because the latter is in local currency value and applies only on local currency debt. We will return to the policy rate in panel D below.

Let us now consider the first key relation on the panel.

1. Supply of external financing:

$$I_1 = (1 + i_1^*)\,. \tag{1a}$$

Equation (1a) determines the value of I_1. The economy faces a horizontal supply curve with the interest rate equal to $(1 + i_1^*)$, the gross interest rate on dollar borrowing. The reason is that in the absence of financial frictions, the global financiers charge a zero expected premium on local currency debt relative to dollar debt. Moreover, after the shock in period 1, there may be further movements in the exchange rate, but there is no remaining uncertainty about what the movements will be. Without remaining uncertainty, the realized premium must also be zero. As a result, I_1 must be equal to $(1 + i_1^*)$, irrespective of the currency denomination of the external debt.[5]

Since non-fundamental capital flow shocks and FX intervention do not show up in equation (1a), the country does not experience premium spikes on local currency debt, and any FX intervention is

[5]The supply curve plots what global financiers must receive *after* tax. The use of a capital inflow tax does not shift this curve, but for any given external financing rate, the tax alters the interest rate available to domestic agents.

ineffective. In addition, there is no external borrowing constraint that can bind and cause a sudden stop.

Summarizing the above discussion, we obtain the following take-away:

- The supply curve is horizontal at the gross dollar interest rate. It is unaffected by non-fundamental capital flow shocks and FX intervention, and there is no external borrowing constraint.

Next, we turn to the second key relation on the panel.

2. Demand for imports:

$$C_{F1} = \frac{C_{F2}}{\beta I_1}\left(\frac{1-\frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1-\frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right) \tag{2a}$$

$$C_{F2} = X_2 + \left(X_1 - C_{F1} - Z_1\left(\underset{(+)}{B_1}, \frac{1-\lambda}{\underset{(+)}{\mathcal{E}_1}}\right)\right) I_1. \tag{2b}$$

Equations (2a)-(2b) are respectively the Euler condition and external budget constraint for the policymaker's welfare optimization problem. The Euler condition explains how consumption should be smoothed over time, while the external budget constraint places a bound on the net present value of consumption. Together, they produce the demand curve in figure 3. It establishes the policymaker's desired imports level in period 1, C_{F1}, and thereby the desired trade balance and external debt, as a function of the gross external interest rate I_1.

The Euler condition (2a) establishes that the demand curve is downward-sloping. The reason is that the policymaker determines the split of import consumption between periods 1 and 2 depending on the interest rate I_1 that they can earn by saving abroad between those periods. If I_1 is lower, the planner consumes more and saves less in period 1.

The demand curve shifts if the home output gaps $\widetilde{Y}_{H1}$ and $\widetilde{Y}_{H2}$ are not balanced over time. These gaps are determined in panel C. In each period t, the gap $\widetilde{Y}_{Ht}$ is defined as the excess demand for home goods, i.e., the difference between the actual home output and its efficient level. In equation (2a), it is normalized by the share of home goods α_H in the consumption bundle and the productivity level A_1. $\widetilde{Y}_{Ht}$ represents an aggregate demand externality, because households do not internalize that their individual demand for home goods affects the aggregate demand.

The policymaker does internalize their own ability to affect aggregate demand, however. Note that in each period and at any given exchange rate, households optimally decide to tie their demand for home goods in panel C to their consumption of imports in panel A. As a result, the policymaker

can shift the demand for home goods between periods by shifting the consumption of imports between periods. If it turns out from panel C that the normalized home output gap is lower in period 1 than in period 2, i.e., $\frac{1}{\alpha_H A_1}\widetilde{Y}_{H1} < \frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}$, equation (2a) indicates that the demand curve on panel A shifts to the right. The policymaker opts to smooth the gaps by shifting some import consumption, and thereby some demand for home goods, from period 2 to period 1. This motive for distorting C_{F1} in panel A is zero if the normalized home output gaps are equal over time, including in the special case when they are zero in all periods.

Equation (2b) is the economy's external budget constraint, which determines the position of the demand curve. It ensures that the net present value of import consumption is equal to the net present value of external income minus debt repayments.

The external income includes the dollar value of export revenues in periods 1 and 2, X_1 and X_2 respectively. There are two kinds of exports: home-produced tradable goods and commodities. The export income from home-produced tradable goods is fixed in dollars, because in the dominant currency paradigm, the dollar price and the quantity of such exports are fixed. The export income from commodities depends on the flexible dollar price of commodities.

The budget constraint subtracts Z_1, the dollar value of interest repayments on the debt B_1 that is inherited from the previous period. The demand curve shifts if Z_1 changes. As the equation shows, the repayment Z_1 depends on the following factors. First, the higher the inherited debt B_1, the higher the repayment Z_1. Note that if there is no inherited debt, there are also no repayments, i.e., $Z_1 = 0$ if $B_1 = 0$. Second, the value of Z_1 depends on the currency denomination of the inherited debt and any exchange rate movement, via the term $\frac{1-\lambda}{\mathcal{E}_1}$. We define λ as the fraction of external debt in dollars, so $(1-\lambda)$ is the fraction of it in local currency. We write the exchange rate $\mathcal{E}_1$ in units of local currency per dollar, and this exchange rate is determined in panel C.

If all inherited external debt and repayments are in dollars, i.e., $\lambda = 1$, we obtain $\frac{1-\lambda}{\mathcal{E}_1} = 0$, as the exchange rate $\mathcal{E}_1$ has no effect on the dollar value of repayments Z_1. If some of the inherited external debt and repayments are in local currency, i.e., $\lambda < 1$, the dollar value of the repayment does depend on the exchange rate, because of the possibility of the shock in period 1. A shock that generates a depreciation in period 1 reduces Z_1, because the depreciation reduces the dollar value of the local currency repayments. Such a depreciation frees up income for the consumption of imports, so the demand curve on panel A shifts to the right.

The policymaker should use its tools as needed to guide households towards the optimized demand curve given by equations (2a)-(2b). The two relevant tools are taxes on banks' external borrow-

ing (i.e., a capital inflow tax, φ_1) and on households' domestic borrowing from banks (i.e., a domestic macroprudential tax targeted at households, θ_{HH1}). These two tools have an identical effect on the demand curve, so either or both of them can be used. For a given external financing rate I_1, a subsidy via either of the tools reduces the interest rate faced by households, inducing them to increase consumption in period 1. Correspondingly, the demand curve can be pushed further to the right at that value of I_1. A tax via either of the tools causes the demand curve to be further to the left at that value of I_1.

If the policymaker is constrained in the use of these tools, it may not be able to achieve the demand curve above, and welfare may be reduced. For example, if a subsidy would be optimal, but it is set too low or it is not available, the demand curve will be to the left of where it should be.

For the specific case where the households are rational and long-lived intertemporal optimizers, the optimal setting of the tools is as follows:

$$\frac{(1-\varphi_1)}{(1+\theta_{HH1})} = \left(\frac{1-\frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1-\frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}} \right). \tag{2d}$$

The capital inflow tax and/or domestic macroprudential tax are needed to correct for the aggregate demand externality mentioned above. If neither tax is available in this specific case, the demand curve is replaced with the households' Euler condition: $\beta I_1 C_{F1} = C_{F2}$. This condition can be backed out from equations (2a) and (2d).

Summarizing the above discussion, we obtain the following take-aways:

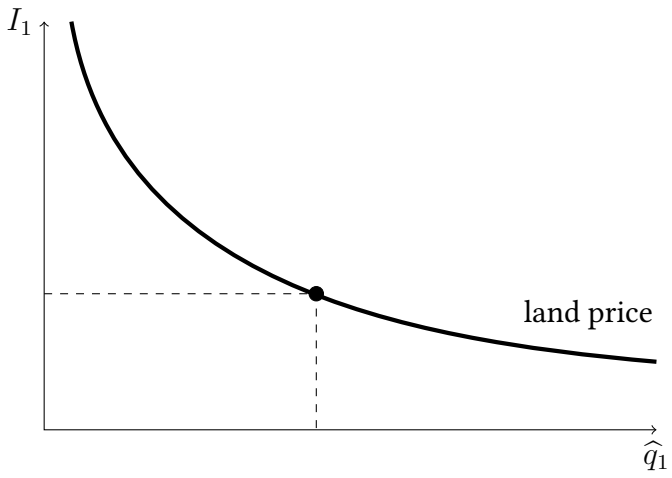
- The demand curve is downward-sloping.
- The demand curve shifts to the right if export income increases.
- The demand curve shifts to the right if the repayment on inherited debt decreases.
- The demand curve shifts to the right if the home output gap is temporarily lower in period 1.

Panel A shows that the intersection of the supply curve of external financing and the demand curve for imports determines the desired levels of import consumption C_{F1} and the gross external financing rate I_1. Correspondingly, shifts in any of these curves alter the desired levels of C_{F1} and I_1. Panel A shows that FX intervention is ineffective, and it shows the impact on the economy's external position from the use of capital controls and domestic macroprudential measures. Finally, there are spillovers from panel C to panel A: changes in the home output gaps $\widetilde{Y}_{Ht}$ and the exchange rate $\mathcal{E}_1$ in panel C cause the demand curve to shift on panel A.

Panel B. Housing

"Global financial cycle in credit"

Figure 4: Panel B. Housing



Panel B is shown in figure 4. It presents how the external financing rate determined in panel A spills over into domestic credit markets, with all variables again converted into dollar values. The vertical axis of this panel is the gross external financing rate I_1, the same as for panel A. The horizontal axis plots $\widehat{q}_1$, the dollar value of the land price in period 1. We plot this variable because we use the housing sector as a proxy for domestic credit markets as a whole, and the relevant asset price in the housing sector is the land price.

There is one key relation on the panel.

3. Land price:

$$\widehat{q}_1 = (1 - \varphi_1) \frac{C_{F2}}{I_1}. \tag{3}$$

Land is purchased by the housing sector to produce nontradable housing services in the next period. Correspondingly, the land price in period 1 is equal to the value of housing rents in period 2, discounted by the domestic financing rate between periods 1 and 2. Equation (3) highlights the variables that determine the housing rents and the domestic financing rate.

The dollar value of rents in period 2 is captured in the equation by the term C_{F2}, the consumption of imports in period 2. These rents are flexibly set and they reflect the demand of households for housing services. This demand moves together with the demand for imports in period 2, because both are determined by the overall resources available to households for consumption in that period.

The remaining variables in equation (3) relate to the dollar value of the domestic financing rate, which is the domestic borrowing interest rate in local currency adjusted for the expected change in the exchange rate between periods 1 and 2. It is given by $\frac{I_1}{(1-\varphi_1)}$, i.e., the external financing rate I_1 adjusted by the capital inflow tax φ_1. Equation (3) is divided by the domestic financing rate, so I_1 goes into the denominator and $(1-\varphi_1)$ goes into the numerator. Next, we explain why these two variables affect the domestic financing rate and the land price.

The higher the external financing rate I_1, the lower the dollar value of the land price. I_1 applies on external debt, which is partially in dollars and partially in local currency, as we have previously described. By contrast, domestic credit markets feature domestic debt between borrowers and lenders both inside the country, and we assume that this debt is entirely in local currency. But note that if there is integration between domestic and external financial markets, the external financing rate moves the dollar value of the domestic financing rate. In turn, this domestic financing rate determines the dollar value of the land price: the higher the rate, the lower the land price.

The policymaker can cut the transmission from the external financing rate to the domestic financing rate and land price by using the tax on capital inflows, φ_1. The important insight here is that while the capital inflow tax and household macroprudential tax have identical effects on households' demand for imports in panel A, only the first of the two tools affects panel B. The reason is that a tax on capital inflows increases the domestic financing rate for all domestic agents including the housing sector, while a household macroprudential tax increases the borrowing interest rate only for households and not for the housing sector. The land price depends on the domestic financing rate for the housing sector.

In the absence of financial frictions, there are no distortions in the housing sector. Irrespective of any volatility in domestic land prices, housing sector firms can purchase all the land they need to produce the desired quantity of nontradable housing services in each period.

Summarizing the above discussion, we obtain the following take-aways:

- The land price curve is downward-sloping.
- The land price curve shifts to the right if period-2 imports increase.
- The land price curve shifts to the right if the capital inflow tax is decreased.

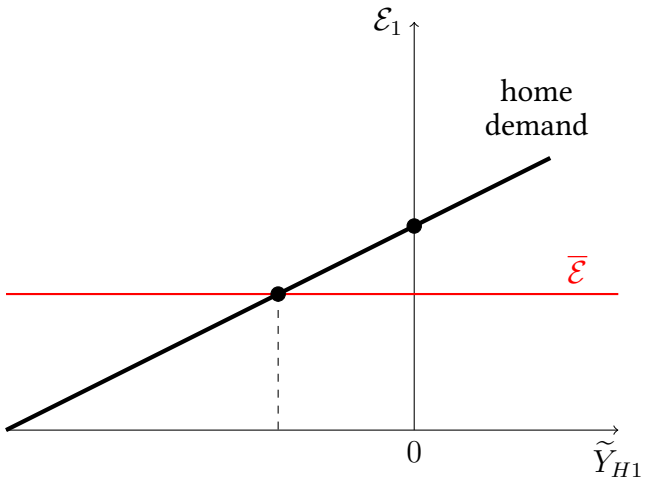
Panel B helps us answer the question of whether there is a case for policies to address the spillover from external financing conditions onto domestic asset prices. In the absence of financial frictions, ex post volatility in land prices does not cause housing sector distortions and hurt overall welfare. Consequently, there is no case for ex post policy action to support land prices. There is also no case

for ex ante macroprudential measures targeted at the housing sector. Even if we suppose that such ex ante measures can reduce inherited housing sector debt and thereby support ex post land prices, there is no welfare benefit of supporting those prices.

Panel C. Home Goods

"Aggregate demand stabilization via the exchange rate"

Figure 5: Panel C. Home Goods



Panel C is shown in figure 5. It presents the policymaker's decision-making on how to determine the exchange rate $\mathcal{E}_1$ in period 1, in units of local currency per dollar. The panel elaborates on expenditure switching between imports and home goods. Accordingly, the other variable plotted is the home output gap $\widetilde{Y}_{H1}$. It is defined as a gap, i.e., the difference between the actual home output and its efficient level. The policymaker prefers this gap to be zero. Since we assume that the home goods market clears, home goods consumption and output move together.[6]

The expenditure switching mechanism was a key insight from the reduced-form Mundell-Fleming approach. Panel C adapts that mechanism for our micro-founded framework. Households optimize their relative consumption of imports and home goods depending on the exchange rate. The policymaker knows this and sets the exchange rate accordingly.

There is one key relation on the panel.

5. Demand for home goods.

[6]The output of home goods is equal to the sum of home goods consumption and exports; and because of dominant currency pricing, exports are fixed, irrespective of exchange rate movements.

$$\widetilde{Y}_{H1} = C_{F1}\mathcal{E}_1 - \alpha_H A_1, \text{ where } \begin{cases} \widetilde{Y}_{H1} = 0 & \text{if floating regime} \\ \mathcal{E}_1 = \overline{\mathcal{E}} & \text{if fixed regime.} \end{cases} \tag{5a}$$

Equation (5a) defines $\widetilde{Y}_{H1}$, and it anchors panel C on the level of optimal imports from panel A. The impact of an exchange rate depreciation is to make home goods cheaper relative to imports, which encourages switching of households' expenditure from imports to home goods. An alternative way of stating this mechanism is to observe that for a given level of imports C_{F1} (as determined in panel A), a higher exchange rate $\mathcal{E}_1$ must be associated with a larger quantity of home goods consumption in the aggregate consumption bundle. This larger quantity is captured by the first term on the right hand side of equation (5a), and it accounts for the upward-sloping straight line in the figure.

The second term on the right hand side of the equation reflects the efficient level of home goods output. It depends on the level of productivity A_1, which measures the capacity to produce output, multiplied by the consumption share α_H of home goods.

As equation (5a) indicates, the monetary policy objective depends on the exchange rate regime.

In a floating exchange rate regime, we assume that the monetary policy objective is to use exchange rate flexibility to ensure that the home output gap is set to zero.[7] The optimal exchange rate $\mathcal{E}_1$ is then the level at which the demand for home goods intersects the vertical axis.

An increase in imports C_{F1} rotates the demand curve clockwise around its intersection with the horizontal axis. This change in the panel means that at the new intersection of the demand curve and the vertical axis, the exchange rate is lower, i.e., more appreciated. The reason is that for the country to have the same efficient level of home goods consumption but more imports consumption, it must be that imports are made cheaper. That change in relative price is achieved via an exchange rate appreciation.

An increase in productivity A_1 in the production process of tradable goods shifts the demand curve to the left. At the new intersection of the demand curve and the vertical axis, the exchange rate is higher, i.e., more depreciated. The reason is that for the country to have a higher efficient level of home goods consumption but the same level of imports consumption, it must be that home goods are made cheaper.[8] That change in relative price is achieved via an exchange rate depreciation.

[7] Our assumption means that in the absence of financial frictions, the policymaker does not seek to depreciate away the dollar value of any local currency external debt. We believe that this assumption is a realistic one. Additionally, in our framework, monetary policy is set to immediately stabilize $\widetilde{Y}_{H1}$, rather than assumed to follow an interest rate rule. In practice, some such rules may turn out to ensure that $\widetilde{Y}_{H1} = 0$.

[8] Imports do not change in panel A because the productivity shock does not expand the economy's external budget

In a fixed exchange rate regime, we include the red line in figure 5. The simple change is that instead of being allowed to move, the exchange rate is set at the peg: $\mathcal{E}_1 = \overline{\mathcal{E}}$.

The impact of this fixing depends on the value of $\overline{\mathcal{E}}$. If $\overline{\mathcal{E}}$ is below the intersection of the demand curve and the vertical axis, the home output gap is negative, i.e., there is inefficiently low demand for home goods. The reason is that if exchange rate is too appreciated, home goods are too expensive relative to imports, so households choose to consume too few home goods. Reversing the direction of the logic, if $\overline{\mathcal{E}}$ is above the intersection point, the home output gap is positive, i.e., there is excess demand for home goods.

Equation (5c) extends the above arguments to the home output gap in period 2, $\widetilde{Y}_{H2}$, but that variable is not plotted on the panel.

$$\widetilde{Y}_{H2} = C_{F2}\mathcal{E}_2 - \alpha_H A_2, \text{ where } \begin{cases} \widetilde{Y}_{H2} = 0 & \text{if floating regime} \\ \mathcal{E}_2 = \overline{\mathcal{E}} & \text{if fixed regime.} \end{cases} \tag{5c}$$

Summarizing the above discussion, we obtain the following take-aways:

- The demand curve is upward-sloping and intersects the vertical axis at the point where the home output gap is zero.
- The demand curve rotates clockwise if imports increase.
- The demand curve shifts to the left if productivity increases.
- For a fixed exchange rate regime, the home output gap depends on the level at which the exchange rate is fixed.

Panel C determines the home output gaps $\widetilde{Y}_{Ht}$ and the exchange rate $\mathcal{E}_1$, and relates both to the exchange rate regime. There is a spillover from panel A to panel C: changes in import consumption C_{F1} from panel A cause rotations of the demand curve for home goods in panel C.

Panel D. Policy Rate

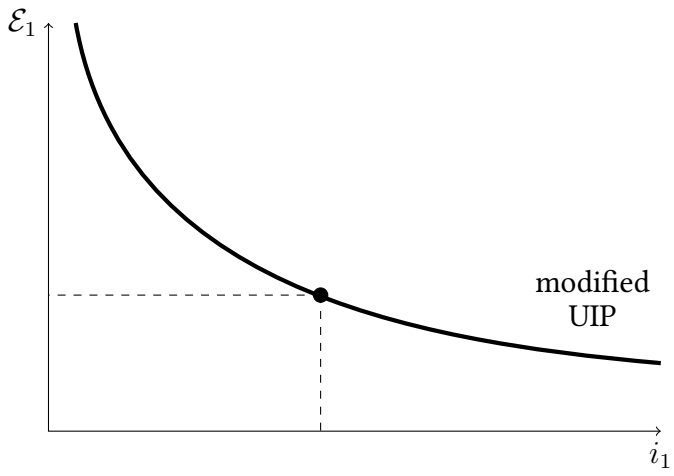
"Monetary policy decision"

Panel D is shown in figure 6. It presents how the period-1 monetary policy rate i_1 should be set to support all the policy decisions made in panels A, B, and C. To connect panels C and D, they both have the same variable on the vertical axis: the exchange rate $\mathcal{E}_1$.

There is one key relation on the panel.

constraint: in the dominant currency paradigm, the dollar values of export income, X_1 and X_2, remain fixed irrespective of exchange rate movements.

Figure 6: Panel D. Policy Rate



7. Modified UIP condition.

$$(1 + i_1) = \frac{(1 + i_1^*)}{(1 - \varphi_1)} \frac{\mathcal{E}_2}{\mathcal{E}_1}. \tag{7}$$

In the absence of financial frictions, equation (7) is the standard uncovered interest parity (UIP) condition, modified to incorporate the capital inflow tax φ_1.[9] This condition states that as a result of perfect arbitrage by global financiers, the returns on domestic and foreign assets should be identical from their perspective. In particular, we compare the financiers' returns on local currency lending to our country (because the interest rate on such lending is governed by the domestic policy rate) against their returns on foreign currency lending to other countries.

Let us first inspect the condition setting the capital inflow tax $\varphi_1 = 0$. The left hand side of the condition, $(1 + i_1)$, captures the gross local currency return from saving one unit of local currency in domestic local currency assets. The right hand side of the condition, $(1 + i_1^*) \frac{\mathcal{E}_2}{\mathcal{E}_1}$, captures the gross return from saving the same unit in foreign dollar assets, converted into local currency.

Following this reasoning, the UIP condition is downward-sloping in panel D. The curve captures what must happen to the exchange rate $\mathcal{E}_1$ if the policy rate is increased but all other variables are unchanged. The increase in the policy rate induces global financiers to indefinitely ramp up their holdings of domestic local currency debt. To stabilize their incentives, there must be an expected depreciation of the exchange rate between periods 1 and 2. For a fixed $\mathcal{E}_2$, the argument means that $\mathcal{E}_1$ must be lower, i.e., more appreciated today.

[9]Notice that because we have assumed that there is no further uncertainty after shocks strike in period 1, there is no need to include an expectations operator over the period 2 exchange rate $\mathcal{E}_2$. As there is no uncertainty to "cover", the condition can also simply be called the modified interest parity (IP) condition in this context.

The curve shifts to the right if the expected exchange rate $\mathcal{E}_2$ depreciates. The reason is that for any given $\mathcal{E}_1$, the expected depreciation makes domestic local currency assets less attractive relative to foreign dollar assets. To bring the returns back in line, the policy rate must be increased.

The curve shifts to the right if the foreign interest rate i_1^* increases. Again, this change makes domestic local currency assets less attractive relative to foreign dollar assets. To bring the returns back in line, the policy rate must be increased.

Next, let us inspect the condition for non-zero values of the capital inflow tax φ_1. Notice that the curve shifts to the right if the tax is increased. The reason is that global financiers must pay the tax when they repatriate abroad their returns on domestic assets, but they do not pay it when they invest in foreign assets. Accordingly, if the tax is increased, financiers earn a lower return on domestic local currency assets for any given level of the policy rate, which makes domestic local currency assets less attractive relative to foreign dollar assets. To bring the returns back in line, the policy rate must be increased.

Summarizing the above discussion, we obtain the following take-aways:

- The modified UIP condition is downward-sloping.
- The modified UIP condition shifts to the right if the expected exchange rate increases.
- The modified UIP condition shifts to the right if the foreign interest rate increases.
- The modified UIP condition shifts to the right if the capital inflow tax is increased.

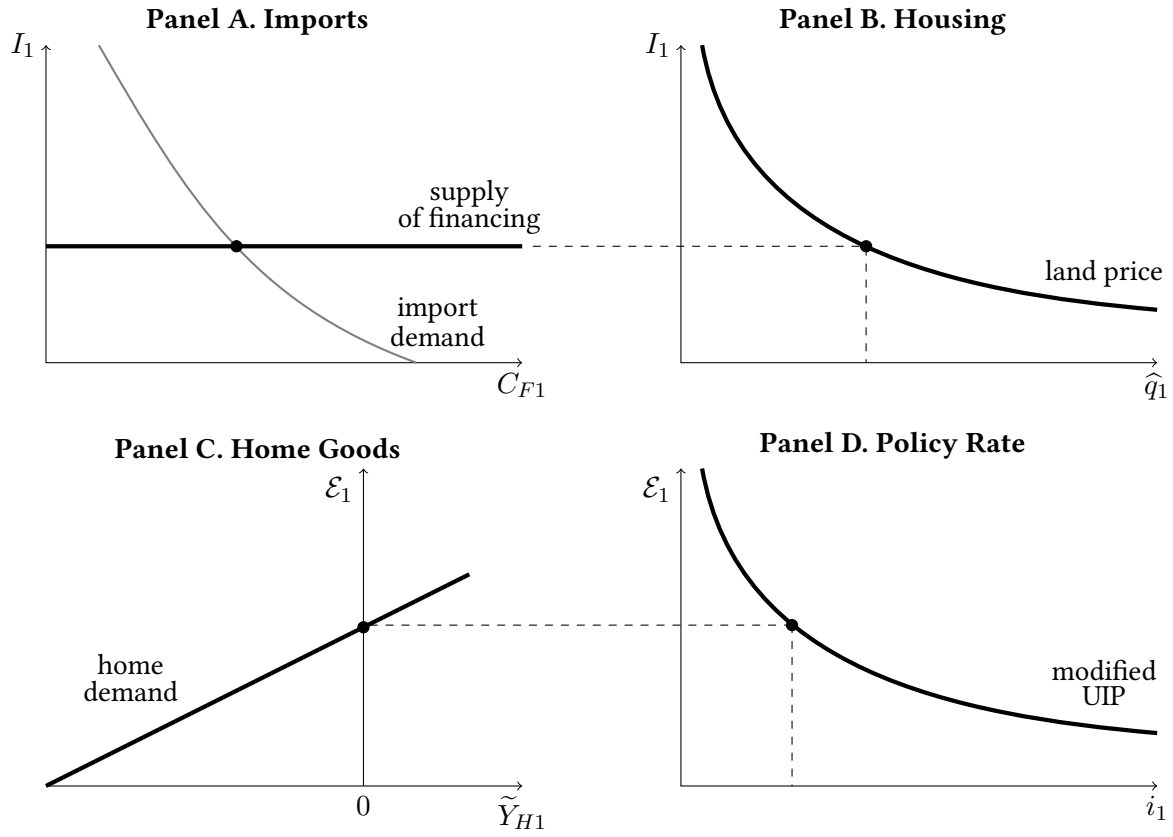
Panel D explains how the monetary policy rate i_1 should be set. As in the IS-LM model, the policymaker can be viewed as choosing the exchange rate first and then picking the policy rate which implements that exchange rate, or choosing the policy rate first and then allowing the exchange rate to be determined by equation (7) above. The two views are equivalent.

If the country follows a fixed exchange rate regime, i.e., $\mathcal{E}_1 = \overline{\mathcal{E}}$, a combination of the policy rate i_1 and capital control φ_1 must be set to implement that exchange rate peg irrespective of shocks.

2.3 The Complete Framework

Putting together all the elements described in this section, figure 7 shows the complete diagram for a country without financial frictions.

Figure 7: Diagram Without Financial Frictions



The associated system of equations is as follows:

$$I_1 = (1 + i_1^*) \tag{1a}$$

$$C_{F1} = \frac{C_{F2}}{\beta I_1} \left(\frac{1 - \frac{1}{\alpha_H A_1} \widetilde{Y}_{H1}}{1 - \frac{1}{\alpha_H A_2} \widetilde{Y}_{H2}} \right) \tag{2a}$$

$$C_{F2} = X_2 + \left(X_1 - C_{F1} - Z_1 \left(\underset{(+)}{B_1}, \underset{(+)}{\frac{1-\lambda}{\mathcal{E}_1}} \right) \right) I_1 \tag{2b}$$

$$\frac{(1 - \varphi_1)}{(1 + \theta_{HH1})} = \left(\frac{1 - \frac{1}{\alpha_H A_1} \widetilde{Y}_{H1}}{1 - \frac{1}{\alpha_H A_2} \widetilde{Y}_{H2}} \right) \tag{2d}$$

$$\widehat{q}_1 = (1 - \varphi_1) \frac{C_{F2}}{I_1} \tag{3}$$

$$\widetilde{Y}_{H1} = C_{F1} \mathcal{E}_1 - \alpha_H A_1, \text{ where } \begin{cases} \widetilde{Y}_{H1} = 0 & \text{if floating regime} \\ \mathcal{E}_1 = \overline{\mathcal{E}} & \text{if fixed regime} \end{cases} \tag{5a}$$

$$\widetilde{Y}_{H2} = C_{F2}\mathcal{E}_2 - \alpha_H A_2, \text{ where } \begin{cases} \widetilde{Y}_{H2} = 0 & \text{if floating regime} \\ \mathcal{E}_2 = \overline{\mathcal{E}} & \text{if fixed regime} \end{cases} \tag{5c}$$

$$(1 + i_1) = \frac{(1 + i_1^*)}{(1 - \varphi_1)} \frac{\mathcal{E}_2}{\mathcal{E}_1}. \tag{7}$$

These equations summarize all the panels that we have discussed. They allow readers to complement the graphical analysis of shocks and policy tools with simple algebraic explorations.

3 Policy Mixes Without Financial Frictions

In this section, we use the version of the framework without financial frictions to illustrate some possible policy responses to the commodity price and dollar interest rate shocks shown in panels a and b of figure 1. Since the framework does not have financial frictions yet, it cannot generate the premium spike and sudden stop shocks in panels c and d. We defer the analysis of these shocks to section 5.

Each shock and/or policy tool generates a shift of the curves in each panel and then spillover effects across panels. After allowing all the iterations of spillover effects to come to a conclusion, we obtain the post-shock allocations.

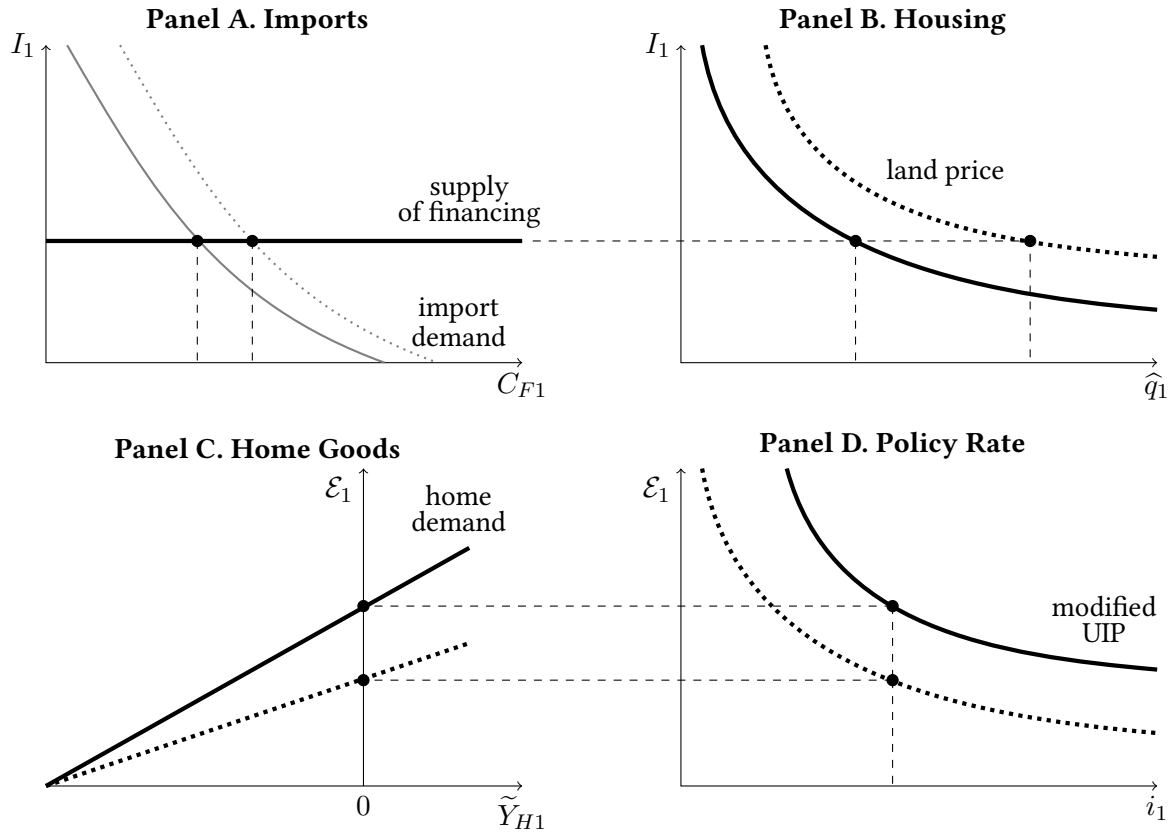
Across the different panels of the diagram, readers can see how each shock and/or policy tool affects different dimensions of welfare. We illustrate some policy mixes below, but the policymaker may choose different mixes, depending on how they value the different dimensions of welfare.

We write all the policy mix sections in a way that accommodates readers at a variety of technical levels. Each shock is illustrated on the diagram and described textually via a series of explanatory bullets. If they wish, readers can follow our reasoning on a purely graphical dimension, by seeing what happens when the curves shift. Descriptions of these shifts are provided in standard font at the start of each bullet. Alternatively, readers can use the algebra to dig deeper, by building on our system of equations. Descriptions of the associated calculations are provided in italicized font after the main messages of each bullet.

3.1 Export Income Shock

We consider a permanent adverse export income shock, i.e., a decrease in the dollar value of export income in both periods 1 and 2. For simplicity, we assume that $X_1 = X_2 = X$ and that there is a decrease in X. We make the following assumptions. First, we assume that the country has no inherited debt, i.e., $B_1 = Z_1 = 0$. Second, we assume that in the absence of the shock, the country

Figure 8: Export Income Shock with Floating Exchange Rate Regime



would have $\widetilde{Y}_{H1} = \widetilde{Y}_{H2} = 0$ and $\beta I_1 = \beta\left(1 + i_1^*\right) = 1$. Solving equations (2a)-(2b), we can show that these assumptions mean that in the absence of the shock, consumption can be smoothed between periods 1 and 2: $C_{F1} = C_{F2} = X$. Finally, we assume that equation (2d) holds, which pins down the necessary capital inflow tax in panel A.[10]

Remark 1. Macroeconomic adjustment is desirable.

Figure 8 illustrates the shock for a country with a floating exchange rate regime. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions.

Panel A. Imports decrease and the external financing rate is unchanged.

- The supply curve is unchanged. *Equation (1a) is unaffected.*
- The demand curve shifts to the left because X decreases. *For a floating regime, panel C will produce* $\widetilde{Y}_{Ht} = 0$. *Then equations (2a)-(2b) establish that* $C_{F1} = X\frac{(1+I_1)}{(1+\beta)I_1}$, *which means that the*

[10] If equation (2d) does not hold, the necessary capital inflow tax in panel A would deviate from what is derived below, so the spillovers from panel A to panels B and D via the capital inflow tax would be correspondingly amended.

decrease in X shifts the demand curve to the left. At $I_1 = (1 + i_1^*) = \frac{1}{\beta}$, we derive $C_{F1} = C_{F2} = X$, so the leftward shift is equal to the decrease in X.

- C_{F1} decreases and I_1 is unchanged. *C_{F1} decreases by the same amount as the decrease in X.*
- Since home output gaps are closed, there is no need for an ex post capital inflow tax or household macroprudential tax. *Since $\widetilde{Y}_{Ht} = 0$, we can set $\varphi_1 = \theta_{HH1} = 0$ in equation (2d).*

Panel B. The land price decreases.

- The land price curve shifts to the left because C_{F2} decreases. *The decrease in C_{F2} from panel A enters equation (3).*
- $\widehat{q}_1$ decreases at the unchanged level of I_1.

Panel C. The exchange rate depreciates and the home output gap is zero.

- The demand curve rotates anticlockwise because C_{F1} decreases. *The decrease in C_{F1} from panel A enters equation (5a).*
- $\mathcal{E}_1$ depreciates to set $\widetilde{Y}_{H1} = 0$. *From equation (5c), $\mathcal{E}_2$ depreciates by the same amount.*

Panel D. The policy rate is unchanged.

- The modified UIP condition shifts to the right because $\mathcal{E}_2$ increases. *Equation (7) incorporates $\varphi_1 = 0$ from panel A and the increase in $\mathcal{E}_2$ from panel C.*
- i_1 is unchanged. *In equation (7), $\mathcal{E}_1$ and $\mathcal{E}_2$ depreciate by the same amount.*

Overall, the country can achieve macroeconomic adjustment by using standard policy tools, i.e., by keeping the policy rate unchanged and allowing the exchange rate to depreciate. Imports can be reduced such that the trade balance and external debt in period 1 are both kept at zero, while home consumption is stabilized.

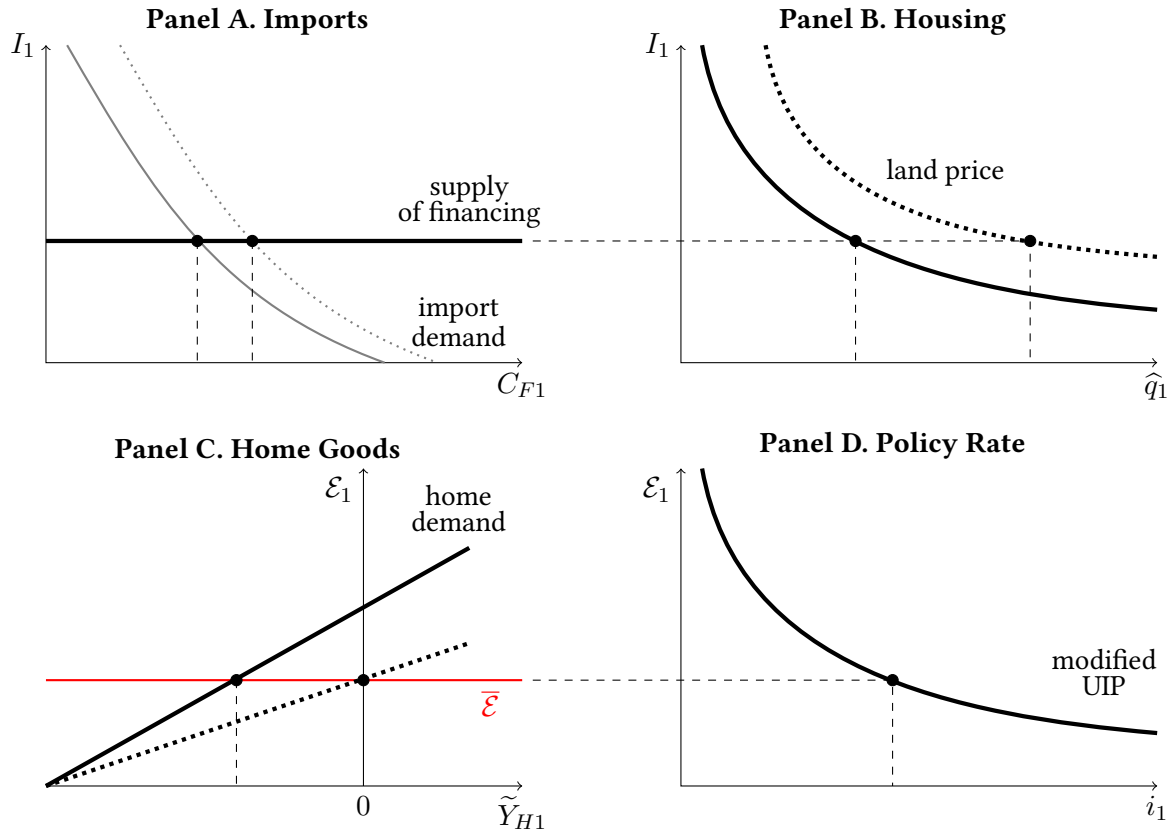
Remark 2. If the exchange rate is fixed, the home output gap turns negative.

Figure 9 illustrates the shock for a country with a fixed exchange rate regime, where $\mathcal{E}_1 = \overline{\mathcal{E}}$. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions.

Panel A. Imports decrease and the external financing rate is unchanged.

- The supply curve is unchanged. *Equation (1a) is unaffected.*

Figure 9: Export Income Shock with Fixed Exchange Rate Regime



- The demand curve shifts to the left because X decreases. *For a fixed regime, panel C will allow for* $\widetilde{Y}_{Ht} \neq 0$. *However, at* $I_1 = (1 + i_1^*) = \frac{1}{\beta}$, *equations (2a)-(2b) and (5a)-(5c) ensure that there is perfect consumption smoothing, i.e.,* $C_{F1} = C_{F2} = X$ *and* $\widetilde{Y}_{H1} = \widetilde{Y}_{H2}$.[11] *As a result, the leftward shift at that point is the same as in the floating regime.*
- C_{F1} decreases and I_1 is unchanged. C_{F1} *decreases by the same amount as the decrease in* X.
- Since home output gaps are balanced, there is no need for an ex post capital inflow tax or household macroprudential tax. *Since* $\widetilde{Y}_{H1} = \widetilde{Y}_{H2}$, *we can set* $\varphi_1 = \theta_{HH1} = 0$ *in equation (2d).*

Panel B. The land price decreases.

- The land price curve shifts to the left because C_{F2} decreases. *The decrease in* C_{F2} *from panel A enters equation (3).*
- $\widehat{q}_1$ decreases at the unchanged level of I_1.

[11] Even if the export income shock is temporary and not permanent, there would still be perfect consumption smoothing if $I_1 = (1 + i_1^*) = \frac{1}{\beta}$.

Panel C. There is a negative home output gap.

- The demand curve rotates anticlockwise because C_{F1} decreases. *The decrease in C_{F1} from panel A enters equation (5a).*
- $\widetilde{Y}_{H1}$ decreases because $\mathcal{E}_1 = \overline{\mathcal{E}}$. *From equation (5c), $\widetilde{Y}_{H2}$ also decreases because $\mathcal{E}_2 = \overline{\mathcal{E}}$.*

Panel D. The policy rate is unchanged.

- The modified UIP condition is unchanged. *Equation (7) incorporates $\varphi_1 = 0$ from panel A and the fixed $\mathcal{E}_2$ from panel C.*
- i_1 is unchanged. *In equation (7), $\mathcal{E}_1$ is also fixed.*

Even for countries with a fixed exchange rate regime, imports should adjust to keep the trade balance and external debt in period 1 at zero. There is a negative home output gap, but that may not justify ex post taxes on capital inflows or household debt. The reason is that if households undertake consumption smoothing, the home output gaps are already balanced over time, so these taxes would not improve welfare.

Notice that a fixed exchange rate regime is a case where fiscal policy may be particularly useful. So far, we have not incorporated fiscal policy because it is not realistic to assume that it can be used at high frequency for small or moderate shocks. But we will return to this issue in section **??**, when we show how fiscal adjustment could be a useful response to this permanent shock.

3.2 U.S. Monetary Tightening

We consider the effect of an increase in the dollar interest rate i_1^*, from $(1 + i_1^*) = \frac{1}{\beta}$ to $(1 + i_1^*) > \frac{1}{\beta}$. We assume that the starting point of the economy is the same as in section 3.1.

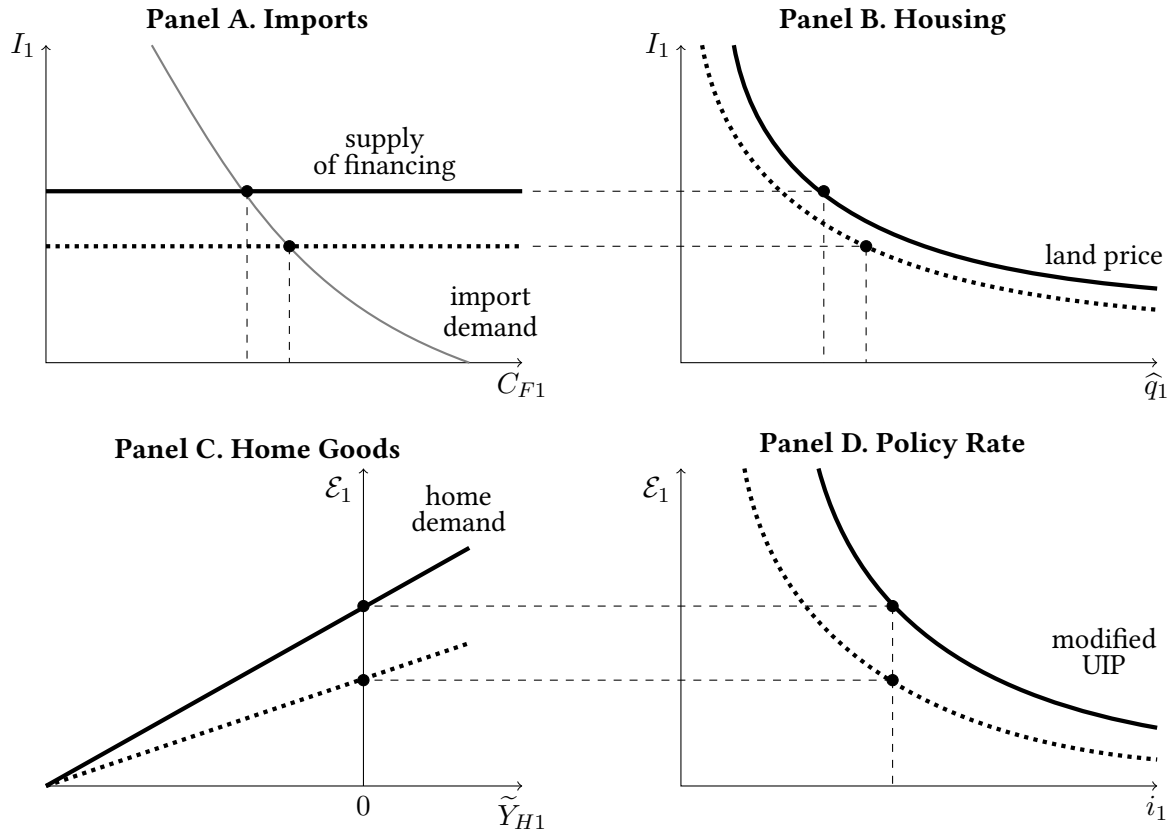
Remark 3. Monetary policy and exchange rate flexibility can achieve desirable adjustment.

Figure 10 illustrates the shock for a country with a floating exchange rate regime. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions.

Panel A. Period-1 imports decrease and the external financing rate increases.

- The supply curve shifts up because i_1^* increases. *Equation (1a) is affected.*
- The demand curve is unchanged. *For a floating regime, panel C will produce $\widetilde{Y}_{Ht} = 0$. Then equations (2a)-(2b) establish that $C_{F1} = X\frac{(1+I_1)}{(1+\beta)I_1}$ and $C_{F2} = X\frac{\beta(1+I_1)}{(1+\beta)}$.*

Figure 10: U.S. Monetary Tightening with Floating Exchange Rate Regime



- C_{F1} decreases and I_1 increases.
- Since home output gaps are closed, there is no need for an ex post capital inflow tax or household macroprudential tax. *Since $\widetilde{Y}_{Ht} = 0$, we can set $\varphi_1 = \theta_{HH1} = 0$ in equation (2d).*

Panel B. The land price decreases.

- The increase in I_1 causes a decrease in $\widehat{q}_1$ for a given land price curve.
- The land price curve shifts to the right because C_{F2} increases; however, $\widehat{q}_1$ still decreases relative to its pre-shock value. *Equation (3) indicates that the increase in C_{F2} from panel A shifts the curve to the right. The post-shock land price follows $\widehat{q}_1 = X\frac{\beta(1+I_1)}{(1+\beta)I_1}$.*

Panel C. The exchange rate depreciates and the home output gap is zero.

- The demand curve rotates anticlockwise because C_{F1} decreases. *The decrease in C_{F1} from panel A enters equation (5a).*
- $\mathcal{E}_1$ depreciates to set $\widetilde{Y}_{H1} = 0$. *Equations (5a)-(5c) establish that $\mathcal{E}_1 = \frac{\alpha_H A_1}{C_{F1}}$ and $\mathcal{E}_2 = \frac{\alpha_H A_2}{C_{F2}}$.*

Panel D. The policy rate is unchanged.

- The modified UIP condition shifts to the right because the increase in i_1^* dominates the decrease in $\mathcal{E}_2$. *Equation (7) incorporates the findings from panels A and C that* $\varphi_1 = 0$ *and* $(1 + i_1^*)\,\mathcal{E}_2 = \frac{\alpha_H A_2}{X}\frac{(1+\beta)I_1}{\beta(1+I_1)}$.
- i_1 is unchanged. *Substituting equations (5a)-(5c) into (7) establishes that* $\mathcal{E}_1$ *depreciates by enough such that no change in* i_1 *is needed.*

Overall, the country can achieve macroeconomic adjustment by using standard policy tools, i.e., by keeping the policy rate unchanged and allowing the exchange rate to depreciate. Imports can be reduced such that the trade balance is improved and external debt is reduced in period 1, while home consumption is stabilized.

3.3 Differences from the IS-LM Framework

So far, our framework does not have financial frictions, but it already features two key differences from the IS-LM model. First, it offers normative advice on whether policymakers should stabilize macroeconomic variables or facilitate their adjustment to shocks. Second, it incorporates additional policy tools (although sterilized FX intervention remains ineffective). Both of these differences can alter the desirable policy mixes after shocks.

For the shocks considered in this section, our framework finds that standard policy tools can achieve macroeconomic adjustments in floating exchange rate regimes.

For the export income shock, our framework finds that there is no change to the desirable levels of home output and trade balance, and there is no need to stabilize asset prices. As a result, we may expect few differences from the IS-LM framework, where we typically assume that returning the economy to the pre-shock levels of home output and trade balance is the desirable outcome. Indeed, in both frameworks, a country with a floating exchange rate regime experiences a depreciation, a reduction in imports, no change in the trade balance and external debt, and no change in home output.

However, while this outcome is similar, the mechanism is different. In IS-LM diagrams with an upward-sloping LM curve, it is the fixed money supply in the money market that stabilizes home output—by making any destabilization infeasible. Any change in home output would cause the policy rate to deviate from the foreign interest rate, generating unbounded capital flows (because the permanent nature of the shock means that there cannot be an expected depreciation). In our framework, money supply is not fixed, and many post-shock outcomes are feasible. It is the monetary

policy rule that stabilizes home output. For any given level of imports, the policy rate and the exchange rate adjust to set the home output gap to zero. If imports adjust optimally so that there is no change in the trade balance and external debt, home output turns out to be stabilized without any need to move the policy rate.[12]

For the U.S. monetary tightening shock, our framework continues to find that there is no change to the desirable level of home output and no need to stabilize asset prices, but it also finds that external debt should be reduced. Correspondingly, imports should be reduced to improve the trade balance while home output is stabilized.

This finding causes our framework and the IS-LM framework to diverge. While both frameworks feature an exchange rate depreciation which boosts home output, the initial financial impact of the shock and the end outcome are different. The impact of the shock on the IS-LM framework operates through an immediate depreciation and boost in home output, which can be reined in with a policy rate increase. To stabilize home output, the policy rate increase would cause the exchange rate to appreciate back to its original level.[13] At that point, both the trade balance and the external debt would revert to their pre-shock values.

By contrast, the impact of the shock in our framework is an immediate deleveraging of external debt which tends to reduce imports and home output, and the latter can be brought back to its original level by the exchange rate depreciation. To maintain a desired reduction in imports and external debt, imports have to be kept relatively more expensive than home goods. Accordingly, the exchange rate remains depreciated relative to its pre-shock value, while the policy rate is not increased.

Our framework can also be used for fixed exchange rate regimes, and unlike the IS-LM framework, it assumes that the capital inflow tax may be available when fiscal policy is not. In the IS-LM framework for a fixed regime, there is typically no tool other than fiscal policy to address the home output contraction after a export income shock or a U.S. monetary tightening. Our framework suggests that a capital inflow tax may not be useful after a export income shock, even if the economy is destabilized and fiscal policy is absent. By contrast, a capital inflow subsidy may be useful after a U.S. monetary tightening if fiscal policy is absent. Having said that, the subsidy does not fully stabilize the home output gap.

[12] If households do not adjust imports optimally, the policymaker may use the capital inflow tax and/or the household macroprudential tax to induce a better outcome.

[13] This result comes from an IS-LM model that excludes investment, to make it comparable to our framework.

4 The Framework With Financial Frictions

In this section, we introduce financial frictions into our framework. After providing a bird's eye view of the frictions, we incorporate them into the framework already described above.

Our framework is a flexible toolkit, with frictions that can be turned on or off. Since different countries have different levels of frictions, readers can draw the diagram differently for each country. Accordingly, the framework may illustrate that each country is affected differently by the same shock: if so, the policy mix it chooses may be different as well.[14]

4.1 Model Overview

We add financial frictions to the model described in section 2.1 and the financial intermediation structure shown in figure 2. The approach described here is again based on the model in Basu et al. (2025), this time including all the financial frictions in that paper.

Each financial friction builds on recent insights in the international finance literature:

- FX markets may be "shallow", meaning that the global financiers require a premium over the dollar interest rate when they lend to the banks in local currency; or they may be "deep" if no premium is required.
- Domestic banks face an external borrowing constraint that in certain circumstances may shrink and become "binding", i.e., limit the entire economy's access to cross-border financing.
- Domestic housing firms face a domestic borrowing constraint that in certain circumstances may also shrink, impairing these firms' borrowing from domestic banks whether or not cross-border financing is disrupted.

These frictions generate externalities which may motivate the use of additional tools by the policymaker. We can summarize the externalities as follows.[15]

If the FX market is shallow and some of the external debt is in local currency, there is a premium externality. The policymaker should internalize the dependence of the external premium on external debt, even though private agents do not take into account the impact of their borrowing decisions on the economy-wide external debt and the external premium. To address the externality, the policymaker may wish to discipline the changes in local currency external borrowing during inflow surges and retrenchments.

[14] In case you are eager for a preview of the complete diagram for this section, it is depicted in figure 15 below.
[15] For more technical details on the externalities and their policy implications, see Basu et al. (2025).

If there is a binding external borrowing constraint, there is a pecuniary aggregate demand externality. The policymaker should internalize the fact that this borrowing constraint depends on the economy-wide external debt and also on the exchange rate, which in turn is determined by aggregate demand. By contrast, households do not internalize the effect of their consumption decisions on economy-wide external debt and aggregate demand. To address the externality, the policymaker may wish to restrict ex ante external borrowing in dollars, and also to prevent large ex post exchange rate depreciations.

If there is a binding domestic borrowing constraint, there is a pecuniary production externality. The policymaker should internalize the fact that this borrowing constraint is affected by the ex ante housing sector debt. Moreover, if the constraint binds, efficient housing sector firms cannot purchase all the land they need for production, so inefficient firms use some of the land instead. Individual housing sector firms do not internalize the impact of their ex ante borrowing decisions on the sector-wide debt. To address the externality, the policymaker may wish to restrict ex ante borrowing by the housing sector.

Our amended framework will illustrate all the above financial frictions, and the effects of shocks and policy tools (both ex ante and ex post) given the frictions. Some of the use of the policy tools will be related to the externalities described above.

Alongside the visual illustration, the framework will provide a simple system of equations which can be analyzed to show the impact of shocks and ex post policies. The diagram and/or equations can help establish whether any borrowing constraints are binding ex post. If they are, the framework will provide reduced-form relations which approximate the ex post nonlinear crisis-zone dynamics, and it will explain how those relations may be affected by ex ante policies.

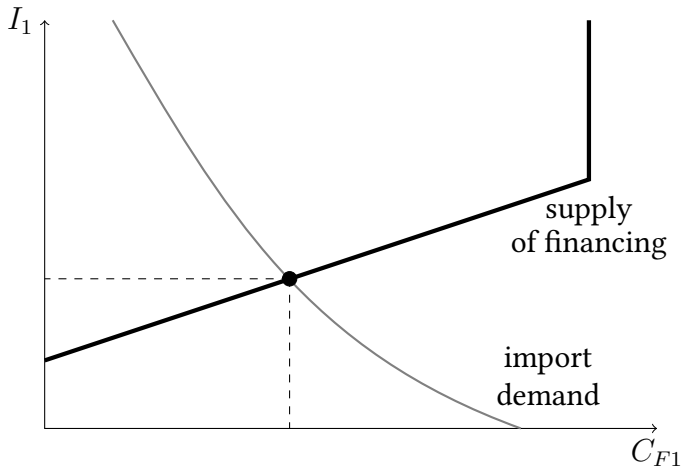
4.2 Construction of the Framework

Next, we go one by one through the four panels which were described in section 2.2, adding in the elements related to the financial frictions. As we do so, we add asterisks as superscripts to the equation numbers to distinguish the amended system from the one in that earlier section.

Panel A. Imports

"Intertemporal theory of the current account"

Figure 11: Panel A. Imports



The amended panel A is shown in figure 11. The addition of the financial frictions related to shallow FX markets and the external borrowing constraint alters both of the curves on this panel, which in turn changes the optimal level of imports C_{F1} in period 1 and the external financing rate I_1 between periods 1 and 2.

Let us now consider the first key relation on the panel.

1*. Supply of external financing:

$$I_1 = (1 + i_1^*) + (1 - \lambda)\,\Gamma\left(C_{F1} - X_1 + Z_1 + FXI_1 - S_1\right) \tag{1a*}$$

$$B_2 = C_{F1} - X_1 + Z_1 \left(\underset{(+)}{B_1}, \underset{(+)}{\frac{1-\lambda}{\mathcal{E}_1}} \right) \leq B_2^{\text{binding}} \left(\underset{(+)}{\kappa_H}, \underset{(-)}{\mathcal{E}_1} \right). \tag{1b*}$$

Equation (1a*) shows that I_1 is now related not just to $(1 + i_1^*)$, the gross dollar interest rate, but also to other variables which together reflect the friction of shallow FX markets.

We assume that there are two kinds of global financiers holding the country's external debt: optimizing financiers who may require a premium to hold the local currency portion of the debt, and noise traders who require no premium but only hold a fixed amount S_1 of the debt. If the FX market is shallow, the country's external financing rate depends on how much debt must be held by the optimizing financiers.

I_1 may deviate from $(1 + i_1^*)$ if the optimizing global financiers lend to domestic banks in local currency and require a premium to do so. λ is the fraction of external debt in dollars, so $(1 - \lambda)$ is the fraction of it in local currency. Γ is a measure of FX market shallowness and it captures the premium that optimizing financiers require per unit of local currency debt that they hold: we have $\Gamma = 0$ if the market is deep and there is no premium on local currency debt, but $\Gamma > 0$ if the market is shallow and a premium is charged. If both $(1 - \lambda)$ and Γ are positive, i.e., if $(1 - \lambda)\,\Gamma > 0$, I_1 may deviate from $(1 + i_1^*)$.

In this case, how much it deviates is determined by multiplying $(1 - \lambda)\,\Gamma$ by the external debt held by the optimizing financiers. This debt is the term in the lengthy brackets.

The debt is increasing in imports C_{F1}, which means that the supply curve becomes upward-sloping in figure 11, rather than being horizontal as in figure 3.

The supply curve shifts up or down if the other variables in the brackets change in value and thereby alter the level of external debt. The supply curve shifts down if there is an increase in dollar export revenues X_1. It shifts up if there is an increase in Z_1, the dollar value of interest payments. As described in section 2.2, the value of Z_1 depends on the currency denomination of inherited debt and any exchange rate movement.

The supply curve also shifts in position if there is sterilized FX intervention FXI_1. We define $FXI_1 > 0$ as an open market operation where the policymaker accumulates dollar assets in a separate external account and issues debt which the global financiers must absorb. The upshot is that with shallow FX markets, sterilized FX intervention becomes an effective and welfare-relevant tool.

Finally, the external financing rate depends on non-fundamental capital flow shocks. We view these as small-to-moderate shocks which strike relatively frequently. The external financing rate is decreasing in S_1, a non-fundamental inflow shock arising from noise traders who decide to purchase local currency debt for reasons unrelated to domestic macroeconomic fundamentals (e.g., financial firms whose headquarters have changed their portfolio allocation rules). Such an inflow means that the optimizing global financiers need to hold less of the debt, so they require less of a premium. The external financing rate increases when $S_1 < 0$, which generates a premium spike such as in the 2013 taper tantrum.

Equation (1b*) adds the friction of the external borrowing constraint. In section 2.2, it was possible to calculate the level of external debt at the end of period 1 from the variables in the external budget constraint (2b), but it did not have any importance distinct from that constraint. However, with the added equation (1b*), the level of external debt acquires distinct importance, as high levels of debt

are no longer supported by global financial markets. The right hand side of the equation represents the maximum amount $B_2^{\text{binding}} \geq 0$ that global financiers are willing to lend.

The external borrowing constraint is represented in figure 11 by the kink after which the supply curve is vertical. The constraint limits the quantity of external debt B_2, so it establishes an upper bound on imports C_{F1}, which is represented by the horizontal position of the kink. Since the constraint applies to total external debt, and not just the component held by the optimizing global financiers, FXI_1 and S_1 are not in equation (1b*) and do not affect the position of the kink.

The constraint becomes binding if the kink goes sufficiently to the left that the demand curve intersects the vertical part of the supply curve. When the constraint binds, the limit on external debt causes a decline in imports C_{F1}. We label this event as a sudden stop, a severe event that occurs rarely.

We turn next to the determinants of B_2^{binding}. Foreign trust in domestic creditworthiness is given by κ_H, the external pledgability of domestic collateral. If it declines, so does the permitted debt. We assume that the collateral is fixed in quantity and has sticky local currency prices. The expression in brackets for B_2^{binding} captures the notion that if the exchange rate $\mathcal{E}_1$ is higher, the dollar value of the collateral is lower, so the permitted debt decreases. This mechanism reflects the pecuniary aggregate demand externality which we described in section 4.1.

How much does the external borrowing constraint tighten when the exchange rate depreciates? The constraint tightens as the kink in the supply curve moves to the left on the panel and import consumption is forced to contract. From equation (1b*), the degree of movement of the kink depends on the relative sizes of the movements in Z_1 and B_2^{binding} as $\mathcal{E}_1$ increases.

The answer is determined by the economy's FX mismatch, as captured by the parameter λ. Here we build on the arguments from section 2.2 regarding the determination of Z_1. If all external debt is in dollars, i.e., $\lambda = 1$, the exchange rate $\mathcal{E}_1$ has no effect on Z_1, so the only effect of a depreciation on equation (1b*) is the reduction in B_2^{binding}. This reduction moves the kink substantially to the left. But if some of the external debt is in local currency, i.e., $\lambda < 1$, an exchange rate depreciation causes not just a reduction in B_2^{binding} but also a reduction in Z_1. The higher is $(1 - \lambda)$, the less that a depreciation tightens the constraint, so the less that the kink moves to the left.

For simplicity, we assume that the kink always moves somewhat (either substantially or just a little) to the left when the exchange rate depreciates. This assumption simplifies the reasoning related to the exchange rate threshold at which the constraint binds in the amended panel C below.

Summarizing the above discussion, we obtain the following take-aways:

- The supply curve is horizontal up to a kink if the FX market is deep and/or all external debt is in dollars. This horizontal part of the curve is unaffected by non-fundamental capital flow shocks and FX intervention.
- The supply curve is upward-sloping up to a kink if the FX market is shallow and some of the external debt is in local currency. This upward-sloping part of the curve shifts up after a non-fundamental outflow shock and shifts down if the policymaker decumulates FX reserves.
- The supply curve has a kink at the external borrowing constraint, when it becomes vertical.
- The kink moves to the left if there is a decline in investors' trust in domestic creditworthiness.
- The dependence of the kink on the exchange rate depends on the economy's FX mismatch. The higher the fraction of external debt in dollars, the more that the kink moves to the left after a depreciation.

Next, we turn to the second key relation on the panel.

2*. Demand for imports:

$$C_{F1} = \frac{C_{F2}}{\beta\left[I_1 + (1-\lambda)\,\Gamma\left(B_2 + FXI_1\right)\right]}\left(\frac{1 - \frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1 - \frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right) \tag{2a*}$$

$$C_{F2} = X_2 + \left(X_1 - C_{F1} - Z_1\right) I_1 - FXI_1\,(1-\lambda)\,\Gamma\left(B_2 + FXI_1 - S_1\right). \tag{2b*}$$

Equations (2a*) and (2b*) are respectively the amended Euler condition and external budget constraints for the policymaker's welfare optimization problem. They are the same as their counterparts in section 2.2, except that there are two new elements related to the friction of shallow FX markets.

The addition of this friction means that there is a new term $(1-\lambda)\,\Gamma\left(B_2 + FXI_1\right)$ in the Euler condition (2a*). The term reflects the premium externality which we described in section 4.1. Unlike the households, the policymaker recognizes that the supply curve for external financing is upward-sloping. Accordingly, the policymaker may try to reduce external debt so as to reduce the premia paid to the global financiers.

Turning next to the external budget constraint, the third term on the right hand side of equation (2b*) is new. It represents the profit or loss from sterilized FX intervention, which is a side-effect of that policy tool. The demand curve shifts to the right if FX intervention earns a profit, but shifts to the left if FX intervention generates a loss. Whether there is a profit or loss from FX intervention

depends on whether the FX intervention is resisting a shock related to macroeconomic fundamentals or one that is not related to them. We will illustrate this issue with examples in section 5.

The policymaker should guide households towards the optimized demand curve given by equations (2a*)-(2b*), by using a capital inflow tax, φ_1, or a household macroprudential tax, θ_{HH1}, or both. As described in section 2.2, these tools can alter the households' import demand as needed. If the policymaker is constrained in the use of these tools, it may not be able to achieve the demand curve above, and welfare may be reduced. For example, if a subsidy would be optimal, but it is set too low or it is not available, the demand curve will be to the left of where it should be.

If the external borrowing constraint (1b*) becomes binding, we keep the demand curve on the panel but it no longer determines imports C_{F1}. Consumption smoothing is disrupted, so as we discussed above, imports are determined by the kink in the supply curve instead. Since the taxes φ_1 and θ_{HH1} only affect the demand curve, they become irrelevant to welfare. For simplicity, we can set them to zero: $\varphi_1 = \theta_{HH1} = 0$.

Wherever the eventual intersection of the demand and supply curves, there may be a premium on external debt owing to the local currency portion of it interacting with FX market shallowness. In this case, we draw attention to a "premium adjustment factor":[16]

$$\mu_1 = \frac{I_1 + \lambda\Gamma\left(B_2 + FXI_1 - S_1\right)}{I_1}, \tag{2c*}$$

which translates the dollar value of this premium on external debt into the dollar value of the corresponding premium on domestic debt. A fraction $(1-\lambda)$ of the external debt is in local currency, while all of the domestic debt is in local currency. Accordingly, if there is a premium on external debt owing to the local currency portion of it, the premium would be even higher for the domestic debt. $\mu_1 = 1$ if all external debt is already in local currency (i.e., $\lambda = 0$), the FX market is deep (i.e., $\Gamma = 0$), and/or the optimizing global financiers hold no debt (i.e., $B_2 + FXI_1 - S_1 = 0$). Otherwise, μ_1 varies with shocks.

Finally, for the specific case where the households are rational and long-lived intertemporal optimizers, and the external borrowing constraint is not binding, the amended optimal setting of the two taxes is as follows:

$$\frac{(1-\varphi_1)}{(1+\theta_{HH1})} = \frac{I_1\mu_1}{I_1 + (1-\lambda)\,\Gamma\left(B_2 + FXI_1\right)}\left(\frac{1 - \frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1 - \frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right). \tag{2d*}$$

The first fraction on the right hand side corrects for the premium externality: the numerator is the

[16] This factor will feed into equation (2d*) as well as the discussion of panels B and D.

dollar value of the domestic financing rate for private agents in the absence of the taxes, and the denominator captures the relevant premium term from equation (2a*). The second fraction corrects for the aggregate demand externality, as in section 2.2. If neither tax is available in this specific case, the demand curve is replaced with the households' Euler condition: $\beta\left[I_1+\lambda\Gamma\left(B_2+FXI_1-S_1\right)\right]C_{F1}=C_{F2}$. This condition can be backed out from equations (2a*) and (2d*).

Summarizing the above discussion, we obtain the following take-aways:

- The demand curve is downward-sloping.
- The demand curve shifts to the right if export income increases.
- The demand curve shifts to the right if the repayment on inherited debt decreases.
- The demand curve shifts to the right if the home output gap is temporarily lower in period 1.
- The demand curve shifts to the left if the FX market is shallow and the local currency premium increases.
- The demand curve shifts to the right if FX intervention earns a profit, but shifts to the left if FX intervention generates a loss.

The amended panel A incorporates the frictions of shallow FX markets and the external borrowing constraint into the intertemporal theory of the current account. The intersection of the supply curve of external financing and the demand curve for imports continues to determine the desired levels of import consumption C_{F1} and the gross external financing rate I_1. With financial frictions, all the additional tools affect panel A. Sterilized FX intervention shifts the position of the supply curve directly, and it shifts the demand curve indirectly via carry costs. The capital inflow tax and/or household macroprudential tax help to set the position of demand curve. And now, there are more spillovers from panel C to panel A. Changes in the home output gaps $\widetilde{Y}_{Ht}$ and the exchange rate $\mathcal{E}_1$ in panel C continue to cause the demand curve to shift on panel A. A new feature is that both the upward-sloping part of the supply curve and its kink shift when $\mathcal{E}_1$ changes.

Different financial shocks generate different magnitudes of macroeconomic destabilization. If the FX market is shallow and some of the external debt is in local currency, non-fundamental capital flow shocks S_1 may cause variation in external premia and imports, but the intersection point always remains to the left of the kink of the supply curve. By contrast, after a sudden stop shock reducing κ_H, the kink moves to the left of the prior intersection point, and the level of imports must contract to be equal to the horizontal position of the kink. But the story does not end there. If the contraction in imports generates an exchange rate depreciation (as we will see in panel C below), this change moves

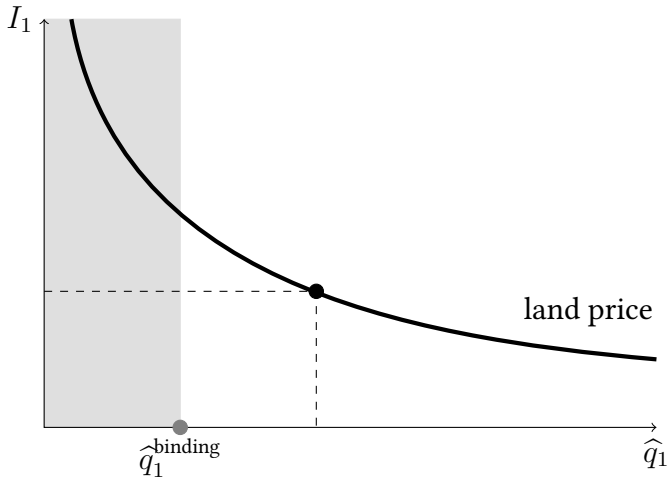
the kink further to the left and further reduces imports. This amplification mechanism depends on the currency composition of the external debt, and it can make a sudden stop especially severe.

In addition, note that shocks which do not affect the value of κ_H may nevertheless cause a sudden stop if they move the supply and demand curves such that the demand curve intersects the vertical part of the supply curve. Such shocks may be real or financial, and they may be related to macroeconomic fundamentals or unrelated to them.

Panel B. Housing

"Global financial cycle in credit"

Figure 12: Panel B. Housing



The amended panel B is shown in figure 12, plotting the external financing rate I_1 between periods 1 and 2 against $\widehat{q}_1$, the dollar value of the land price in period 1. The addition of the financial frictions of shallow FX markets and the external borrowing constraint amends the transmission of the external financing rate to the land price. The addition of the financial friction related to the domestic borrowing constraint generates the possibility that ex post volatility in land prices causes housing sector distortions and hurts overall welfare, because of the pecuniary production externality which we described in section 4.1.

There is one key relation on the panel.

3*. Land price:

$$\widehat{q}_1 = \frac{(1-\varphi_1)}{\mu_1 \Delta} \frac{C_{F2}}{I_1}. \tag{3*}$$

Equation (3*) represents the amended expression for the land price. Relative to section 2.2, the dependence of the land price on import consumption C_{F2}, the external financing rate I_1, and the capital inflow tax φ_1 remains unchanged. In addition, the equation incorporates the first two of the three frictions mentioned above.

The reason is that these two frictions amend the domestic financing rate to the new expression $\frac{I_1\mu_1\Delta}{(1-\varphi_1)}$. Both I_1 and the premium adjustment factor μ_1 incorporate the friction of shallow FX markets. The new term Δ is an interest rate spread which reflects the friction of the external borrowing constraint. Equation (3*) is divided by the domestic financing rate, so the new terms μ_1 and Δ go into the denominator. Next, we describe these two new terms and explain why they affect the domestic financing rate and the land price.

The friction of shallow FX markets adds the premium adjustment factor μ_1, which was introduced in the amended panel A. It is needed because we assume that all domestic debt is in local currency, while only the fraction $(1-\lambda)$ of the external debt is in local currency. If $\mu_1 > 1$, the dollar value of the domestic financing rate for the housing sector goes above the external financing rate. If so, the land price curve shifts to the left.

The friction of the external borrowing constraint adds the spread term $\Delta \geq 1$, which represents the ratio of the domestic borrowing interest rate to the domestic policy rate. The reason is that the friction introduces the possibility that this ratio exceeds one. If the external borrowing constraint binds in panel A, the economy's borrowing must be curtailed even if the policy rate remains low. The necessary curtailment is achieved by domestic banks charging all domestic agents a borrowing rate above the policy rate. Correspondingly, the domestic financing rate for the housing sector increases, which shifts the land price curve to the left.

When the external borrowing constraint binds, there are also additional effects on the land price through the other terms in equation (3*). First, the counterpart of the decrease in C_{F1} is an increase in C_{F2}, via the external budget constraint (2b*). This higher household demand in period 2 boosts housing rents in that period and thereby raises the land price in period 1. Second, if the FX market is shallow, there may also be a reduction in I_1 and μ_1 as a result of the reduction in the external debt. We assume that the impact of the increase in Δ dominates these other effects, so the land price decreases in a sudden stop.

Summarizing the above discussion, we obtain the following take-aways:

- The land price curve is downward-sloping.
- The land price curve shifts to the right if period-2 imports increase.

- The land price curve shifts to the left if the capital inflow tax is increased.
- The land price curve shifts to the left if the FX market is shallow and the local currency premium increases.
- The land price curve shifts to the left if the domestic borrowing rate increases above the domestic policy rate.

So far, the panel has incorporated the insight of the global financial cycle literature that external financing conditions may spill over onto domestic asset prices, and we have enhanced the transmission mechanism by incorporating two financial frictions. However, the existence of such spillovers does not necessarily rationalize policy tools targeted at supporting asset prices: such tools are only desirable if the asset price decline itself worsens frictions somewhere in the economy.

Once we add the financial friction of the domestic borrowing constraint, there may be a case for ex ante or ex post policies to address the spillover. Our discussion requires exploring the gray zone in figure 12.

4*. Point at which domestic borrowing constraint binds.

$$\widehat{q}_1^{\text{binding}} = \widehat{q}_1^{\text{binding}} \left(\underset{(-)}{\kappa_q}, \underset{(+)}{B_1^{\text{housing}}}, \underset{(-)}{C_{F1}} \right). \tag{4*}$$

Since land is used as collateral by housing sector firms when they borrow domestically to finance housing production, a reduction in the land price may cause their domestic borrowing constraint to shrink until eventually, it becomes binding. For all $\widehat{q}_1$ lower than $\widehat{q}_1^{\text{binding}}$, i.e., for the gray zone in figure 12, there is a domestic credit crunch and overall welfare declines. In the underlying model in Basu et al. (2025), the reason is that if the constraint binds on efficient housing sector firms, they can no longer borrow enough to purchase the economy's land. Consequently, inefficient housing sector firms use some of the land instead, so housing output declines.

Equation (4*) explains the position of the gray zone. The gray zone is further to the left if the pledgability parameter κ_q of land is higher; if so, even if the land price is low, enough of the value of the land can be offered as collateral that borrowing is not affected. The gray zone is also further to the left if there is a lower value of B_1^{housing}, the inherited housing sector debt at the start of period 1. Lower inherited debt means that there are lower debt rollover needs between periods 1 and 2, so there is less debt subject to any domestic borrowing constraint.

Because of the dependence of the gray zone on B_1^{housing}, ex ante macroprudential measures on the housing sector can be welfare-improving. The economy features a pecuniary production externality:

individual housing sector firms do not internalize the impact of their borrowing decisions on the sector-wide debt and the severity of the domestic borrowing constraint. As a result, they may borrow too much in period 0 and end up with too much debt at the start of period 1. By setting an appropriate ex ante tax or quantity regulation on housing sector debt, the policymaker can induce the housing sector to borrow less in period 0, reducing B_1^{housing} and thereby pushing the gray zone to the left.[17]

Finally, the gray zone is further to the left if imports C_{F1} are higher. The reason is that higher C_{F1} is associated with higher resources for consumption in period 1, and correspondingly a higher value of housing rents in that period. These rents can be used to pay down the inherited debt and reduce rollover needs between periods 1 and 2, loosening the constraint.

Summarizing the above discussion, we obtain the following take-aways:

- The gray zone (representing a binding domestic borrowing constraint) shifts to the left if the domestic pledgability of assets is higher.
- The gray zone shifts to the left if the policymaker sets an ex ante tax or quantity regulation on housing sector debt.
- The gray zone shifts to the left if period-1 imports increase.

In the amended panel B, the addition of financial frictions changes the assessment of whether policy tools should be used to address the spillover from external financing conditions onto domestic asset prices.

The amended answer is as follows. The transmission of the external financing rate in panel A to domestic asset prices in panel B is amplified by the frictions of shallow FX markets and the external borrowing constraint, but the transmission is not on its own a rationale for the use of policy tools to support asset prices. There is a case for such policy tools only if there is a risk that shocks cause the domestic borrowing constraint to become binding ex post. An ex post capital inflow subsidy can boost the land price in period 1, thereby preventing the economy from entering the gray zone. Ex ante macroprudential measures on the housing sector can reduce the sector's overborrowing in period 0, mitigating the ex post salience of the domestic borrowing constraint by shifting the gray zone to the left.

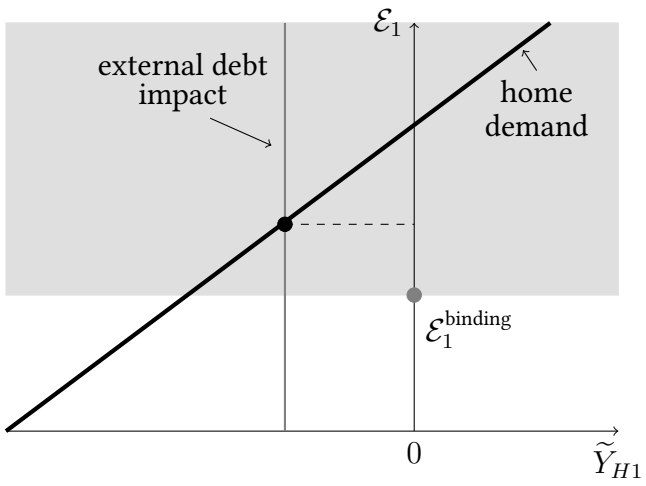
Of course, each tool may generate distortions in the economy. The optimal mix between ex ante and ex post policy tools depends on their relative distortive effects in practice.

[17] We do not consider ex post macroprudential subsidies targeted at the constrained housing sector because they are unlikely to be effective in supporting the land price. While they induce housing sector firms to try to borrow more to purchase land, the firms do not succeed in doing so because their borrowing constraint is already binding.

Panel C. Home Goods

"Aggregate demand stabilization via the exchange rate"

Figure 13: Panel C. Home Goods



The amended panel C is shown in figure 13, plotting the exchange rate $\mathcal{E}_1$ against the home output gap $\widetilde{Y}_{H1}$ in period 1. The impact of adding the financial friction of the external borrowing constraint depends on whether the constraint is binding in panel A and on the exchange rate regime. If the constraint is binding, it shifts the position of the home goods demand curve. In a fixed exchange rate regime, the constraint has no further effect on panel C. In a floating exchange rate regime, an extra line appears on panel C if the constraint is binding, as shown in figure 13. The constraint can then alter the exchange rate that the policymaker chooses, and it can cause the chosen output gap to deviate from zero.

Let us now consider the first key relation on the panel.

5*. Demand for home goods.

$$\widetilde{Y}_{H1} = C_{F1}\mathcal{E}_1 - \alpha_H A_1 \tag{5a*}$$

$$\text{where} \begin{cases} \widetilde{Y}_{H1} = 0 & \text{if floating regime and no binding external constraint} \\ \mathcal{E}_1 = \overline{\mathcal{E}} & \text{if fixed regime.} \end{cases} \tag{5b*}$$

Equation (5a*) notes that the home output gap $\widetilde{Y}_{H1}$ is defined as it was in section 2.2. As in that section, the demand curve is upward-sloping, and it remains anchored on the level of imports C_{F1} from panel A and the productivity level A_1.

The level of imports C_{F1} depends on all the factors discussed in panel A above, including whether or not the external borrowing constraint is binding. If it is binding, C_{F1} decreases, which causes the demand curve in panel C to rotate anticlockwise around its intersection with the horizontal axis.

Equation (5b*) outlines two cases where the demand curve is the only relation needed to derive the outcome of panel C, because the financial friction of the external borrowing constraint does not add any extra line to the panel.

The first case is a country with a fixed exchange rate regime. In this case, the policymaker continues to set the exchange rate at the peg: $\mathcal{E}_1 = \overline{\mathcal{E}}$. The country goes to the intersection of the demand curve and the horizontal line representing the peg.

The second case is a country with a floating exchange rate regime where the external borrowing constraint is not binding. In this case, the policymaker continues to use exchange rate flexibility to set the home output gap to zero.

The external constraint is never binding provided that some conditions are satisfied. As we assumed in the discussion of panel A above, the kink in the supply curve in that panel moves to the left when the exchange rate $\mathcal{E}_1$ depreciates. The amended panel C remains the same as in section 2.2 for a floating exchange rate regime if irrespective of the shock, the kink always remains to the right of the intersection point of the supply and demand curves in panel A. This configuration is true if the pledgability parameter κ_H is high, the inherited external debt B_1 is low, and/or the trade balance $(X_1 - C_{F1})$ is high.

Summarizing the above discussion, we obtain the following take-aways:

- The demand curve is upward-sloping and intersects the vertical axis at the point where the home output gap is zero.
- The demand curve rotates clockwise if imports increase.
- The demand curve shifts to the left if productivity increases.
- For a fixed exchange rate regime, the home output gap depends on the level at which the exchange rate is fixed.

Next, we consider the final case that could arise: a country with a floating exchange rate regime where the external borrowing constraint does sometimes bind. In panel A, some shocks could move the kink in the supply curve so much to the left that the demand curve intersects the vertical part of the supply curve, and the external borrowing constraint reduces imports C_{F1}. For such a country, the following new relation is added to figure 13.

6*. External debt impact from depreciation.

$$\mathcal{E}_1^{\text{binding}} = \mathcal{E}_1^{\text{binding}} \left(\underset{(+)}{\kappa_H}, \underset{(-)}{B_1}, \underset{(+)}{X_1 - C_{F1}} \right) \tag{6a*}$$

$$\widetilde{Y}_{H1} = -T + (1-\lambda) B_1 L \text{ if floating regime and binding external constraint.} \tag{6b*}$$

Equation (6a*) captures the notion that a depreciation makes the external borrowing constraint more likely to bind because it shifts the kink in the supply curve on panel A to the left. For exchange rates higher than $\mathcal{E}_1^{\text{binding}}$, the constraint becomes binding, which is shown as the gray zone on panel C. $\mathcal{E}_1^{\text{binding}}$ is higher if the characteristics of the country make the constraint less likely to be relevant, i.e., if the pledgability parameter κ_H is higher, the inherited external debt B_1 is lower, and the trade balance $(X_1 - C_{F1})$ is higher. Note that since $B_2^{\text{binding}} \geq 0$, the constraint cannot bind if panel A produces $B_2 \leq 0$. $\mathcal{E}_1^{\text{binding}}$ is arbitrarily high in that case.

After some shocks, the country remains outside the gray zone. In such cases, setting $\widetilde{Y}_{H1} = 0$ does not require a value of $\mathcal{E}_1$ higher than $\mathcal{E}_1^{\text{binding}}$. When the external borrowing constraint is not binding, we assume that the monetary policy objective remains to use exchange rate flexibility to set the home output gap to zero.

However, after other shocks, the country enters the gray zone. In such cases, setting $\widetilde{Y}_{H1} = 0$ would require a value of $\mathcal{E}_1$ higher than $\mathcal{E}_1^{\text{binding}}$. As $\mathcal{E}_1$ increases past $\mathcal{E}_1^{\text{binding}}$ and the external borrowing constraint becomes binding, we assume that monetary policy now also considers how much a further exchange rate depreciation in panel C would tighten the constraint in panel A. As shown in figure 13, a new line representing equation (6b*) must be plotted on panel C to incorporate this trade-off once the country enters the gray zone.

This equation represents the external debt impact from the depreciation. The right hand side of the equation captures the argument described above in our explanation of panel A, with constants T ("tightening") and L ("loosening"). The term $-T$ captures how a depreciation tightens the constraint because of a decline in B_2^{binding}. It is the only term on the right hand side if all external debt is in dollars, i.e., $\lambda = 1$. The term $(1-\lambda) B_1 L$ captures how a depreciation may loosen the constraint because of a decline in the dollar value of repayments Z_1. It becomes relevant if some of the external debt is in local currency, i.e., $\lambda < 1$.

Since we assumed that a depreciation always tightens the external borrowing constraint to some degree, the right hand side of equation (6b*) is negative, so the equation shows up in panel C as a vertical line to the left of the vertical axis. The policymaker's choice of variables on panel C is given by the intersection of this vertical line with the demand curve for home goods, because equation

(5a*) represents the marginal benefit of depreciation while equation (6b*) represents the marginal cost. [18]

If all external debt is in dollars, i.e., $\lambda = 1$, the vertical line representing equation (6b*) is substantially to the left of the vertical axis. The desired exchange rate $\mathcal{E}_1$ is substantially lower than the value that sets $\widetilde{Y}_{H1}$ to zero, and so $\widetilde{Y}_{H1}$ is substantially negative. A further depreciation to try to close $\widetilde{Y}_{H1}$ via expenditure switching is not chosen because it would excessively tighten the external constraint via an amplification mechanism, i.e., the kink in the supply curve in panel A would shift excessively to the left.

If some of the external debt is in local currency, i.e., $\lambda < 1$, the vertical line representing equation (6b*) shifts to the right. The desired exchange rate $\mathcal{E}_1$ is closer to the value that sets $\widetilde{Y}_{H1}$ to zero, and so $\widetilde{Y}_{H1}$ is less negative. The depreciation does not tighten the external constraint much, i.e., the kink in panel A does not shift much to the left.

Because of the dependence of the gray zone on the inherited external debt B_1, ex ante capital controls at the border or ex ante macroprudential measures on household borrowing can be welfare-improving. The economy features a pecuniary aggregate demand externality: domestic agents do not internalize the effect of their borrowing decisions on economy-wide external debt and aggregate demand, which in turn affect the chosen exchange rate and the severity of the external borrowing constraint. As a result, domestic agents may borrow too much in period 0 and end up with too much external debt at the start of period 1. By setting an appropriate ex ante tax or quantity regulation, the policymaker can induce these agents to borrow less in period 0, reducing B_1 and thereby pushing up the gray zone.

The case for such regulation diminishes if a large portion of the external debt is in local currency. The reason is that as argued above, the higher is the local currency fraction of the external debt, $(1 - \lambda)$, the smaller the distortions to the exchange rate $\mathcal{E}_1$ and the home output gap $\widetilde{Y}_{H1}$ generated by the external constraint.

Summarizing the above discussion, we obtain the following take-aways:

- The gray zone (representing a binding external borrowing constraint) shifts up if the external pledgability of assets is higher.
- The gray zone shifts up if the policymaker sets an ex ante tax or quantity regulation on external debt.
- The gray zone shifts up if the trade balance increases.

[18] Since equation (6b*) only applies for exchange rates within the gray zone, any intersection between equations (5a*) and (6b*) must also lie within the gray zone.

- The external debt impact line appears on the panel as a vertical line to the left of the vertical axis once the exchange rate increases into the gray zone.
- The external debt impact line shifts to the right if some of the external debt is in local currency.

Finally, equation (5c*) states that in period 2, the applicable equation is the same as in section 2.2. We do not plot $\widetilde{Y}_{H2}$ on the panel.

$$\widetilde{Y}_{H2} = C_{F2}\mathcal{E}_2 - \alpha_H A_2, \text{ where } \begin{cases} \widetilde{Y}_{H2} = 0 & \text{if floating regime} \\ \mathcal{E}_2 = \overline{\mathcal{E}} & \text{if fixed regime.} \end{cases} \tag{5c*}$$

The amended panel C augments the theory of expenditure-switching with the financial friction of the external borrowing constraint.

Relative to section 2.2, the addition of the external borrowing constraint in a floating exchange rate regime generates a new amplification mechanism between panels A and C. If the constraint binds in panel A, the reduction in imports causes an anticlockwise rotation of the demand curve for home goods and the addition of the external debt impact line in panel C. And the spillovers continue: if there is an exchange rate depreciation in panel C, the constraint becomes tighter and imports decline further in panel A, causing a further depreciation in panel C. The magnitudes of the distortions to import consumption C_{F1}, the external financing rate I_1, the exchange rate $\mathcal{E}_1$, and the home output gap $\widetilde{Y}_{H1}$ determine the severity of the sudden stop, and the amplification mechanism is larger when more of the external debt is in dollars rather than in local currency.

Panel D. Policy Rate

"Monetary policy decision"

The amended panel D is shown in figure 14. It plots the period-1 monetary policy rate i_1 against the exchange rate $\mathcal{E}_1$.

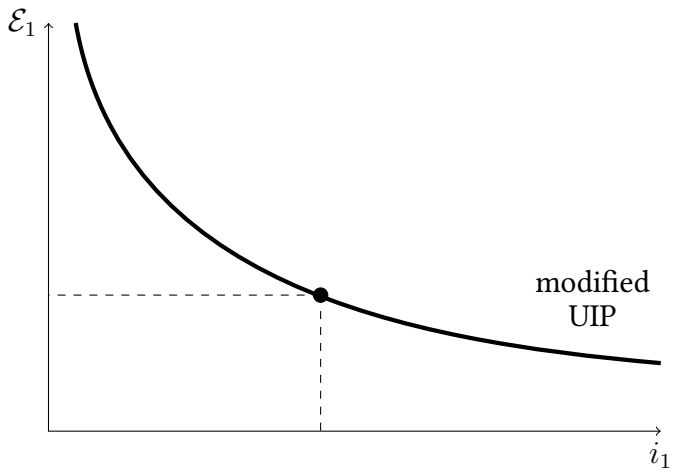
There is one key relation on the panel.

7*. Modified UIP condition.

$$(1 + i_1) = \frac{I_1 \mu_1}{(1 - \varphi_1)} \frac{\mathcal{E}_2}{\mathcal{E}_1}. \tag{7*}$$

Equation (7*) is the modified UIP condition. The addition of the financial friction of shallow FX markets causes a change in the condition relative to its counterpart in section 2.2. Since the optimizing global financiers can no longer perfectly arbitrage between local currency and dollar

Figure 14: Panel D. Policy Rate



assets, there can be a divergence between the returns on domestic local currency assets and foreign dollar assets.

The first new term is I_1, because this external financing rate is the after-tax return that is now required on the country's external debt by the optimizing global financiers. They are no longer willing to finance the debt at $(1 + i_1^*)$, the gross dollar interest rate. Drawing on our discussion of equation (1a*) from panel A above, we observe that for a country with shallow FX markets, the policy rate must be increased if there is an increase in external debt, if the policymaker accumulates FX assets $FXI_1 > 0$, or if there is a non-fundamental capital outflow shock $S_1 < 0$.

The second new term is the premium adjustment factor μ_1. As described in panel A, it is needed to translate the dollar value of the premium on external debt into the dollar value of the premium on domestic debt.

Summarizing the above discussion, we obtain the following take-aways:

- The modified UIP condition is downward-sloping.
- The modified UIP condition shifts to the right if the expected exchange rate increases.
- The modified UIP condition shifts to the right if the foreign interest rate increases.
- The modified UIP condition shifts to the right if the capital inflow tax is increased.
- The modified UIP condition shifts to the right if the FX market is shallow and there is an increase in external debt, FX accumulation, or a non-fundamental capital outflow shock.

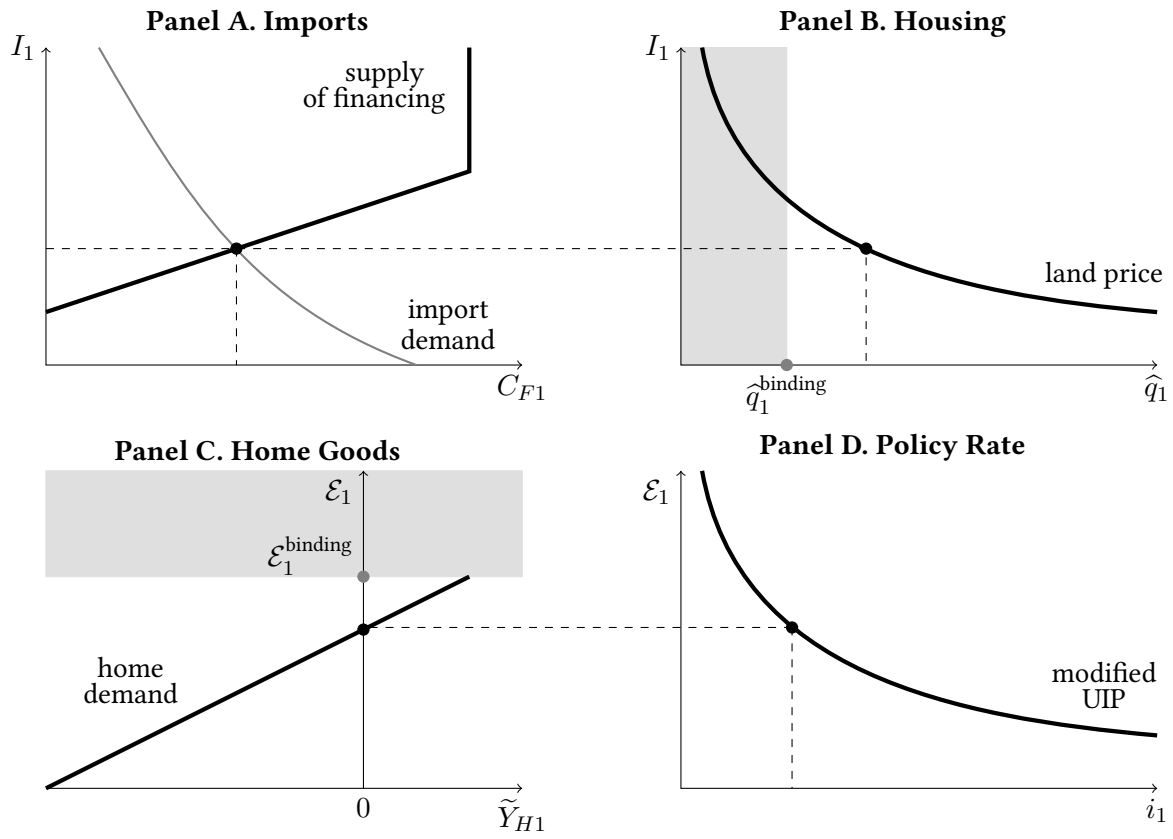
The amended panel D explains how the monetary policy rate i_1 is set in an environment with multiple frictions and tools, incorporating all the policy decisions made in panels A, B, and C. As in

the IS-LM model, the policy rate should be in line with the desired exchange rate path. Going beyond IS-LM, the policy rate must also take into account whether the FX market is shallow and whether policy tools such as sterilized FX intervention and capital controls are being used.

4.3 The Complete Framework

Putting together all the elements described in this section, figure 15 shows the complete diagram for a country with all the financial frictions. Readers can draw the diagram differently for different countries: for each country, the configuration of lines on each panel depends on which policy tools and frictions are most relevant for that country.

Figure 15: Diagram With All Financial Frictions



The associated system of equations is as follows:

$$I_1 = (1 + i_1^*) + (1 - \lambda)\,\Gamma\left(C_{F1} - X_1 + Z_1 + FXI_1 - S_1\right) \tag{1a*}$$

$$B_2 = C_{F1} - X_1 + Z_1 \left(\underset{(+)}{B_1}, \underset{(+)}{\frac{1-\lambda}{\mathcal{E}_1}}\right) \leq B_2^{\text{binding}} \left(\underset{(+)}{\kappa_H}, \underset{(+)\ (-)}{\mathcal{E}_1}\right) \tag{1b*}$$

$$C_{F1} = \frac{C_{F2}}{\beta\left[I_1 + (1-\lambda)\,\Gamma\left(B_2 + FXI_1\right)\right]} \left(\frac{1 - \frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1 - \frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right) \tag{2a*}$$

$$C_{F2} = X_2 + \left(X_1 - C_{F1} - Z_1\right) I_1 - FXI_1\,(1-\lambda)\,\Gamma\left(B_2 + FXI_1 - S_1\right) \tag{2b*}$$

$$\mu_1 = \frac{I_1 + \lambda\Gamma\left(B_2 + FXI_1 - S_1\right)}{I_1} \tag{2c*}$$

$$\frac{(1-\varphi_1)}{(1+\theta_{HH1})} = \frac{I_1\mu_1}{I_1 + (1-\lambda)\,\Gamma\left(B_2 + FXI_1\right)} \left(\frac{1 - \frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1 - \frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right) \tag{2d*}$$

$$\widehat{q}_1 = \frac{(1-\varphi_1)}{\mu_1\Delta}\frac{C_{F2}}{I_1} \tag{3*}$$

$$\widehat{q}_1^{\text{binding}} = \widehat{q}_1^{\text{binding}} \left(\underset{(-)}{\kappa_q}, \underset{(+)}{B_1^{\text{housing}}}, \underset{(-)}{C_{F1}}\right) \tag{4*}$$

$$\widetilde{Y}_{H1} = C_{F1}\mathcal{E}_1 - \alpha_H A_1 \tag{5a*}$$

$$\text{where } \begin{cases} \widetilde{Y}_{H1} = 0 & \text{if floating regime and no binding external constraint} \\ \mathcal{E}_1 = \overline{\mathcal{E}} & \text{if fixed regime} \end{cases} \tag{5b*}$$

$$\widetilde{Y}_{H2} = C_{F2}\mathcal{E}_2 - \alpha_H A_2, \text{ where } \begin{cases} \widetilde{Y}_{H2} = 0 & \text{if floating regime} \\ \mathcal{E}_2 = \overline{\mathcal{E}} & \text{if fixed regime} \end{cases} \tag{5c*}$$

$$\mathcal{E}_1^{\text{binding}} = \mathcal{E}_1^{\text{binding}} \left(\underset{(+)}{\kappa_H}, \underset{(-)}{B_1}, \underset{(+)}{X_1 - C_{F1}}\right) \tag{6a*}$$

$$\widetilde{Y}_{H1} = -T + (1-\lambda)\,B_1 L \text{ if floating regime and binding external constraint} \tag{6b*}$$

$$(1 + i_1) = \frac{I_1\mu_1}{(1-\varphi_1)}\frac{\mathcal{E}_2}{\mathcal{E}_1}. \tag{7*}$$

Readers who wish to conduct algebraic explorations may first inspect the system of equations given by (1a*), (2a*)-(2d*), (3*), (5a*)-(5c*), and (7*). If the solution from that system indicates that borrowing constraints are binding, some or all of the nonlinear dynamics indicated in the equations (1b*), (4*), and/or (6a*)-(6b*) also become relevant.

Next, it is time to put this more complete framework to use.

5 Policy Mixes With Financial Frictions

In this section, we use the version of the framework with financial frictions to illustrate some possible policy responses to the shocks shown in figure 1. The addition of financial frictions enables the framework to meaningfully consider all four of the shocks. For each shock, we plot our chosen combination of financial frictions and available policy tools. Readers should draw the diagram differently for different countries and consider different policy mixes.

As we explore the shocks, notice that the lessons from section 3 are an important input into this one. To explain this point, it is instructive to divide shocks into "fundamental" and "non-fundamental":

- A fundamental shock changes the optimal level of macroeconomic variables even in the absence of financial frictions.
- A non-fundamental shock does not change the optimal level of macroeconomic variables in the absence of financial frictions, but it does change the actual level of those variables in the presence of financial frictions.

On the positive dimension, the addition of financial frictions can generate a destabilizing impact from non-fundamental shocks and a modification of the impact of fundamental shocks.

On the normative dimension, whether a shock should be accommodated or resisted in a country with financial frictions depends on whether it is fundamental or non-fundamental.[19] If a shock is fundamental, it is not desirable to preserve the pre-shock level of macroeconomic variables. The policymaker should facilitate the economy's adjustment to the shock as shown in section 3, unless financial frictions cause destabilizing distortions to emerge in the transition. If a shock is non-fundamental and the policymaker has the necessary policy tools to address the relevant financial frictions, they may find it optimal to resist the shock and seek to stabilize macroeconomic variables.

We can now categorize the four shocks from figure 1. The export income shock is a real fundamental shock. The dollar interest rate shock is a financial fundamental shock. Regarding the premium spike, we will focus on a spike that is caused by a non-fundamental capital outflow shock. The sudden stop shock is an additional financial shock, and it may have a combination of non-fundamental and fundamental elements. The latter two shocks may be idiosyncratic to the country, or they may be generated by the global financial cycle. Even if they are part of a global financial cycle, their relevance and severity may vary across countries.

[19] The discussion in this paragraph draws on Basu et al. (2025). Our framework offers different policy mixes as options but it cannot prove the optimal mix.

5.1 Export Income Shock

We consider a permanent adverse export income shock, i.e., we assume that $X_1 = X_2 = X$ and that there is a decrease in X. We consider a country with a floating exchange rate regime. It has shallow FX markets which interact with the local currency fraction of any external debt, i.e., $(1-\lambda)\,\Gamma > 0$; but the external and domestic borrowing constraints are not binding.

We make the following assumptions. First, we assume that the country has no inherited debt, i.e., $B_1 = Z_1 = 0$. Second, we assume that in the absence of the shock, the country would have $\widetilde{Y}_{H1} = \widetilde{Y}_{H2} = 0$ and $\beta I_1 = 1$. Solving equations (2a*)-(2b*), we can show that these assumptions mean that in the absence of the shock and sterilized FX intervention, consumption can be smoothed between periods 1 and 2: $C_{F1} = C_{F2} = X$. Finally, we assume that equation (2d*) holds.[20]

Remark 4. Macroeconomic adjustment is desirable.

Figure 16 illustrates the shock in our framework. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions.

Panel A. Imports decrease and the external financing rate is unchanged.

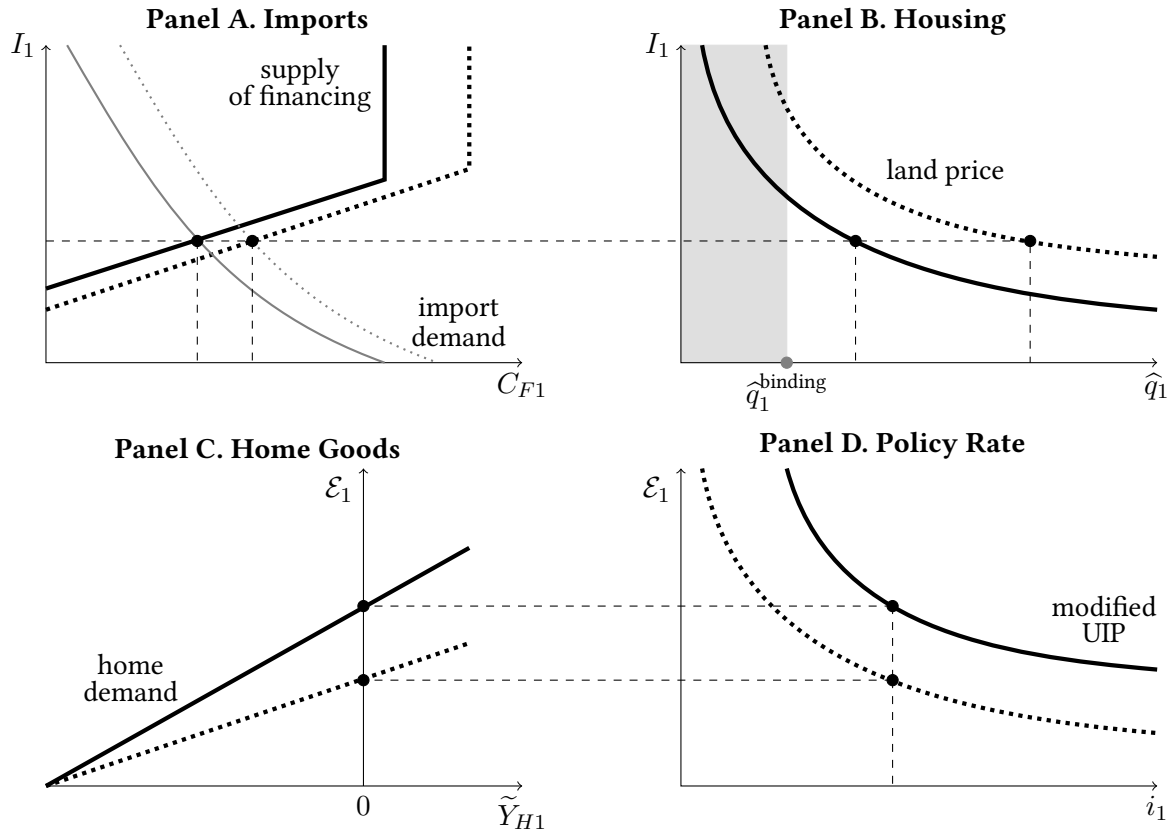
- The upward-sloping part of the supply curve shifts up and to the left because X decreases. *Equation (1a*) establishes that the leftward shift is equal to the decrease in X. Equation (1b*) indicates that the kink moves even more to the left because of the additional impact of the increase in $\mathcal{E}_1$ from panel C, but the kink does not affect the outcome of the panel.*
- The demand curve shifts to the left because X decreases. *For a floating regime, panel C will produce $\widetilde{Y}_{Ht} = 0$. In addition, we set $FXI_1 = 0$. Then equations (2a*)-(2b*) establish that:*

$$C_{F1} = X\frac{(1+I_1)}{(1+\beta)\,I_1 + \beta\,(1-\lambda)\,\Gamma\,(C_{F1}-X)}.$$

  Given this expression, the decrease in X shifts the demand curve to the left except possibly for very low values of C_{F1}. At $I_1 = \frac{1}{\beta}$, $C_{F1} = C_{F2} = X$ remains a solution, so the leftward shift is equal to the decrease in X.
- C_{F1} decreases and I_1 is unchanged. *C_{F1} decreases by the same amount as the decrease in X.*
- There is no need for an ex post capital inflow tax or household macroprudential tax. *Since $\widetilde{Y}_{Ht} = 0$ and $B_2 = FXI_1 = 0$, equations (2c*)-(2d*) yield $\mu_1 = 1$ and permit $\varphi_1 = \theta_{HH1} = 0$.*

[20] If equation (2d*) does not hold, the necessary capital inflow tax in panel A would deviate from what is derived below, so the spillovers from panel A to panels B and D via the capital inflow tax would be correspondingly amended.

Figure 16: Export Income Shock with Shallow FX Markets



Panel B. The land price decreases.

- The land price curve shifts to the left because C_{F2} decreases. *The decrease in C_{F2} from panel A enters equation (3*), while $\varphi_1 = 0$ and $\mu_1 = \Delta = 1$.*
- $\widehat{q}_1$ decreases at the unchanged level of I_1.
- The economy gets closer to the gray zone but we assume that it does not enter the zone. *Alongside the decrease in $\widehat{q}_1$ above, equation (4*) indicates that the decrease in C_{F1} from panel A causes an increase in $\widehat{q}_1^{\text{binding}}$.*

Panel C. The exchange rate depreciates and the home output gap is zero.

- The demand curve rotates anticlockwise because C_{F1} decreases. *The decrease in C_{F1} from panel A enters equation (5a*).*
- $\mathcal{E}_1$ depreciates to set $\widetilde{Y}_{H1} = 0$. *Equations (5a*)-(5b*) establish this result. From equation (5c*), $\mathcal{E}_2$ depreciates by the same amount.*

- There is no gray zone. *Equation (6a*) indicates an arbitrarily high* $\mathcal{E}_1^{\text{binding}}$*, because the external borrowing constraint cannot become binding if panel A produces* $B_2 = 0$.

Panel D. The policy rate is unchanged.

- The modified UIP condition shifts to the right because $\mathcal{E}_2$ increases. *Equation (7*) incorporates the findings from panels A and C that* $\varphi_1 = 0$*,* I_1 *is unchanged,* $\mu_1 = 1$*, and* $\mathcal{E}_2$ *increases.*
- i_1 is unchanged. *In equation (7*),* $\mathcal{E}_1$ *and* $\mathcal{E}_2$ *depreciate by the same amount.*

Overall, as in the case without financial frictions, the country can achieve macroeconomic adjustment by using standard policy tools, i.e., by keeping the policy rate unchanged and allowing the exchange rate to depreciate. Imports can be reduced such that the trade balance and external debt in period 1 are both kept at zero, while home consumption is stabilized.

5.2 U.S. Monetary Tightening

We consider the effect of an increase in the dollar interest rate i_1^* in a country with a floating exchange rate regime. The country has shallow FX markets which interact with the local currency fraction of any external debt, i.e., $(1 - \lambda)\,\Gamma > 0$; but the external and domestic borrowing constraints are not binding. We assume that the starting point of the economy is the same as in section 5.1.

Remark 5. Monetary policy and exchange rate flexibility can achieve some adjustment.

The financial friction of shallow FX markets dampens the adjustment to the dollar interest rate shock. Figure 17 illustrates the shock in our framework. In all the panels, the dotted lines show the positions of the curves in the absence of the shock. The solid lines show their post-shock positions, assuming that the policymaker relies solely on standard tools, i.e., monetary policy and exchange rate flexibility.

Panel A. Period-1 imports decrease and the external financing rate increases, but both by less than in the case without financial frictions.

- The upward-sloping part of the supply curve shifts up because i_1^* increases. *Equation (1a*) is affected. Equation (1b*) indicates that the kink moves to the left because of the increase in* $\mathcal{E}_1$ *from panel C, but the kink does not affect the outcome of the panel.*
- The demand curve is unchanged.

- C_{F1} decreases and I_1 increases, but both by less than in figure 10. *For a floating regime, panel C will produce* $\widetilde{Y}_{Ht} = 0$. *Then equations (2a*)-(2b*) establish the impact of a small shock:*

$$\frac{dC_{F1}}{di_1^*} = -\frac{\beta X}{(1+\beta)(1+i_1^*) + 2\beta(1-\lambda)\Gamma X} < 0 \text{ and } \frac{dC_{F2}}{di_1^*} = -(1+i_1^*)\frac{dC_{F1}}{di_1^*} > 0,$$

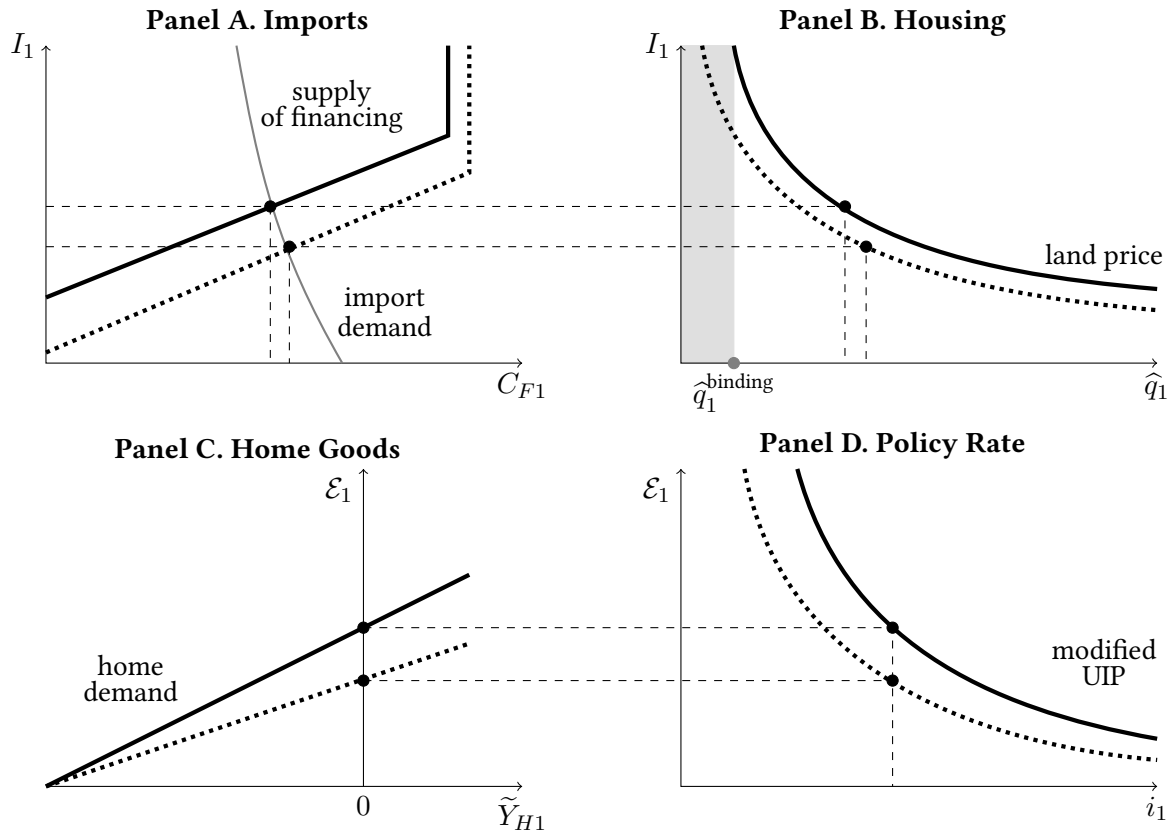
where the signs of the impacts on C_{F1} *and* C_{F2} *are the same as in figure 10, but their magnitudes are smaller if* $(1-\lambda)\Gamma > 0$. *Equation (2c*) indicates that* $\mu_1 < 1$.

- We assume that if any tax is needed, the household macroprudential tax is used instead of the capital inflow tax. *From equation (2d*), the impact on* φ_1 *is ambiguous even though* $\widetilde{Y}_{Ht} = 0$ *is maintained. We assume that* $\varphi_1 = 0$, *either because the right hand side of equation (2d*) is 1, or because the household macroprudential tax* θ_{HH1} *is used instead.*

Panel B. The change in the land price is ambiguous.

- The increase in I_1 causes a decrease in $\widehat{q}_1$ for a given land price curve.

Figure 17: U.S. Monetary Tightening; Standard Policy Tools



- The land price curve shifts to the right because C_{F2} increases and μ_1 decreases; correspondingly, the eventual change in $\widehat{q}_1$ is ambiguous. *Equation (3*) indicates that the increase in C_{F2} and decrease in μ_1 from panel A both shift the curve to the right. We plot a country where $\widehat{q}_1$ decreases relative to its pre-shock value.*
- The economy gets closer to the gray zone but we assume that it does not enter the zone. *Alongside the decrease in $\widehat{q}_1$ above, equation (4*) indicates that the decrease in C_{F1} from panel A causes an increase in $\widehat{q}_1^{\text{binding}}$.*

Panel C. The exchange rate depreciates and the home output gap is zero.

- The demand curve rotates anticlockwise because C_{F1} decreases. *The decrease in C_{F1} from panel A enters equation (5a*).*
- $\mathcal{E}_1$ depreciates to set $\widetilde{Y}_{H1} = 0$. *Equations (5a*)-(5b*) establish this result. From equation (5c*), $\mathcal{E}_2$ appreciates.*
- There is no gray zone. *Equation (6a*) indicates an arbitrarily high $\mathcal{E}_1^{\text{binding}}$, because the external borrowing constraint cannot become binding if panel A produces $B_2 < 0$.*

Panel D. The change in the policy rate is ambiguous.

- i_1 may increase or decrease. *In equation (7*), the modified UIP condition may shift to the right as I_1 increases from panel A, although the decrease in μ_1 and $\mathcal{E}_2$ from panels A and C may offset some of this shift. In addition, the increase in $\mathcal{E}_1$ decreases i_1. We plot a country where the policy rate does not change.*

5.3 Non-fundamental Outflow Shock

We consider a local currency premium spike caused by an outflow shock from local currency debt unrelated to domestic macroeconomic fundamentals, i.e., $S_1 < 0$. We consider a country with a floating exchange rate regime. It has shallow FX markets which interact with the local currency fraction of any external debt, i.e., $(1-\lambda)\,\Gamma > 0$. The external and domestic borrowing constraints are not binding to begin with, but the latter constraint is close to being binding.[21] We assume that the starting point of the economy is the same as in section 5.1.

[21] This assumption allows us to explore the spillover from external financing conditions to domestic asset prices. However, it is not the only rationale for the use of sterilized FX intervention and the capital inflow tax in the below discussion.

Remark 6. Standard policy tools cannot prevent macroeconomic destabilization.

Figure 18 illustrates the shock in our framework. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions assuming that the policymaker uses only the policy rate and exchange rate flexibility. The result is macroeconomic destabilization.

Panel A. Period-1 imports decrease and the external financing rate increases.

- The upward-sloping part of the supply curve shifts up and to the left because $S_1 < 0$. *Equation (1a*) indicates that the leftward shift is equal to the absolute value of* S_1. *Equation (1b*) indicates that the kink moves to the left because of the increase in* $\mathcal{E}_1$ *from panel C, but the kink does not affect the outcome of the panel.*
- This shift decreases C_{F1} and increases I_1. *If equation (2a*) were to hold, the demand curve would not shift. The decrease in* C_{F1} *would be smaller than the leftward shift in the supply curve, so* $B_2 = C_{F1} - X < 0$ *while* $B_2 - S_1 > 0$. *Equations (2a*)-(2b*) would also establish that* C_{F2} *increases.*
- There is a side-effect if the capital inflow tax and household macroprudential tax are not available: the demand curve also shifts to the left. *For a floating regime, panel C will produce* $\widetilde{Y}_{Ht} = 0$. *Equation (2d*) establishes that a subsidy, i.e.,* $\varphi_1 < 0$ *and/or* $\theta_{HH1} < 0$, *would be needed to implement equation (2a*):*

$$\frac{(1-\varphi_1)}{(1+\theta_{HH1})} = \frac{I_1 + \lambda\Gamma\left(B_2 - S_1\right)}{I_1 + (1-\lambda)\,\Gamma B_2} > 1.$$

  Since these tools are not available, the demand curve shifts to the left of where it should be, and welfare is reduced. The curve is replaced with $\beta\left[I_1 + \lambda\Gamma\left(B_2 - S_1\right)\right] C_{F1} = C_{F2}$, *and the shock causes* $B_2 - S_1 > 0$. *Equation (2c*) indicates that* $\mu_1 > 1$, *so the higher external premium has an amplified pass-through to the domestic financing rate, and there is no tool available to dampen that pass-through.*
- This shift amplifies the decrease in C_{F1}, while I_1 remains above its pre-shock value. C_{F2} *increases.*

Panel B. The domestic borrowing constraint binds ex post, which rationalizes ex ante macroprudential regulations on the housing sector.

- The increase in I_1 causes a decrease in $\widehat{q}_1$ for a given land price curve.

- The shift in the land price curve is ambiguous; however, $\widehat{q}_1$ still decreases relative to its pre-shock value. *Equation (3*) indicates that the increase in C_{F2} from panel A tends to shift the curve to the right, but $\mu_1 > 1$ tends to shift the curve to the left. We plot a country where the land price curve shifts slightly to the right.*
- Ex post, we assume that the economy enters the gray zone. *Alongside the decrease in $\widehat{q}_1$ above, equation (4*) indicates that the decrease in C_{F1} from panel A causes an increase in $\widehat{q}_1^{\text{binding}}$.*
- Ex ante macroprudential measures on the housing sector can improve welfare. *They can decrease B_1^{housing}, which decreases $\widehat{q}_1^{\text{binding}}$ in equation (4*) and thereby shifts the gray zone to the left.*

Panel C. The exchange rate depreciates and the home output gap is zero.

- The demand curve rotates anticlockwise because C_{F1} decreases. *The decrease in C_{F1} from panel A enters equation (5a*).*
- $\mathcal{E}_1$ depreciates to set $\widetilde{Y}_{H1} = 0$. *Equations (5a*)-(5b*) establish this result. From equation (5c*), $\mathcal{E}_2$ appreciates.*
- There is no gray zone. *Equation (6a*) indicates an arbitrarily high $\mathcal{E}_1^{\text{binding}}$, because the external borrowing constraint cannot become binding if panel A produces $B_2 < 0$.*

Panel D. The policy rate is unchanged.

- The modified UIP condition shifts to the right because $S_1 < 0$. *Equation (7*) incorporates the increase in I_1 and $\mu_1 > 1$ from panel A, although their impact is partially mitigated by the decrease in $\mathcal{E}_2$ from panel C.*
- i_1 is unchanged. *Combining equations (5a*)-(5c*) with equation (7*) and the households' Euler condition, we can show that $\mathcal{E}_1$ depreciates by enough such that no change in i_1 is needed.*

Remark 7. Ex post FX intervention and/or capital controls can improve stabilization.

We consider the addition of sterilized FX intervention and then we add the capital inflow tax.

To begin with, we show that FX sales, i.e., $FXI_1 < 0$, can cushion the economy. Figure 19 illustrates the intervention. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions adding the intervention to the policy mix. We assume that the FX intervention offsets some but not all of the shock.

Panel A. The decrease in period-1 imports and the increase in the external financing rate are both mitigated by FX sales.

- The FX intervention reduces the upward and leftward shift of the upward-sloping part of the supply curve. *Equation (1a*) indicates that relative to panel A in figure 18, the supply curve shifts to the right by the absolute value of* FXI_1. *Equation (1b*) indicates that the kink moves less to the left because the increase in* $\mathcal{E}_1$ *from panel C is mitigated.*
- This change mitigates the decrease in C_{F1} and increase in I_1. *In the absence of any shift in the demand curve,* C_{F1} *would increase by less than the amount of the FX intervention, so* $C_{F1}+FXI_1$ *would decrease. Correspondingly, the intervention would also decrease the term* $B_2+FXI_1-S_1$. *In figure 18, that term was positive; we assume that the intervention is limited and stops while* $B_2<0$, $B_2+FXI_1<0$, *and* $B_2+FXI_1-S_1>0$. *The intervention mitigates the increase in* C_{F2}.
- The FX intervention has a beneficial side-effect: it generates a carry profit and shifts the demand curve to the right. *The demand curve follows* $\beta\left[I_1+\lambda\Gamma\left(B_2+FXI_1-S_1\right)\right]C_{F1}=C_{F2}$ *and equation (2b*). The decrease in* $B_2+FXI_1-S_1$, *and the fact that the carry profits term* $-FXI_1\left(1-\lambda\right)\Gamma\left(B_2+FXI_1-S_1\right)$ *is positive, shifts the demand curve to the right relative to figure 18. Equation (2c*) indicates that* $\mu_1>1$.
- Since the capital inflow tax and household macroprudential tax are not available, the demand curve remains to the left of where it should be. *If the tools were available, equation (2d*) continues to establish that a subsidy would be appropriate:*

$$\frac{\left(1-\varphi_1\right)}{\left(1+\theta_{HH1}\right)}=\frac{I_1+\lambda\Gamma\left(B_2+FXI_1-S_1\right)}{I_1+\left(1-\lambda\right)\Gamma\left(B_2+FXI_1\right)}>1.$$

Panel B. The domestic borrowing constraint is less severe ex post, so the case for ex ante macroprudential regulations on the housing sector is weaker.

- The FX intervention mitigates the increase in I_1, which in turn mitigates the decrease in $\widehat{q}_1$ for a given land price curve.
- The shift in the land price curve is ambiguous; however, the decrease in $\widehat{q}_1$ ends up being mitigated by the FX intervention. *Equation (3*) indicates that the smaller changes in* C_{F2} *and* $\mu_1<1$ *push the land price curve in oppsite directions. We plot a country where the land price curve shifts further to the right.*
- The FX intervention mitigates the rightward shift in the gray zone. *Equation (4*) indicates that* $\widehat{q}_1^{\text{binding}}$ *increases by less if* C_{F1} *decreases by less in panel A.*
- Ex post, the domestic borrowing constraint is less severe. *We plot a country where the economy remains in the gray zone.*

Figure 18: Taper Tantrum; Standard Policy Tools

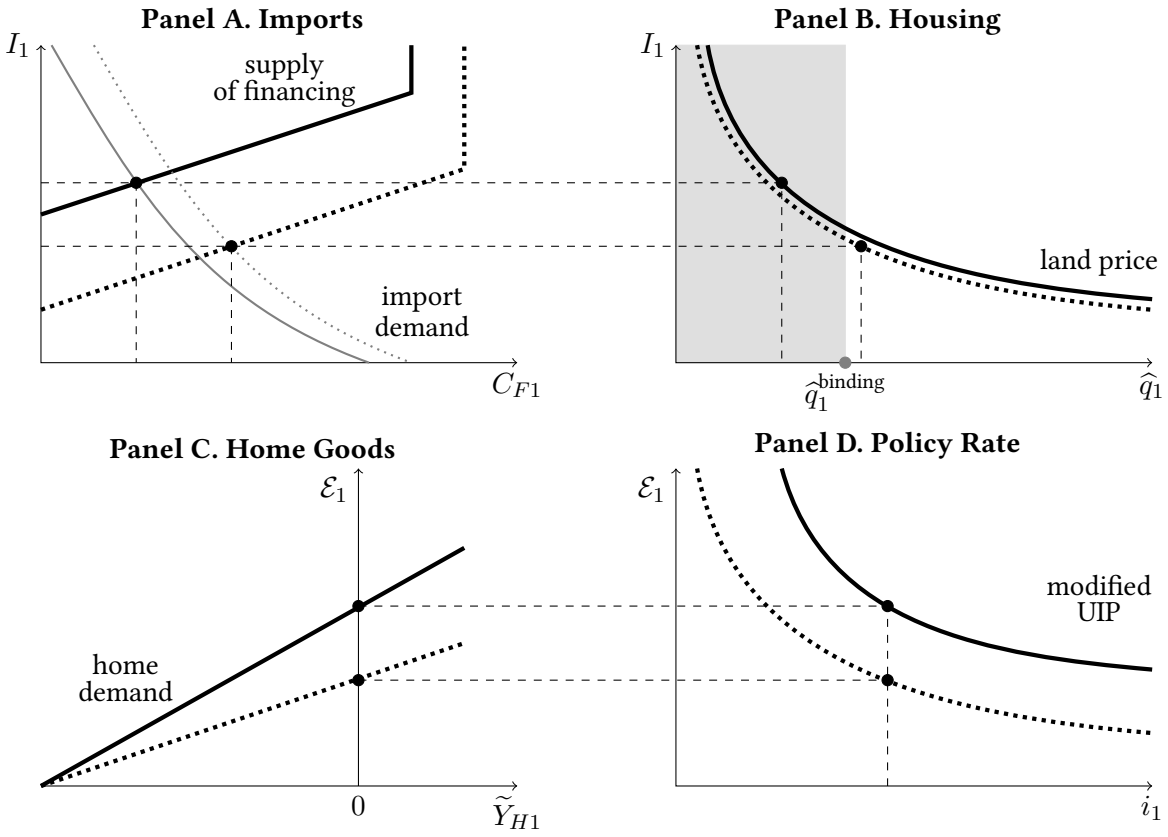


Figure 19: Taper Tantrum; Adding FX Intervention

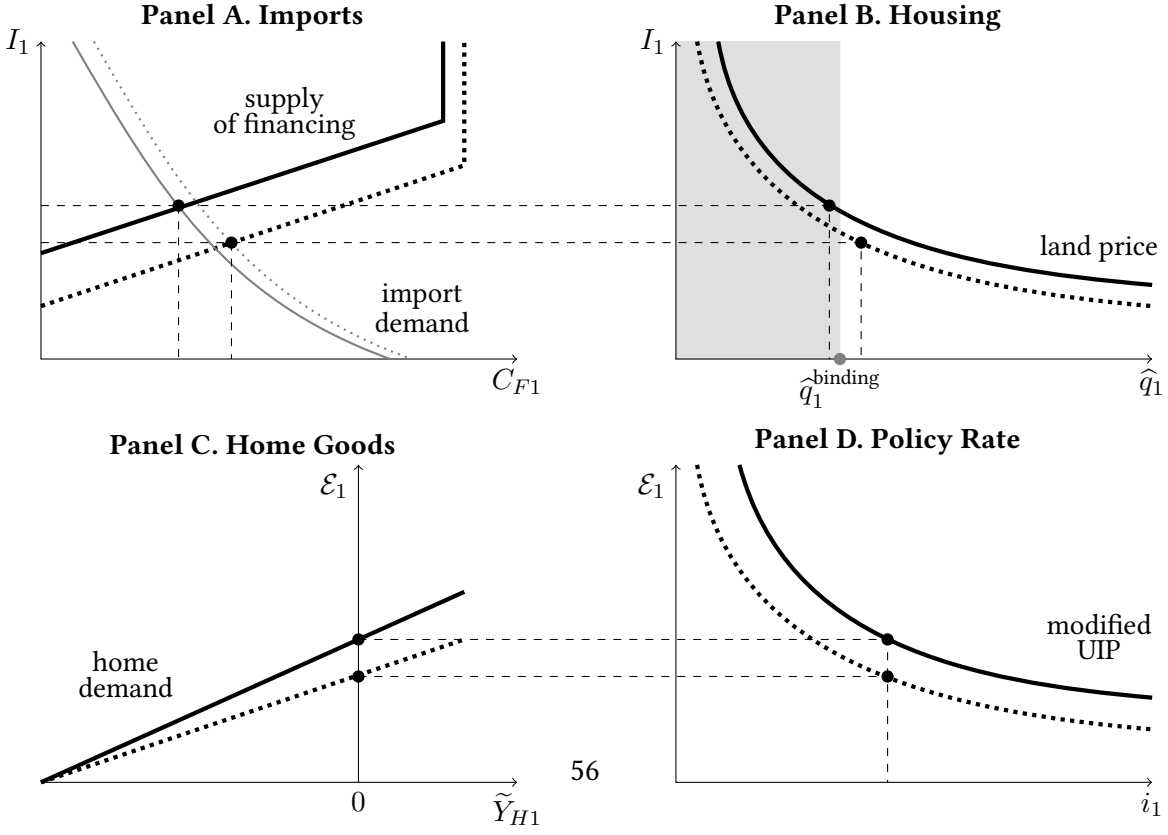
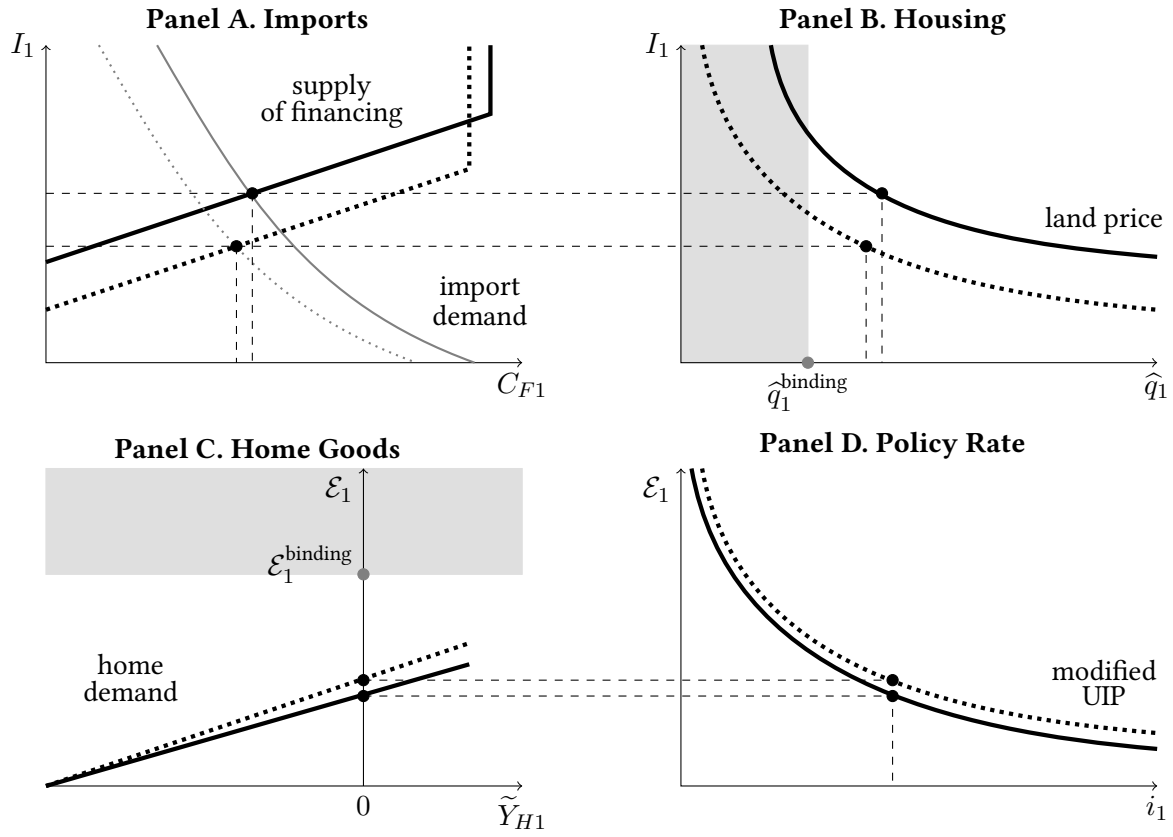


Figure 20: Taper Tantrum; Adding FX Intervention and Capital Controls



- The case for ex ante macroprudential measures on the housing sector is decreased when ex post FX intervention is available to handle premium spikes.

Panel C. The exchange rate depreciation is mitigated by FX sales, while the home output gap remains at zero.

- The demand curve rotates anticlockwise by less because C_{F1} decreases by less. *The smaller decrease in C_{F1} from panel A enters equation (5a*).*
- $\mathcal{E}_1$ depreciates by less to set $\widetilde{Y}_{H1} = 0$. *Equations (5a*)-(5b*) establish this result. From equation (5c*), $\mathcal{E}_2$ appreciates by less because of the intervention.*
- There is no gray zone. *Equation (6a*) continues to indicate an arbitrarily high $\mathcal{E}_1^{\text{binding}}$ because $B_2 < 0$ from panel A.*

Panel D. The policy rate is unchanged.

- The modified UIP condition remains to the right of its pre-shock position. *Equation (7*) incorporates the increase in I_1 relative to its pre-shock value and $\mu_1 > 1$ from panel A, although their impact is partially mitigated by the decrease in $\mathcal{E}_2$ from panel C.*

- i_1 is unchanged. *Combining equations (5a*)-(5c*) with equation (7*) and the households' Euler condition, we can show that $\mathcal{E}_1$ depreciates by enough such that no change in i_1 is needed.*

Adding a capital inflow subsidy, i.e., $\varphi_1 < 0$, to the policy mix can further stabilize the economy. Figure 20 illustrates the effect of this tool. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions adding both sterilized FX sales and the capital inflow subsidy to the policy mix. Our framework cannot prove the optimal mix of FX intervention and the capital inflow tax, but we choose to illustrate a policy mix such that imports are smoothed over time despite the shock, i.e., $C_{F1} = C_{F2}$. Basu et al. (2025) prove that this policy mix can be optimal.

Panel A. Imports can be stabilized over time.

- The upward-sloping part of the supply curve is unchanged relative to figure 19. *Equation (1a*) is unaffected. Equation (1b*) indicates that the kink moves a little to the right relative to its pre-shock value because $\mathcal{E}_1$ decreases a little relative to its pre-shock value in panel C.*
- The demand curve shifts to the right if an ex post capital inflow subsidy, $\varphi_1 < 0$, is imposed. *As calculated above, equation (2d*) establishes that a subsidy is optimal. The use of this tool enables the policymaker to optimize the demand curve as in equations (2a*)-(2b*).*
- C_{F1} can be stabilized a little higher than its pre-shock value because of carry profits, while the subsidy causes I_1 to increase further. *Using the subsidy alongside FX intervention to set $C_{F1} - X + FXI_1 = \frac{S_1}{2}$, we can achieve:*

$$C_{F1} = C_{F2} = X + \frac{(1-\lambda)\,\Gamma\,(S_1)^2}{4\,[1+(1+i_1^*)]},$$

where the second term represents the little boost to imports owing to the carry profits from the FX intervention. Correspondingly, $B_2 = C_{F1} - X > 0$ but remains small. Equation (2c) indicates that $\mu_1 > 1$.*

Panel B. The domestic borrowing constraint can be fully relaxed ex post, so there is no case for ex ante macroprudential regulations on the housing sector.

- The further increase in I_1 causes a further decrease in $\widehat{q}_1$ for a given land price curve.
- However, the ex post capital inflow subsidy can cause the land price curve to shift sufficiently to the right such that $\widehat{q}_1$ ends up higher than its pre-shock value. *Substituting the value of φ_1 from panel A into equation (3*) establishes that $\widehat{q}_1 = \frac{C_{F2}}{(1+i_1^*)}$, i.e., the domestic financing rate can be fully insulated from the increase in I_1 and $\mu_1 > 1$ caused by the shock. Moreover, as calculated above, C_{F2} is higher than its pre-shock value.*

- Ex post, the economy is no longer in the gray zone. *Alongside the stabilization in $\widehat{q}_1$ above, equation (4*) indicates that $\widehat{q}_1^{\text{binding}}$ decreases relative to its pre-shock value because C_{F1} increases relative to its pre-shock value in panel A.*
- There is no case for ex ante macroprudential measures on the housing sector when both ex post FX intervention and capital controls are available to handle premium spikes. *If the domestic borrowing constraint is not binding ex post, there is no need to reduce B_1^{housing} ex ante.*

Panel C. The home output gap is at zero without a need for exchange rate depreciation.

- The demand curve rotates clockwise a little relative to its pre-shock position because C_{F1} increases a little relative to its pre-shock position. *The increase in C_{F1} from panel A enters equation (5a*).*
- $\mathcal{E}_1$ appreciates a little relative to its pre-shock value to set $\widetilde{Y}_{H1} = 0$. *Equations (5a*)-(5b*) establish this result. From equation (5c*), $\mathcal{E}_2$ appreciates relative to its pre-shock position by the same amount.*
- The gray zone appears on the panel but remains very high. *Equation (6a*) indicates that $\mathcal{E}_1^{\text{binding}}$ decreases, because C_{F1} increases and $B_2 > 0$ from panel A.*

Panel D. The policy rate is unchanged.

- The modified UIP condition shifts a little to the left relative to its pre-shock position because $\mathcal{E}_2$ appreciates a little relative to its pre-shock position. *In equation (7*), panel A indicates that the changes in φ_1, I_1, and μ_1 offset each other, while panel C indicates that $\mathcal{E}_2$ appreciates relative to its pre-shock position.*
- i_1 is unchanged. *In equation (7*), $\mathcal{E}_1$ and $\mathcal{E}_2$ appreciate by the same amount.*

Overall, the country can improve macroeconomic stabilization by using FX intervention or capital controls or both. Using these tools can help stabilize imports and home output, cut the transmission of global financing conditions to domestic borrowing constraints, and reduce the need to alter monetary policy and to depreciate the exchange rate. Moreover, if there are more tools to stabilize outcomes ex post, the macroprudential regulations on the housing sector need to be less restrictive ex ante.

Clearly, distinguishing whether an outflow shock is fundamental or non-fundamental is a judgment of great importance in practice. While the friction of shallow FX markets dampened the effect of the fundamental dollar interest rate shock in section 5.2, it actually amplifies the effect of the

non-fundamental outflow shock. And while resisting the fundamental export income shock using FX sales generated a carry loss in section 5.1 and would have impeded the adjustment of imports in section 5.2, using FX sales to resist the non-fundamental outflow shock actually generates a carry profit and helpfully stabilizes imports.

5.4 Sudden Stop Shock

We consider the effect of a sudden stop shock, i.e., a decrease in the external pledgability of domestic collateral κ_H that in turn causes the external borrowing constraint to bind in panels A and C. We consider a country with shallow FX markets and some of the external debt is in local currency, i.e., $(1-\lambda)\,\Gamma > 0$. We consider a case where the shock also causes the domestic borrowing constraint to become binding in panel B.

We make the following assumptions. First, we assume that the country has constant export income, i.e., $X_1 = X_2 = X$, and positive inherited debt, i.e., $B_1 > 0$ and $Z_1 > 0$. Second, we assume that in the absence of the shock, the country would have $\widetilde{Y}_{H1} = \widetilde{Y}_{H2} = 0$ and $\beta\left[I_1 + (1-\lambda)\,\Gamma B_2\right] = 1$. Solving equations (2a*)-(2b*), we can show that these assumptions mean that in the absence of the shock and sterilized FX intervention, consumption can be smoothed between periods 1 and 2: $C_{F1} = C_{F2} = X - Z_1 \frac{I_1}{1+I_1}$.

Remark 8. Financial stability concerns may rationalize ex ante capital controls.

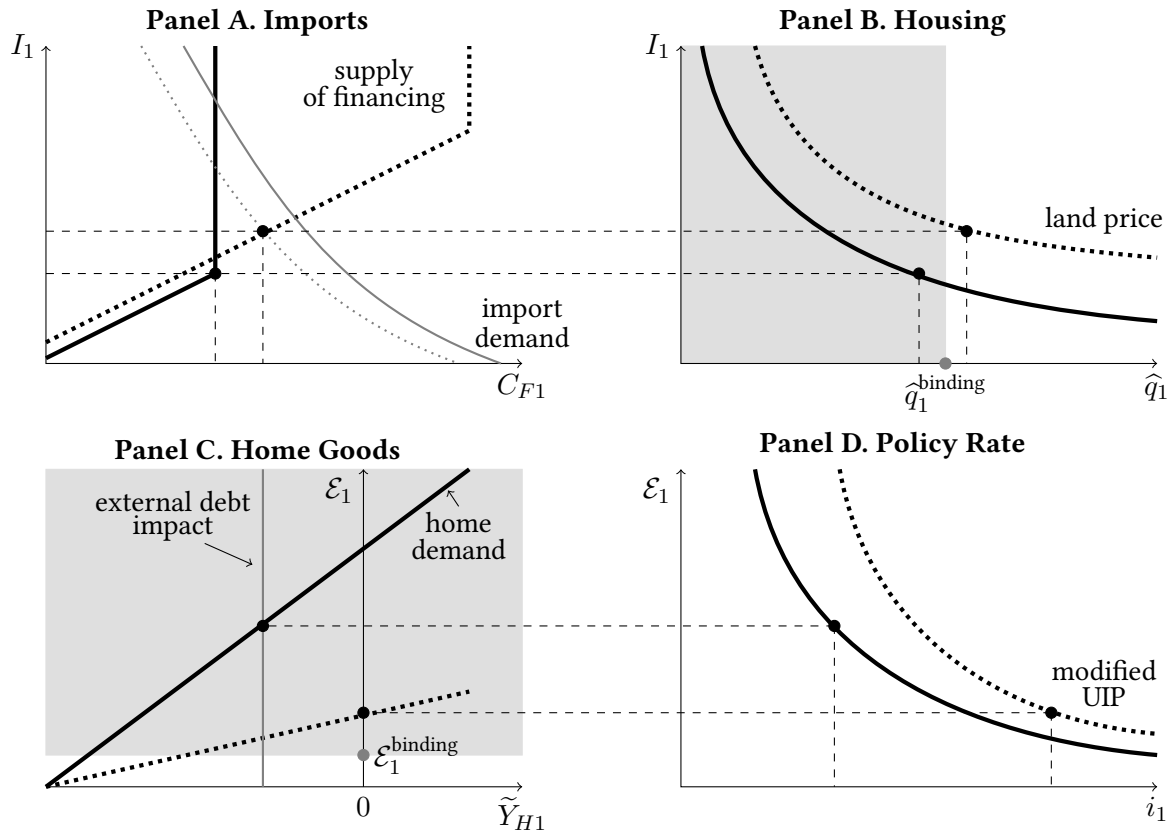
Figure 21 illustrates the shock for a country which has a floating exchange rate regime and mostly dollar-denominated external debt, i.e., λ is near 1. In all the panels, the dotted lines show the positions of the curves in the absence of the shock, while the solid lines show their post-shock positions.

Panel A. Period-1 imports and the external financing rate decrease.

- The decrease in κ_H causes the kink of the supply curve to move to the left until the demand curve intersects the vertical part of the supply curve; thereafter, the position of the kink determines C_{F1}.
- C_{F1} and I_1 both decrease while C_{F2} increases. *I_1 is determined by the supply curve (1a*). C_{F1} is determined by the values of B_2^{binding} and Z_1 in equation (1b*). C_{F2} is determined by equation (2b*). Equation (2c*) indicates that μ_1 decreases.*
- The demand curve shifts to the right but no longer determines outcomes. *When the external borrowing constraint binds, the capital inflow and household macroprudential taxes become irrelevant to welfare, so we can set $\varphi_1 = \theta_{HH1} = 0$.*

- An amplification mechanism causes a further leftward movement in the kink of the supply curve, a slight downward shift in the upward-sloping part of the curve, and a substantial decrease in C_{F1}. *The decrease in C_{F1} causes an exchange rate depreciation in panel C, which further decreases B_2^{binding} and Z_1 in equations (1a*)-(1b*). Since λ is near 1, the impact on Z_1 is small, and the kink moves substantially to the left.*

Figure 21: Sudden Stop Shock with Floating Exchange Rate Regime



Panel B. The domestic borrowing constraint binds ex post, which rationalizes ex ante macroprudential regulations on the housing sector.

- The decrease in I_1 causes an increase in $\widehat{q}_1$ for a given land price curve.
- The shift in the land price curve is ambiguous; however, we assume that $\Delta > 1$ is so large that the curve shifts substantially to the left and $\widehat{q}_1$ decreases relative to its pre-shock value. *In equation (3*), the increase in C_{F2} and the decrease in μ_1 from panel A shifts the curve to the right, but the binding external borrowing constraint from panel A causes $\Delta > 1$, which shifts the curve to the left. We assume that the latter impact dominates.*

- Ex post, we assume that the economy enters the gray zone. *Alongside the decrease in $\widehat{q}_1$ above, equation (4*) indicates that the decrease in C_{F1} from panel A causes an increase in $\widehat{q}_1^{\text{binding}}$.*
- Ex ante macroprudential measures on the housing sector can improve welfare. *They can decrease B_1^{housing}, which decreases $\widehat{q}_1^{\text{binding}}$ in equation (4*) and thereby shifts the gray zone to the left.*

Panel C. The exchange rate depreciates but the home output gap stays negative, and ex ante capital controls may be useful.

- The demand curve rotates anticlockwise because C_{F1} decreases. *The decrease in C_{F1} from panel A enters equation (5a*).*
- We assume that $\mathcal{E}_1$ depreciates, but $\widetilde{Y}_{H1} < 0$ because the economy enters the gray zone. *Since λ is near 1, equation (6b*) shows up on panel C as a vertical line substantially to the left of the vertical axis. The decrease in C_{F1} from panel A causes the value of $\mathcal{E}_1^{\text{binding}}$ to increase in equation (6a*), but it is not enough for the economy to escape the gray zone.*
- An amplification mechanism causes $\mathcal{E}_1$ to depreciate further. *The increase in $\mathcal{E}_1$ on panel C causes a further decrease in C_{F1} on panel A, which then causes the demand curve in panel C to rotate further anticlockwise. Separately, equation (5c*) indicates that $\mathcal{E}_2$ appreciates.*
- Ex ante restrictions on capital inflows can improve welfare. *They can decrease B_1, which increases $\mathcal{E}_1^{\text{binding}}$ in equation (6a*) and thereby shifts up the gray zone. Additionally, from equation (5a*), if C_{F1} decreases by less in panel A, the demand curve rotates anticlockwise by less in panel C.*

Panel D. The policy rate decreases but there is some "interest rate defense".

- The modified UIP condition shifts to the left. *Equation (7*) incorporates $\varphi_1 = 0$ and the decreases in I_1 and μ_1 from panel A and the decrease in $\mathcal{E}_2$ from panel C.*
- i_1 decreases further because of the increase in $\mathcal{E}_1$, but there is some "interest rate defense". *To prevent the external borrowing constraint from tightening too much, i_1 is not loosened all the way to set $\widetilde{Y}_{H1} = 0$.*

Remark 9. Ex ante capital controls are less necessary with local currency external debt.

Instead of assuming that the country's external debt is mostly in dollars, we next consider what happens if most of that debt is in local currency, i.e., λ is low. Relative to the case in figure 21, the analysis changes as follows.

Panel A. The decrease in period-1 imports may be mitigated by the local currency component of the external debt.

- The amplification mechanism is smaller, so the kink of the supply curve may move less to the left. *The impact effect of the shock still decreases C_{F1} via the external borrowing constraint (1b*), and we assume that there is still an associated exchange rate depreciation in panel C. But a lower value of λ means that any given size of depreciation in panel C causes a larger decrease in Z_1 in equation (1b*). As a result, the final decrease in C_{F1} may be mitigated.*
- The decreases in C_{F1} and I_1 and the increase in C_{F2} may be mitigated. *Equations (1a*)-(1b*) and (2b*) are the determinants of these outcomes.*

Panel B. The domestic borrowing constraint may be less severe ex post, so the case for ex ante macroprudential regulations on the housing sector may be weaker.

- The shift in the land price curve and the decrease in $\widehat{q}_1$ may be mitigated. *A looser external borrowing constraint from panel A may decrease the term Δ in equation (3*).*
- Ex post, the domestic borrowing constraint may be less severe. *Alongside the mitigated decrease in $\widehat{q}_1$ above, equation (4*) shows that $\widehat{q}_1^{\text{binding}}$ increases by less if C_{F1} decreases by less in panel A.*
- The case for ex ante macroprudential measures on the housing sector is decreased.

Panel C. The exchange rate depreciation may be mitigated and the home output gap is less negative, so ex ante capital controls may be less useful.

- The demand curve rotates anticlockwise by less because C_{F1} decreases by less. *The smaller decrease in C_{F1} from panel A enters equation (5a*).*
- $\mathcal{E}_1$ still depreciates relative to its pre-shock value, but now also ensures that $\widetilde{Y}_{H1}$ is close to zero. *Since λ is low, equation (6b*) shows up on panel C as a vertical line just a little to the left of the vertical axis. Equation (5c*) indicates that $\mathcal{E}_2$ still appreciates relative to its pre-shock value.*
- Ex ante restrictions on capital inflows may be less welfare-improving. *The external borrowing constraint is no longer severe ex post, so the benefit of the ex ante tool is smaller.*

Panel D. There is less "interest rate defense".

- i_1 can be set closer to the value that achieves $\widetilde{Y}_{H1} = 0$.

5.5 Differences from the IS-LM Framework

The addition of financial frictions causes our amended framework to diverge further from the IS-LM model. Correspondingly, our framework can analyze a wider range of shocks in detail, and its policy mixes may differ more from those of the IS-LM model.

Our framework illustrates that the desirability of any policy mix depends on each country's precise combination of financial frictions and available policy tools. Nevertheless, an over-arching observation can be made: our framework finds that standard policy tools may help achieve some adjustment after fundamental shocks while additional tools may be especially useful to resist non-fundamental shocks.

For the export income shock, the addition of the single friction of shallow FX markets does not alter the outcomes in our framework and the IS-LM framework that were discussed in section 3.3. The reason is that in both frameworks, the post-policy outcome featured no change in the trade balance and external debt. In our framework with shallow FX markets, and in versions of the IS-LM-BP approach which incorporate imperfect capital mobility, external debt can only be absorbed by foreigners at a premium. However, there is no necessary change in the premium if there is no change in external debt, so the same final outcomes can be achieved.

For the U.S. monetary tightening shock, section 3.3 highlighted that an external debt reduction is recommended by our framework; by contrast, if we assume that home output is stabilized in the IS-LM framework, external debt does not change. Introducing the friction of shallow FX markets causes a further divergence between the frameworks. The IS-LM framework's previous outcome remains feasible, because the unchanged external debt means an unchanged external premium. In our framework, external debt reduction remains desirable, but it also reduces the external premium if the FX market is shallow. As a result, the external financing rate faced by domestic households and banks increases by less than the dollar interest rate does. The upshot is that standard tools alone achieve less macroeconomic adjustment, and the policymaker has the option of adding sterilized FX intervention to help increase the adjustment.

For both of the above shocks, the addition of the frictions of the external and domestic borrowing constraints would cause a greater divergence between our framework and the IS-LM framework. In our framework, the shocks can cause one or both constraints to become binding. The IS-LM framework does not incorporate these frictions and the mix of ex ante and ex post policy tools that can address them.

For the non-fundamental outflow shock, our framework and the IS-LM framework diverge on two

dimensions. The first divergence relates to the initial financial impact of the shock. In the IS-LM-BP approach which incorporates imperfect capital mobility, the outflow shock causes an immediate depreciation, improvement in trade balance, and boost in home output. By contrast, the immediate impact in our framework is a deleveraging of external debt which tends to reduce imports and home output, after which an exchange rate depreciation is needed to stabilize home output.

The second divergence relates to the policy mix. The IS-LM model recommends similar policies to handle the U.S. monetary tightening shock and the non-fundamental outflow shock, because they both have a similar impact on the exchange rate. Our framework indicates that different policies could be used. Because our framework has an intertemporal budget constraint, it can differentiate further between the U.S. monetary tightening shock and the non-fundamental outflow shock. The former shock is fundamental, so its effect on the budget constraint cannot be eliminated, and standard tools can help support the needed macroeconomic adjustments. By contrast, the latter shock is non-fundamental, so the policymaker can use additional tools such as sterilized FX intervention and capital controls to insulate the budget constraint from the shock, if they wish to remove the need for macroeconomic adjustments.

For the sudden stop shock, our framework can generate a contractionary depreciation, breaking from the IS-LM framework. The contractionary depreciation occurs if much of the external debt is in foreign currency. In this case, a depreciation causes the external constraint to get substantially tighter and reduce imports, which in turn reduces home output. As a result, exchange rate flexibility is not sufficient to cushion the economy from the sudden stop. Instead, ex post exchange flexibility may only be welfare-improving if supported by an ex ante capital inflow tax and/or ex ante macroprudential regulation on external debt—tools whose impacts are not typically considered in the IS-LM framework.

Finally, the combination of financial frictions in our framework means that readers have more flexibility in tailoring and/or amending its application than is typically possible for the IS-LM framework. For illustration, let us return to the U.S. monetary tightening shock. In EMDEs, such a shock may sometimes be associated with a spread in some domestic borrowing interest rates over the policy rate, even if the policy rate does not increase and there is no economy-wide sudden stop (e.g., De Leo et al., 2022). One way of generating this kind of spread in our framework is to posit that a U.S. monetary tightening may aggravate balance sheet problems in those domestic banks who lend in domestic asset markets, and thereby may increase the spread term in panel B without requiring an economy-wide sudden stop in panel A.

6 Connecting Different Literatures

Since our framework builds on several different strands of the international finance literature, it can be used to illustrate the connections between these strands of work. In this section, we highlight a few examples of such connections.

First, panels A and C of the diagram visually integrate the intertemporal theory of the current account with more recent work on frictions in private external borrowing. Obstfeld and Rogoff's seminal 1996 textbook developed the intertemporal theory as a cornerstone microfoundation, essential to help explain whether import consumption should be adjusted after external shocks, so we adopt it too. They focused on fundamental shocks, with an extension for sovereign default risks (the latter of which we do not emphasize). Since then, one strand of literature has established that the exchange rate is disconnected from available measures of fundamentals, which means that there may be substantial frictions on foreigners' absorption of local currency external debt (e.g., Gabaix and Maggiori, 2015; Itskhoki and Mukhin, 2021).[22] Another strand of literature has emphasized external borrowing constraints on foreign currency external debt (e.g., Mendoza 2010; Bianchi 2011; Benigno et al., 2013; Farhi and Werning, 2016; Jeanne and Korinek, 2020).

Our framework illustrates that countries which borrow externally in both local and foreign currency may be subject to both frictions, with the salience of each depending on the shock and the currency composition of the external debt. The slope of the supply curve in panel A captures the premia on local currency debt, while the amplification mechanism between the external borrowing constraint in panel A and the exchange rate movement in panel C depends on the FX mismatch on external debt. These frictions may rationalize FX intervention, capital controls, and household macroprudential measures.

Second, the framework sheds light on a literature exploring whether countries can retain policy independence in an integrated world. The traditional monetary trilemma is based on the Mundell-Fleming model and posits that only two out of three of the following are possible: perfect capital mobility, monetary independence, and a fixed exchange rate. According to this trilemma, having a flexible exchange rate should allow for monetary independence even if capital mobility is high. The more recent financial trilemma (Schoenmaker, 2013) posits that only two out of three of the following are possible: international financial integration, national financial regulation, and financial

[22] An alternative approach in the literature has been to focus on the premia on foreign currency borrowing (e.g., Bianchi and Lorenzoni, 2022; Gourinchas, 2023). While that approach is complementary to the approach in this paper, it does not give a distinct role to the especially salient premia on local currency debt (as in Kalemli-Özcan and Varela, 2021), and the policy tools to address foreign currency premia have differently-defined costs of use.

stability. According to this trilemma, since financial regulation is mostly national, financial stability is no longer always achievable in an integrated world. Some authors have argued that the global financial cycle now determines domestic credit conditions and may rationalize capital controls (e.g., Rey, 2013; Miranda-Agrippino and Rey, 2020) but others have found that exchange rate flexibility still helps achieve some independence (e.g., Klein and Shambaugh, 2015; Obstfeld et al., 2019).

Our framework disentangles different forms of independence across its different panels, revealing that independence is multi-dimensional and depends on the relative salience of different frictions. Panel B illustrates independence in domestic credit conditions, while Panel C captures independence in stabilizing the home output gap and external borrowing conditions.

Correspondingly, our framework can justify nuanced empirical findings. For countries whose domestic borrowing constraints are close to binding, the loss of financial independence from panel B would be concerning, and it may rationalize the use of capital controls during shocks. Nevertheless, despite the loss of financial independence, there may be a continued role for independent monetary policy and exchange rate flexibility to close the home output gap in panel C. By contrast, if external borrowing constraints are also salient, it may no longer be possible to close the home output gap in panel C. Empirical evidence may then show that some degree of exchange rate flexibility is useful to stabilize a combination of the home output gap and external borrowing conditions, even if monetary policy alone can no longer close the home output gap.

Third, panel D of the diagram visually captures the notion that EMDEs' monetary policy frameworks should be designed bearing in mind each country's most salient frictions. If there are no salient financial frictions, an EMDE can follow the recommendations developed in the AE context (e.g., Woodford's 2003 textbook). Monetary policy can be assigned to the home output gap in panel C, and there may be a stable relationship between the desired policy rate and the home output gap because the UIP condition in panel D is relatively stable.

However, if the FX market is shallow and/or if there are occasionally binding borrowing constraints that generate sudden stops and domestic credit market crashes, the UIP condition can become unstable in stressed times. If the policy rate is the only available instrument, the country's monetary policy framework may need to allow for it to deviate substantially from the kinds of policy rate rules that are optimal in AEs. Alternatively, the framework may envisage that additional tools should be used in stressed times, which could allow the policy rate to follow a more stable path.

Fourth, our framework synthesizes divergent insights in the literature about the effects of fiscal policy. In the Mundell-Fleming IS-LM model, an increase in government spending causes an ex-

pansion of output in a fixed exchange rate regime and an exchange rate appreciation in a floating regime. By contrast, Obstfeld and Rogoff's 1996 textbook posits that the effect of government spending should depend on the characteristics of that spending. Their version of government spending causes an exchange rate depreciation. Our framework allows for a variety of government spending categories with distinct effects: an increase in government spending on home goods causes an appreciation; an increase in government spending on imports causes a depreciation; while government support for the housing sector stimulates domestic asset prices, and any exchange rate impact is secondary.

7 Conclusion

The Mundell-Fleming approach has guided generations of economists over the past 60 years. But countries have experienced new problems, the international finance literature has advanced, and the composition of the global economy has changed. The scene is set for an updated approach.

In this paper, we have proposed a new framework to help manage the kinds of shocks and frictions that pose conundrums for countries around the world today. We hope that the framework is visually appealing enough to provide guidance to policymakers in central banks and finance ministries, advanced students, and the wider economics profession alike.

Our framework is kept as simple as possible, but no simpler. The reason is that for our framework to be useful in policymaking, it has to overcome the shortcomings of the existing Mundell-Fleming approach. Specifically, we have designed the framework to incorporate the following key elements: a normative structure to explain which shocks to accommodate and which to resist; additional policy tools beyond monetary and fiscal policy; and financial frictions that can explain key episodes of macroeconomic destabilization in EMDEs. Our framework balances the need for visual tractability on the one hand, and the growing sophistication of EMDE policy frameworks on the other.

We have used our framework to illustrate some possible policy responses to the four shocks shown in the introduction. For each shock, we plot our chosen combination of financial frictions and available policy tools. Readers can follow our reasoning on a purely graphical dimension (by seeing what happens when the curves shift), or they can use the algebra to dig deeper (by building on our system of equations). Readers should draw the diagram differently for different countries and consider different policy mixes.

Finally, we hope that by highlighting the connections between different strands of the international finance literature, we encourage further interest in those areas where the literatures overlap.

8 References

[1] Basu, Suman S., Emine Boz, Gita Gopinath, Francisco Roch, and D. Filiz Unsal, 2025, "Integrated Monetary and Financial Policies for Small Open Economies," *Econometrica*, Vol. 93 (6), pp. 2201-2234.

[2] Basu, Suman S., Roberto A. Perrelli, and Weining Xin, 2023, "External Crisis Prediction Using Machine Learning: Evidence from Three Decades of Crises Around the World," mimeo.

[3] Benigno, Gianluca, Huigang Chen, Christopher Otrok, Alessandro Rebucci, and Eric R. Young, 2013, "Financial Crises and Macro-Prudential Policies," *Journal of International Economics*, Vol. 89 (2), pp. 453-470.

[4] Bianchi, Javier, 2011, "Overborrowing and Systemic Externalities in the Business Cycle," *American Economic Review*, Vol. 101 (7), pp. 3400-3426.

[5] Bianchi, Javier, and Guido Lorenzoni, 2022, "The Prudential Use of Capital Controls and Foreign Currency Reserves," Chapter 6 in *Handbook of International Economics*, Vol. 6, pp. 237-289.

[6] Blanchard, Olivier J., 2021, *Macroeconomics* (8th edition), Pearson.

[7] Boughton, James M., 2003, "On the Origins of the Fleming-Mundell Model," *IMF Staff Papers*, Vol. 50 (1), pp. 1-9.

[8] Das, Mitali, Gita Gopinath, and Sebnem Kalemli-Özcan, 2021, "Preemptive Policies and Risk-Off Shocks in Emerging Markets," NBER Working Paper No. 29615.

[9] De Leo, Pierre, Gita Gopinath, and Sebnem Kalemli-Özcan, 2022, "Monetary Policy Cyclicality in Emerging Economies," NBER Working Paper No. 30458.

[10] Dornbusch, Rudiger, 1980, *Open Economy Macroeconomics*, Basic Books.

[11] Dornbusch, Rudiger, Stanley Fischer, and Richard Startz, 2018, *Macroeconomics* (13th edition), McGraw-Hill.

[12] Farhi, Emmanuel, and Iván Werning, 2016, "A Theory of Macroprudential Policies in the Presence of Nominal Rigidities," *Econometrica*, Vol. 84 (5), pp. 1645-1704.

[13] Feenstra, Robert C., and Alan M. Taylor, 2021, *International Macroeconomics* (5th edition), Macmillan.

[14] Fleming, J. Marcus, 1962, "Domestic Financial Policies Under Fixed and Under Floating Exchange Rates," *IMF Staff Papers*, Vol. 9 (3), pp. 369-380.

[15] Friedman, Milton, 1953, *Essays in Positive Economics*, University of Chicago Press.

[16] Gabaix, Xavier, and Matteo Maggiori, 2015, "International Liquidity and Exchange Rate Dynamics," *The Quarterly Journal of Economics*, Vol. 130 (3), pp. 1369-1420.

[17] Ghosh, Atish R., Jonathan D. Ostry, and Mahvash S. Qureshi, 2017, "Managing the Tide: How do Emerging Markets Respond to Capital Flows?" IMF Working Paper No. 17/69.

[18] Ghosh, Atish R., Jonathan D. Ostry, and Mahvash S. Qureshi, 2018, *Taming the Tide of Capital Flows: A Policy Guide*, The MIT Press.

[19] Gourinchas, Pierre-Olivier, 2023, "International Macroeconomics: From the Great Financial Crisis to COVID-19, and Beyond," *IMF Economic Review*, Vol. 71, pp. 1-34.

[20] Itskhoki, Oleg, and Dmitry Mukhin, 2021, "Exchange Rate Disconnect in General Equilibrium," *Journal of Political Economy*, Vol. 129 (8), pp. 2183-2232.

[21] Jeanne, Olivier, and Anton Korinek, 2020, "Macroprudential Regulation versus Mopping up After the Crash," *The Review of Economic Studies*, Vol. 87 (3), pp. 1470–1497.

[22] Kalemli-Özcan, Sebnem, and Liliana Varela, 2021, "Five Facts About the UIP Premium," NBER Working Paper No. 28923.

[23] Kiyotaki, Nobuhiro, and John Moore, 1997, "Credit Cycles," *Journal of Political Economy*, Vol. 105 (2), pp. 211-248.

[24] Klein, Michael W., and Jay C. Shambaugh, 2015, "Rounding the Corners of the Policy Trilemma: Sources of Monetary Policy Autonomy," *American Economic Journal: Macroeconomics*, Vol. 7 (4), pp. 33-66.

[25] Krugman, Paul R., Maurice Obstfeld, and Marc J. Melitz, 2022, *International Economics: Theory and Policy* (12th edition), Pearson.

[26] Mankiw, N. Gregory, 2022, *Macroeconomics* (11th edition), Macmillan.

[27] Meade, James E., 1951, *The Balance of Payments: The Theory of International Economic Policy*, Vol. 1. London: Oxford University Press.

[28] Mendoza, Enrique, 2010, "Sudden Stops, Financial Crises, and Leverage," *American Economic Review*, Vol. 100 (5), pp. 1941-1966.

[29] Miranda-Agrippino, Silvia, and Hélène Rey, 2020, "U.S. Monetary Policy and the Global Financial Cycle," *The Review of Economic Studies,* Vol. 87 (6), pp. 2754–2776.

[30] Mundell, Robert A., 1960, "The Monetary Dynamics of International Adjustment under Fixed and Flexible Exchange Rates," *Quarterly Journal of Economics*, Vol. 74 (2), pp. 227-257.

[31] Mundell, Robert A., 1961, "Flexible Exchange Rates and Employment Policy," *Canadian Journal of Economics and Political Science*, Vol. 27 (4), pp. 509-517.

[32] Mundell, Robert A., 1963, "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," *Canadian Journal of Economics and Political Science*, Vol. 29 (4), pp. 475-485.

[33] Obstfeld, Maurice, Jonathan D. Ostry, and Mahvash S. Qureshi, 2019, "A Tie That Binds: Revisiting the Trilemma in Emerging Market Economies," *The Review of Economics and Statistics,* Vol. 101 (2), pp. 279-293.

[34] Obstfeld, Maurice, and Kenneth Rogoff, 1996, *Foundations of International Macroeconomics*, The MIT Press.

[35] Rey, Hélène, 2013, "Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence," in *Jackson Hole Symposium*, Vol. 25, Federal Reserve Bank at Kansas City.

[36] Romer, David, 2000, "Keynesian Macroeconomics Without the LM Curve," *Journal of Economic Perspectives*, Vol. 14 (2), pp. 149-169.

[37] Schoenmaker, Dirk, 2013, *Governance of International Banking: The Financial Trilemma*, Oxford University Press.

[38] Woodford, Michael, 2003, *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press.