INTERNATIONAL MONETARY FUND

An Integrated Policy Framework (IPF) Diagram for International Economics

Suman Basu and Gita Gopinath

WP/24/38

WORKING PAPER

2024
FEB

 WP/24/38

IMF Working Paper
Research Department

An Integrated Policy Framework (IPF) Diagram for International Economics
Prepared by Suman Basu and Gita Gopinath*

Authorized for distribution by Prachi Mishra
February 2024

ABSTRACT: The Mundell-Fleming IS-LM 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, so the scene is set for an updated approach. We propose an Integrated Policy Framework (IPF) diagram to analyze the use of multiple policy tools as a function of shocks and country characteristics. The underlying model features dominant currency pricing, shallow foreign exchange (FX) markets, and occasionally-binding external and domestic borrowing constraints. Our diagram includes the use of monetary policy, FX intervention, capital controls, and domestic macroprudential measures. It has four panels to explore four key trade-offs related to import consumption, home goods consumption, the housing market, and monetary policy. Our extended diagram adds fiscal policy into the mix.

JEL Classification Numbers:	E58, F38, F41, G28
Keywords:	integrated policy framework; monetary policy; foreign exchange intervention; capital controls; macroprudential policy; fiscal policy
Author's E-Mail Address:	sbasu2@imf.org, ggopinath@imf.org

* This paper was prepared as background for the Integrated Policy Framework (IPF) at the IMF. It presents a diagrammatic form of the *IPF conceptual model*. The IMF's IPF and its Institutional View (IV) on The Liberalization and Management of Capital Flows incorporate and reconcile findings from this conceptual model, other analytical work including the IPF quantitative model, countries' policy experiences, and other inputs. For their key role in the encouragement of this paper and for their helpful comments, we thank Giovanni Dell'Ariccia and Pierre-Olivier Gourinchas. We also thank our co-authors on IPF-related work: Emine Boz, Francisco Roch, and Filiz Unsal. Finally, we thank seminar and internal training participants as well as reviewers at the IMF. 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.

WORKING PAPERS

An Integrated Policy Framework (IPF) Diagram for International Economics

Suman Basu and Gita Gopinath

INTERNATIONAL MONETARY FUND

Contents

1 Introduction

The Mundell-Fleming approach has inspired the construction of open-economy IS-LM diagrams in generations of economics textbooks. These diagrams typically assume 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 some 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.

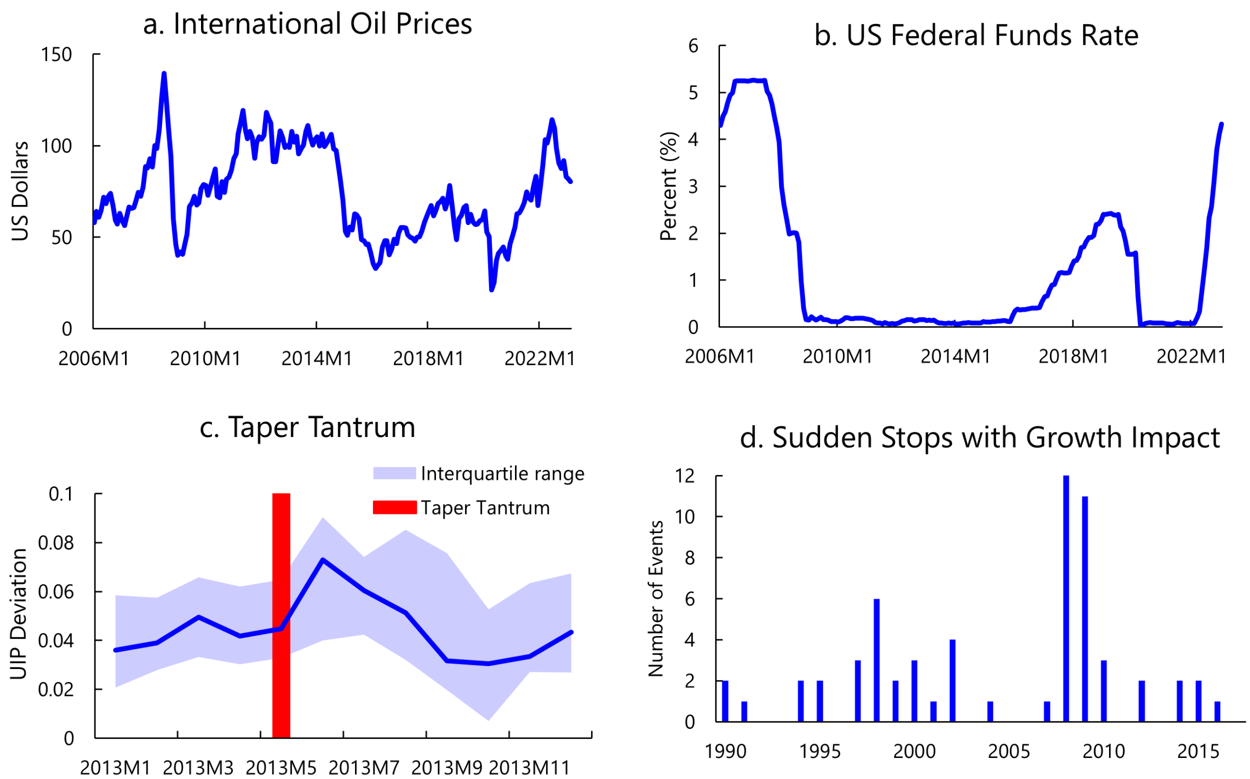
Designing policy responses requires an assessment of the effect of each shock and the appropriateness of the available tools. Specifically, we need to answer:

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

In this paper, we argue that 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. Should countries use only monetary and fiscal policy to tackle premium spikes? 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?

We know that the simplicity of the familiar IS-LM diagrams is powerfully appealing, and that an equally appealing diagram should ideally be offered for any alternative framework.

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).

Accordingly, the contribution of this paper is to introduce an "Integrated Policy Framework"—aka, "IPF"—diagram. The diagram 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. The new IPF approach 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. The reason is that it builds on market frictions and normative policy approaches proposed by recent papers at the forefront of the international finance literature.

To back up this claim, we use the IPF diagram 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, the diagram can show how shocks and policy tools have different effects in different countries, and how the policy mix can be tailored to each country.

Our diagram builds on some core papers (Basu et al. 2023, 2024) which derive optimal policy responses in specific settings. Our goal in this paper is to facilitate experimentation with a variety of possible policy responses and their main normative aspects *diagrammatically*; our diagram cannot prove the optimal policy mixes formally. The diagram combines a subset of the analytical equations from the core papers with some approximations and reduced-form relations simplifying the crisis-zone dynamics from those papers.

We proceed step by step in building the IPF diagram.

Our first step is to build the diagram for a simple intertemporal New Keynesian framework with sticky prices. The diagram can provide normative advice on which shocks to accommodate and which to resist, and this version of it should be used for countries without salient financial frictions.

Our second step is to add financial frictions that can generate premium spikes, sudden stops, and domestic credit crunches. The resulting diagram can be tailored to each country depending on which frictions are most relevant to that country.

These first two steps include all the tools except fiscal policy, because it is typically too slow-moving to handle high-frequency external shocks. Bearing in mind, however, that fiscal policy has sometimes swung into action to handle the largest shocks (such as during the COVID pandemic), our third and final step is to show how the (occasional) addition of fiscal policy may alter the results.

A narrative on the policy mix emerges from our multiple variants of the IPF diagram. The diagram illustrates that for shocks to commodity prices and global interest rates in the absence of financial frictions, monetary and fiscal policies may help achieve a combination of macroeconomic adjustment and stabilization. These tools appear to be helpful to manage such shocks even after the addition of some financial frictions. When we turn to premium spikes and sudden stops that are amplified by financial frictions, the use of FX intervention, capital controls, and domestic macroprudential measures may become especially helpful to improve outcomes.

The paper is structured as follows. Section 2 elaborates on the case for moving on from the Mundell-Fleming approach, and motivates the novel elements that the IPF diagram will include. Sections 3 to 8 undertake the three steps in building the IPF diagram, with each section on model-building followed by a section with illustrative examples. Section 9 discusses how the IPF diagram can illustrate connections between different strands of the international finance literature, some of which have been evolving in parallel up to this point. Section 10 concludes.

2 Moving on from Mundell-Fleming

The Mundell-Fleming approach has an illustrious 60-year history. Mundell (1960, 1961, 1963) and Fleming (1962) laid the groundwork for the analysis of fixed and floating exchange rate regimes.[1] They appeared to validate Friedman's (1953) argument in favor of a flexible exchange rate regime, because they showed that after shocks, monetary policy and exchange rate flexibility could achieve macroeconomic stabilization in this regime. They also pointed to a larger role for fiscal policy and the ineffectiveness of monetary policy in a fixed exchange rate regime. The Mundell-Fleming approach took off after the Bretton Woods system of fixed exchange rates broke down in 1973, and as it became immortalized in the form of an open-economy IS-LM diagram in Dornbusch's 1980 textbook.

In the years since then, different textbooks have adapted and refined their own versions of this IS-LM diagram.[2] While every change in assumptions has altered the policy advice to some degree, the broad thrust of the advice from these diagrams has remained robust.

However, some practical limitations of the Mundell-Fleming approach have emerged over time, as countries have experienced new problems, the international finance literature has advanced, and the composition of the global economy has changed. These limitations are particularly stark in EMDEs and also apply in some AEs. As a result, when considering which tools to use and how to use them, policymakers have typically already moved beyond the IS-LM diagram towards a mix of other frameworks which inform them about what IS-LM is missing. If there is no formal integration of these inputs, it is not clear whether the results from each framework are consistent with, or actually invalidate, each other.

In this section, we discuss these limitations and explain that the IPF diagram aims to tackle all of them. To our knowledge, some of the existing textbooks partially tackle one of the problems, and none of the textbooks tackle all of them in an integrated manner.

2.1 Normative Advice

The Mundell-Fleming approach is positive in nature. Its IS curve relies on a reduced-form behavioral (i.e., unoptimized) equation for consumption and it uses the Keynesian cross diagram to describe how changes in demand affect output. When applying it after a shock, we typically assume that returning the economy to the pre-shock levels of home output and trade balance is the desirable outcome, but

[1] For more details on the development of the Mundell-Fleming approach, and its relation to earlier comprehensive yet more opaque works such as Meade (1951), see Boughton (2003).

[2] Examples of modern textbooks with such a diagram include Blanchard (2021), Dornbusch et al. (2018), Feenstra and Taylor (2021), Krugman et al. (2022), and Mankiw (2022). Ghosh et al. (2018) provide another recent framework.

the framework itself does not actually justify why this is desirable.

Over time, policymakers have become more sophisticated. They know that it may be appropriate to make macroeconomic policy adjustments in response to some shocks while resisting others. Simply put, some shocks do not alter the desirable levels of home output, trade balance, and asset prices, but other shocks do alter one or more of these. If the desirable levels of these variables are altered, policies should facilitate macroeconomic adjustments instead of resisting them.

The IPF diagram will fill this normative gap by incorporating the optimization of decisions, i.e., maximization of welfare subject to a resource constraint. It will focus on the task from the policymakers' perspective, so that the welfare of the economy as a whole is considered.[3] The rationale for the policymaker to intervene will be based on externalities that are not internalized by the private sector. The diagram will show how each policy tool can improve or worsen welfare along different dimensions, and then it leaves to the reader the resolution of the trade-offs across those dimensions and the final judgment on the policy mix.

This approach will replace the IS-LM model's Keynesian cross diagram, while preserving that model's insight that the exchange rate plays a key role in the open economy.

2.2 Policy Tools

The Mundell-Fleming approach typically features an outdated form of monetary policy for a floating exchange rate regime. Its LM curve is upward-sloping because the money supply is fixed. However, countries have generally switched to some form of interest rate control. Even in those countries that continue monitoring the money supply, central banks use their tools to stabilize the resulting financing conditions, which is effectively a form of interest rate management. Correspondingly, the IPF diagram will assume that the monetary policy rate is the relevant monetary tool.[4] If so, the reaction function of this policy rate to macroeconomic variables will determine macroeconomic stability. This approach will replace the IS-LM model's money market diagram.

The IPF diagram will also incorporate the additional tools of sterilized FX intervention, capital controls, and domestic macroprudential measures, which are not part of the typical Mundell-Fleming

[3]The IPF diagram will draw on the literature related to the intertemporal theory of the current account (as initiated by Obstfeld and Rogoff's 1996 textbook). In addition to assuming that policymakers make welfare-maximizing decisions, we usually assume that private agents are rational optimizers—but even if they are not, the diagram should still guide advice, because policymakers should use their tools to induce these agents to make welfare-maximizing decisions.

[4]The IPF diagram will accept the argument of Romer (2000) and will go further in eliminating the LM curve entirely: if it is horizontal as Romer established, it is no longer needed. We follow the New Keynesian approach to monetary policy (as reflected in Woodford's 2003 textbook), in which a "cashless" economy is enough.

approach.[5] Guidance is needed on the use of these tools because empirical evidence (e.g., Ghosh et al., 2017) suggests that they are frequently used by EMDEs to manage capital flows. Such evidence also suggests that fiscal policy is less used for this purpose, although it has proved important after large shocks. Accordingly, the IPF diagram breaks from the Mundell-Fleming approach and excludes fiscal policy from the first two steps of model-building, before including it in the third step.

2.3 Financial Frictions

The Mundell-Fleming approach does not feature frictions that can explain the observed mix of premium spikes, sudden stops, and domestic credit crunches, and how to tackle them. The most common versions of the open-economy IS-LM diagram feature perfect capital mobility. Premium spikes can be plotted in the versions of the IS-LM-BP approach which incorporate Fleming's (1962) case of imperfect capital mobility. However, there is limited policy advice on the use of additional tools to address these spikes. Guidance on the use of these tools needs to factor in the impact of the shocks and the joint use of tools on the economy's intertemporal budget constraint, which the Mundell-Fleming approach does not include.

Over time, EMDEs have grown as a share of global economy. Their policymakers are alert to the risk of financial destabilization and they observe that such destabilization may be connected to the currency denomination of debts.

The IPF diagram will incorporate a set of financial frictions which can generate these forms of financial destabilization, and whose salience is related to the currency denomination of debts.[6] Imperfect capital mobility will be allowed in the form of limited arbitrage in the FX market, resulting in premium spikes. Limited arbitrage may be relevant after both small and large shocks. Occasionally-binding external and domestic borrowing constraints will be used to generate sudden stops and domestic credit crunches respectively. Because the borrowing constraints are occasionally binding, they only become relevant after large shocks.

2.4 Looking Forward

To summarize, the IPF diagram will discard some elements from the Mundell-Fleming approach, preserve other elements, and add new elements. The scene is set for an updated approach.

[5] The Mundell-Fleming approach does include the unsterilized FX intervention needed in a fixed exchange rate regime.

[6] The IPF diagram will draw on the literatures related to the frictions on foreigners' absorption of local currency external debt (e.g., Gabaix and Maggiori, 2015; Itskhoki and Mukhin, 2021), 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), and borrowing constraints on local currency domestic debt (e.g., Kiyotaki and Moore, 1997).

3 The IPF Diagram Without Financial Frictions

In this section, we introduce the first step of the IPF approach. We construct the IPF diagram 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).[7]

The diagram 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 diagram 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).

3.1 Model Overview

The IPF approach described here is based on the model in Basu et al. (2023), for the special case where all the financial frictions in that model are turned off. In the main text, we focus on the details necessary for the building of the IPF diagram; we relegate to appendix A.1 the technical details and approximations tracing out the connection between the diagram in this paper and the system of equations in that previous paper.

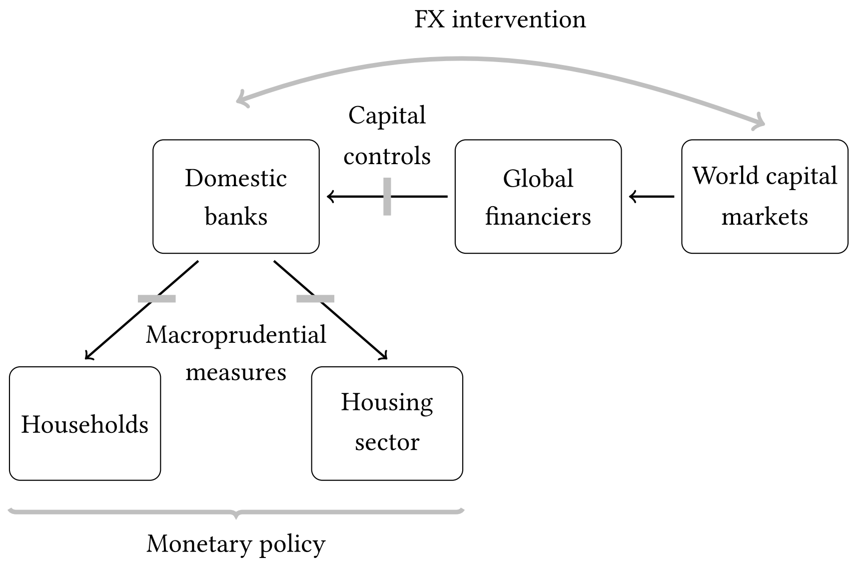
The IPF diagram includes micro-foundations for expenditure-switching, based on optimizing households who consume several goods. Price stickiness generates a role for exchange rate flexibility. We choose assumptions which extend the "dominant currency paradigm"[8]:

- 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.

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

[8] 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.

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.

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 IPF 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 diagram.

3.2 Construction of the Diagram

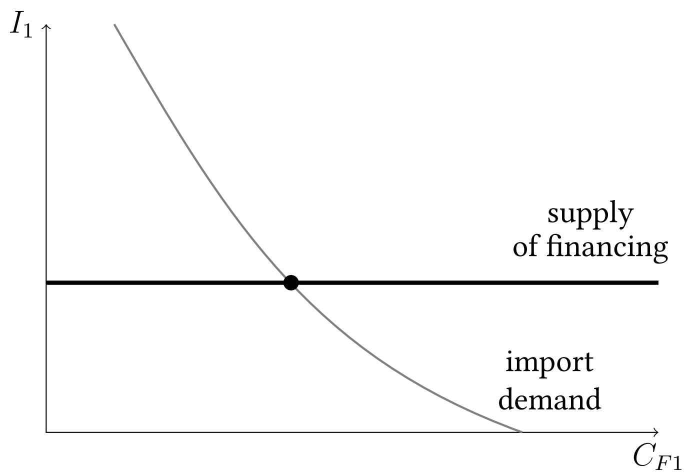
The IPF diagram features four interlinked panels. In this sense, its spirit stays close to the IS-LM framework, which includes ancillary panels plotting the economic forces behind each of the IS and LM curves.

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.[9]

Panel A. Imports

"Intertemporal theory of the current account"

Figure 3: Panel A. Imports



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.[10] Accordingly, the optimal level

[9]Some of the numbers are not sequential, because we are leaving space for equations that will be added in section 5.2.

[10]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.

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 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.[11]

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 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.

[11] 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.

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 borrowing (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.

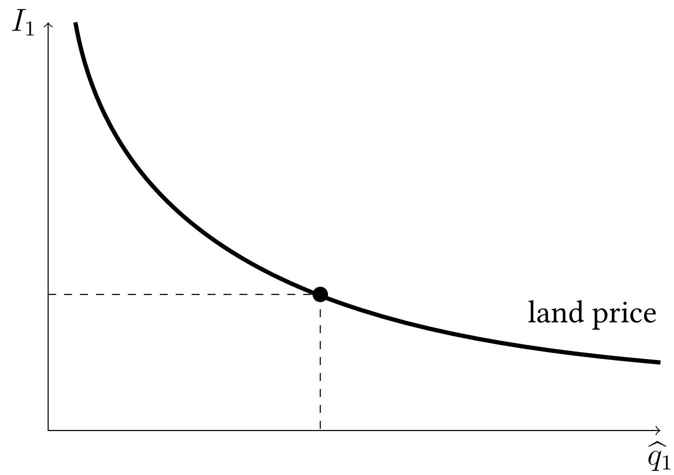
Panel A shows that the intersection of the supply curve of external financing and the demand curve for imports determines the desired levels of import consumption C_{F1} and the gross external financing rate I_1. Correspondingly, shifts in any of these curves alter the desired levels of C_{F1} and I_1. 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"

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

Figure 4: Panel B. Housing



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:

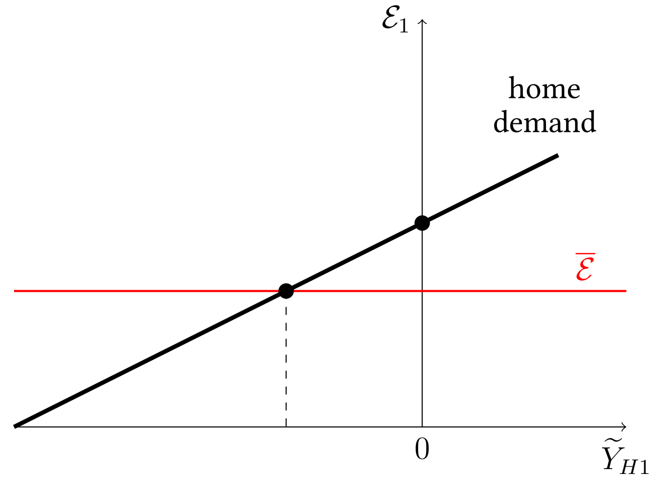
- The land price curve is downward-sloping.
- The land price curve shifts to the right if period-2 imports increase.
- The land price curve shifts to the right if the capital inflow tax is decreased.

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.[12]

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.

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

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,

[12]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.

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.[13] 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.[14] That change in relative price is achieved via an exchange rate depreciation.

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

[13] 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. For more details on the relation of this assumption to Basu et al. (2023), see appendix A.1. Additionally, in our diagram, 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 $\widetilde{Y}_{H1} = 0$.

[14] Imports do not change in panel A because the productivity shock does not expand the economy's external budget constraint: in the dominant currency paradigm, the dollar values of export income, X_1 and X_2, remain fixed irrespective of exchange rate movements.

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"

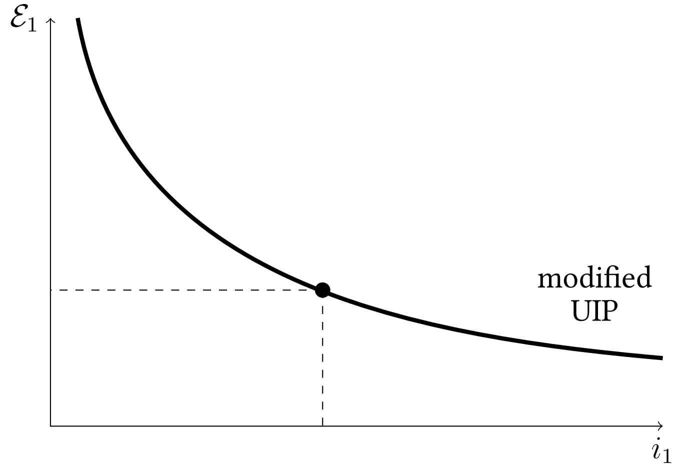
Panel D is shown in figure 6. It presents how the period-1 monetary policy rate i_1 should be set to support all the policy decisions made in panels A, B, and C. To connect panels C and D, they both have the same variable on the vertical axis: the exchange rate $\mathcal{E}_1$.

There is one key relation on the panel.

7. Modified UIP condition.

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

Figure 6: Panel D. Policy Rate



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.[15] 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.

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.

[15] 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 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.

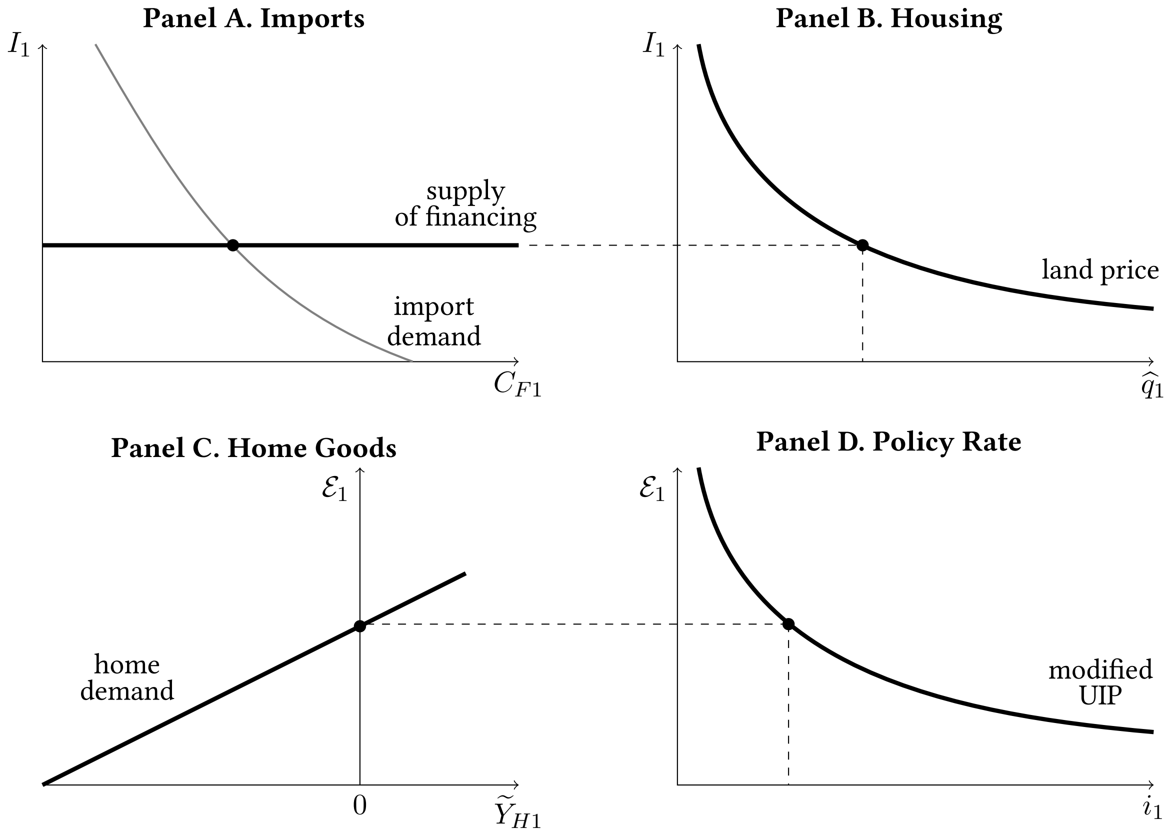
Panel D explains how the monetary policy rate i_1 should be set. As in the IS-LM model, the policymaker can be viewed as choosing the exchange rate first and then picking the policy rate which implements that exchange rate, or choosing the policy rate first and then allowing the exchange rate to be determined 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.

3.3 The Complete Diagram

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

Figure 7: IPF 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.

4 Policy Mixes Without Financial Frictions

In this section, we use the version of the IPF diagram 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 diagram 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 6.

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.

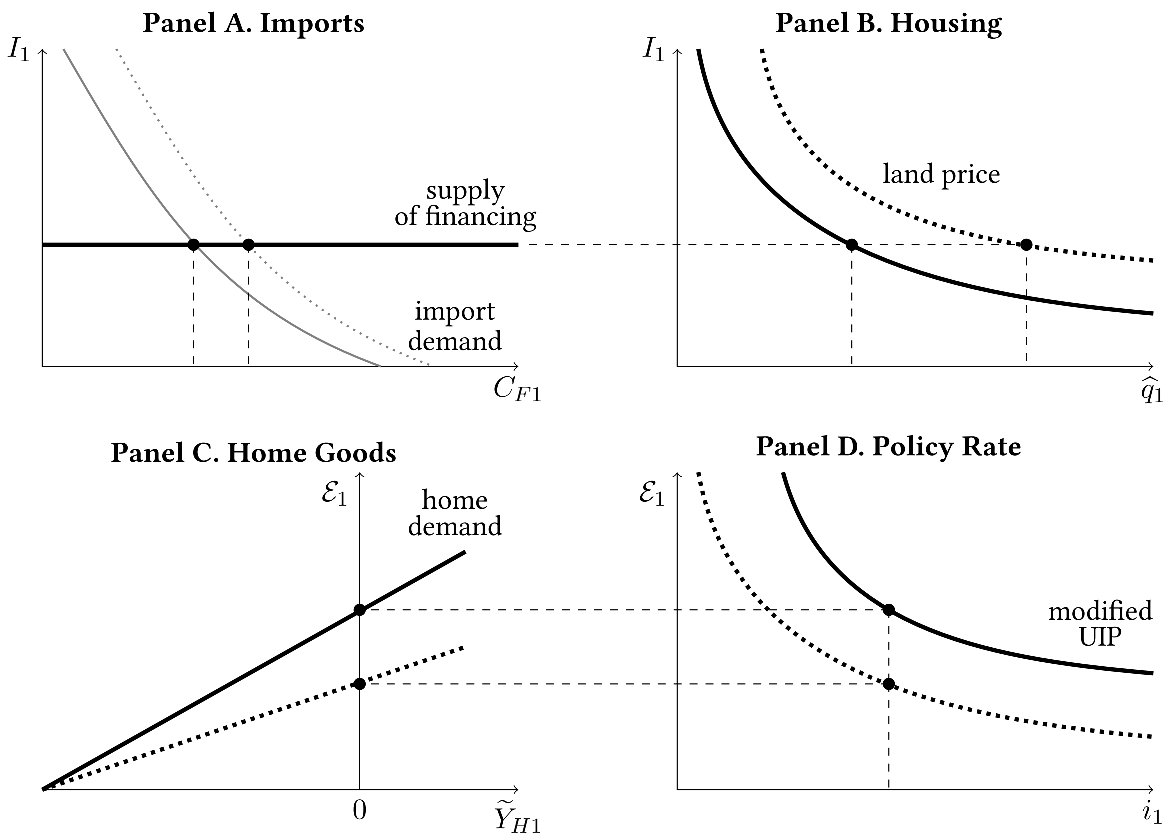
Across the different panels of the diagram, readers can see how each shock and/or policy tool affects different dimensions of welfare. We illustrate some policy mixes below, but the policymaker may choose different mixes, depending on how they value the different dimensions of welfare.

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 IPF 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.

4.1 Commodity Price Shock

We consider a permanent adverse commodity price shock, i.e., a decrease in the dollar value of commodity 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

Figure 8: Commodity Price Shock with Floating Exchange Rate Regime



shock, the country would have $\widetilde{Y}_{H1} = \widetilde{Y}_{H2} = 0$ and $\beta I_1 = \beta(1 + i_1^*) = 1$. 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.[16]

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*

[16] 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.

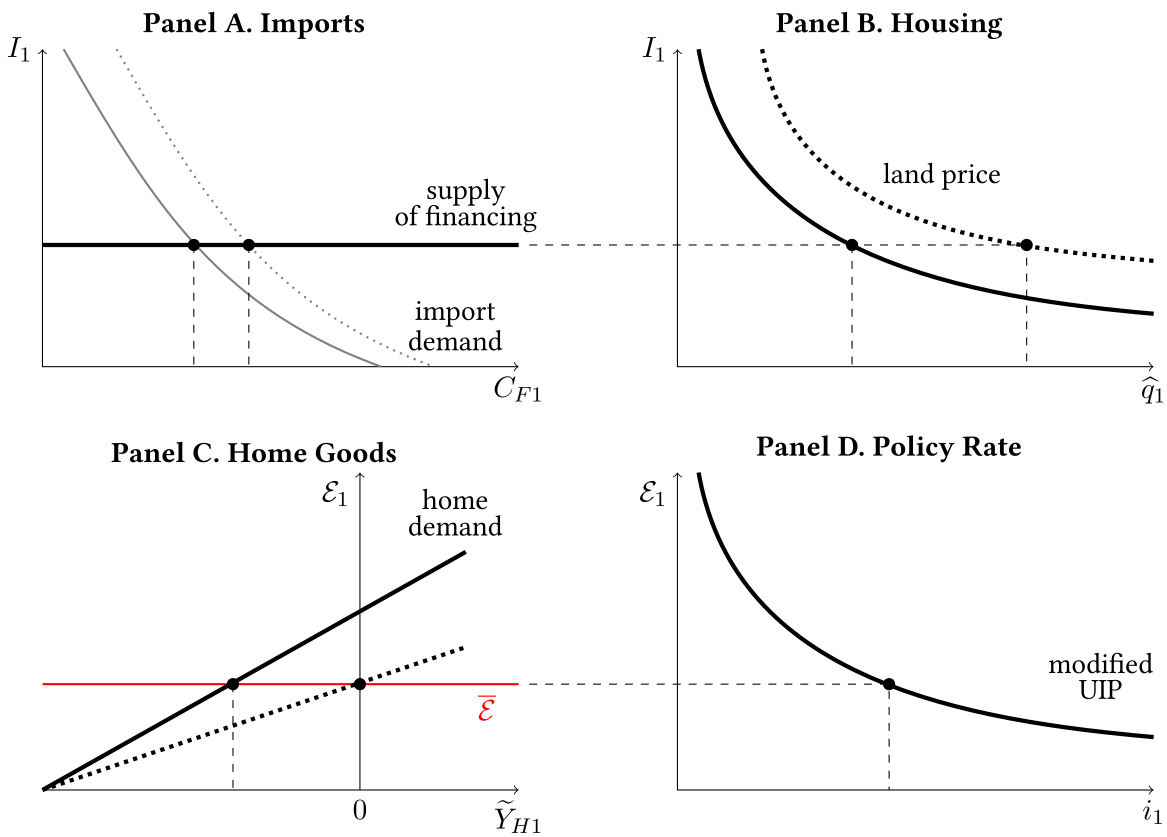
Remark 2. If the exchange rate is fixed, the home output gap turns negative.

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: Commodity Price 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 $\widetilde{Y}_{H1} = \widetilde{Y}_{H2}$.[17] 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.

[17] Even if the commodity price 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 8.1, when we show how fiscal adjustment could be a useful response to this permanent shock.

4.2 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 4.1.

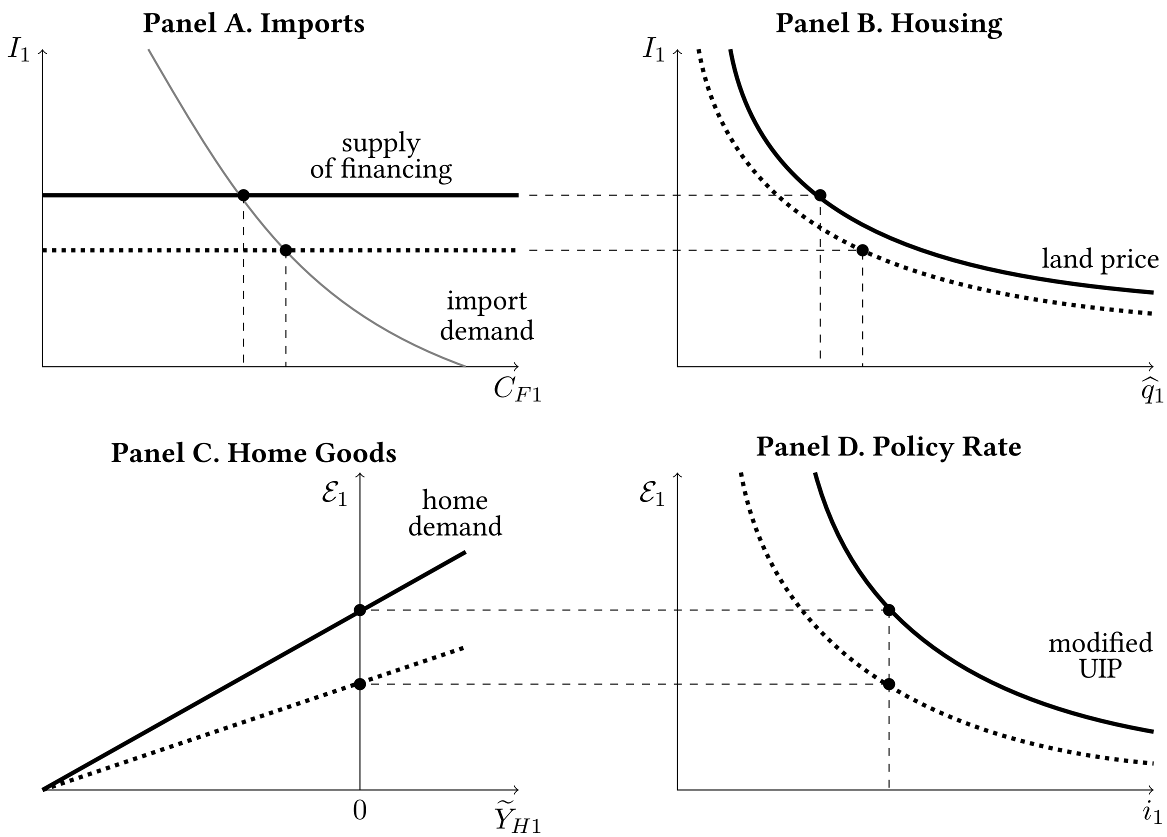
Remark 3. Monetary policy and exchange rate flexibility can achieve desirable adjustment.

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.

Remark 4. If the exchange rate is fixed, there may be a role for ex post capital controls.

Figure 11 illustrates the shock for a country with a fixed 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. positions.

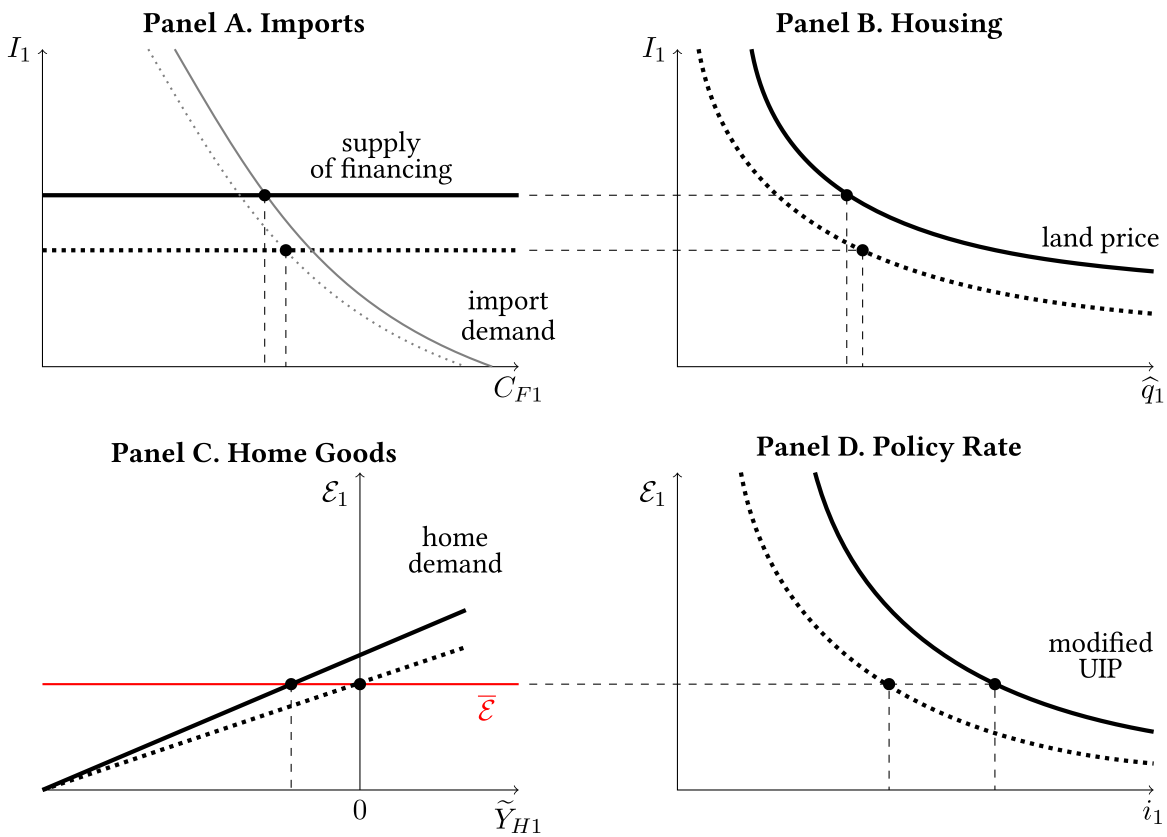
Panel A. An ex post capital inflow subsidy can be used to mitigate the decrease in period-1 imports while the external financing rate increases.

- The supply curve shifts up because i_1^* increases. *Equation (1a) is affected.*
- For $I_1 = (1 + i_1^*) > \frac{1}{\beta}$, the demand curve shifts to the right because $\widetilde{Y}_{H1}$ is temporarily low. *For a fixed regime, panel C will allow for* $\widetilde{Y}_{Ht} \neq 0$. *Since the shock causes* $I_1 = (1 + i_1^*) > \frac{1}{\beta}$, *equations (2a)-(2b) and (5a)-(5c) establish that* $C_{F1} < X < C_{F2}$ *and* $\widetilde{Y}_{H1} < \widetilde{Y}_{H2}$.
- This shift can be implemented using an ex post capital inflow subsidy, $\varphi_1 < 0$. *Substituting* $\widetilde{Y}_{H1} < \widetilde{Y}_{H2}$ *into equation (2d) indicates that* $\varphi_1 < 0$ *is desirable if* θ_{HH1} *is not available.*
- C_{F1} decreases by less than in the floating regime, while I_1 increases the same amount. *Although the shock causes* C_{F1} *to decrease and* C_{F2} *to increase, the shift in the demand curve means that* C_{F1} *is higher and* C_{F2} *is lower than in the floating regime. The relevant expressions are:*

$$C_{F1} = X \frac{\left(\frac{1-\frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1-\frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right)}{\left(\frac{1-\frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1-\frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right) + \beta} \frac{(1 + I_1)}{I_1} \text{ and } C_{F2} = X \frac{\beta\,(1 + I_1)}{\left(\frac{1-\frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1-\frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right) + \beta},$$

where $\left(\frac{1-\frac{1}{\alpha_H A_1}\widetilde{Y}_{H1}}{1-\frac{1}{\alpha_H A_2}\widetilde{Y}_{H2}}\right) = 1$ *in the floating regime and* > 1 *in the fixed regime.*

Figure 11: U.S. Monetary Tightening with Fixed Exchange Rate Regime



Panel B. The land price decreases by less than in the floating regime.

- The increase in I_1 causes a decrease in $\widehat{q}_1$ for a given land price curve.
- For $I_1 = (1 + i_1^*) > \frac{1}{\beta}$, the land price curve shifts to the right by more than in the floating regime if $\varphi_1 < 0$; however, $\widehat{q}_1$ still decreases relative to its pre-shock value. *Equation (3) indicates that for $I_1 = (1 + i_1^*) > \frac{1}{\beta}$, both the subsidy and the increase in C_{F2} (even though the latter increase is lower than in the floating regime) from panel A push the curve to the right.*

Panel C. The negative home output gap is mitigated by the ex post capital inflow subsidy.

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

Panel D. The policy rate increases by less than the increase in i_1^*.

- The modified UIP condition shifts to the right because i_1^* increases, but any subsidy mitigates the rightward shift. *Equation (7) incorporates both the subsidy $\varphi_1 < 0$ from panel A and the increase in i_1^*.*
- i_1 increases by less than the increase in i_1^*.

For countries with a fixed exchange rate regime, macroeconomic adjustment remains desirable and imports should still be reduced after a U.S. monetary tightening. However, the lack of exchange rate flexibility means that there may be a case for the ex post use of capital controls to prevent the period-1 home output gap from getting too negative. Mitigating the decline in import consumption also mitigates the worsening of the home output gap. In section 8.2, we will address the question of whether fiscal policy may also be useful to handle this shock, in case the shock persists long enough for government spending to be able to respond.

4.3 Differences from the IS-LM Diagram

So far, our IPF diagram 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, the IPF diagram finds that standard policy tools can achieve macroeconomic adjustments in floating exchange rate regimes.

For the commodity price shock, the IPF diagram 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 diagram, 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 diagrams, 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 the IPF diagram, 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.[18]

For the U.S. monetary tightening shock, the IPF diagram 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 the IPF and IS-LM diagrams to diverge. While both diagrams 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 diagram 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.[19] 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 on the IPF diagram 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.

The IPF diagram can also be used for fixed exchange rate regimes, and unlike the IS-LM diagram, it assumes that the capital inflow tax may be available when fiscal policy is not. In the IS-LM diagram for a fixed regime, there is typically no tool other than fiscal policy to address the home output contraction after a commodity price shock or a U.S. monetary tightening. The IPF diagram suggests that a capital inflow tax may not be useful after a commodity price 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.

[18]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.

[19]This result comes from an IS-LM model that excludes investment, to make it comparable to the IPF diagram.

5 The IPF Diagram With Financial Frictions

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

The IPF diagram 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 IPF diagram differently for each country. Accordingly, the diagram may illustrate that each country is affected differently by the same shock: if so, the policy mix it chooses may be different as well.[20]

5.1 Model Overview

We add financial frictions to the model described in section 3.1 and the financial intermediation structure shown in figure 2. The IPF approach described here is again based on the model in Basu et al. (2023), this time including all the financial frictions in that paper. Again, we relegate the technical details and approximations to appendix A.1.

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.[21]

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

[20] In case you are eager for a preview of the complete IPF diagram for this section, it is depicted in figure 16 below.

[21] For more technical details on the externalities and their policy implications, see Basu et al. (2023).

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.

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.

The amended IPF diagram 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 diagram 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 diagram 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.

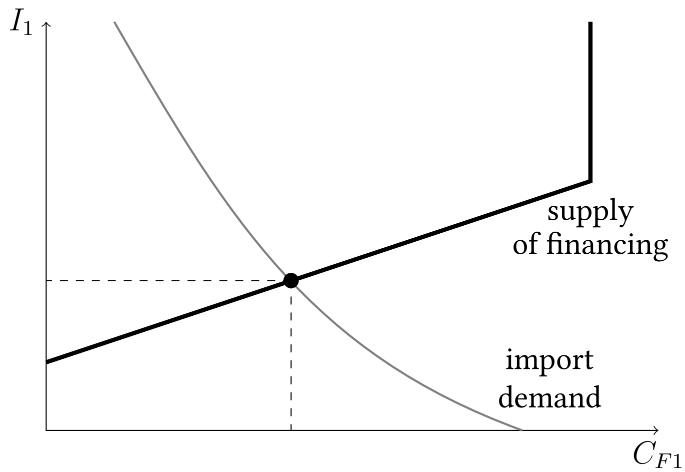
5.2 Construction of the Diagram

Next, we go one by one through the four panels which were described in section 3.2, 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 12: Panel A. Imports



The amended panel A is shown in figure 12. 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:

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

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

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 12, 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 3.2, 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 3.2, 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 12 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 5.1.

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 3.2 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 3.2, 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 5.1. 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.[22] 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

[22] The explanation of the particular functional form for this term is contained in appendix A.1.

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 6.

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 3.2, 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":[23]

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

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

[23] 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 3.2. 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.

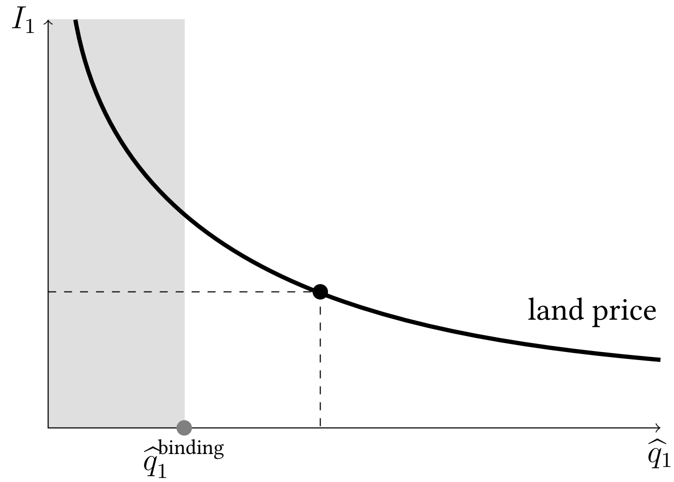
Different financial shocks generate different magnitudes of macroeconomic destabilization. If the FX market is shallow and some of the external debt is in local currency, non-fundamental capital flow shocks S_1 may cause variation in external premia and imports, but the intersection point always remains 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 13: Panel B. Housing



The amended panel B is shown in figure 13, 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 5.1.

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 3.2, 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 13.

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 13, there is a domestic credit crunch and overall welfare declines. In the underlying model in Basu et al. (2023), 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.[24]

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.

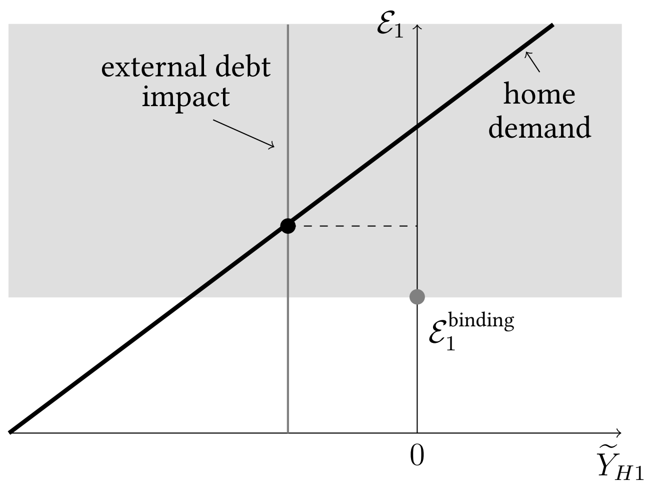
Of course, each tool may generate distortions in the economy. The optimal mix between ex ante and ex post policy tools depends on their relative distortive effects in practice.

[24]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 14: Panel C. Home Goods



The amended panel C is shown in figure 14, 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 14. 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 3.2. 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 3.2 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 14.

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.[25] As shown in figure 14, 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").[26] 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

[25] For more details on how this assumption matches Basu et al. (2023) when the external borrowing constraint binds, see appendix A.1.

[26] As described in appendix A.1, these constants help approximate the salient first order condition in Basu et al. (2023).

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. [27]

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

[27] 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.

debt.

- The gray zone shifts up if the trade balance increases.
- 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 3.2. 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 3.2, 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"

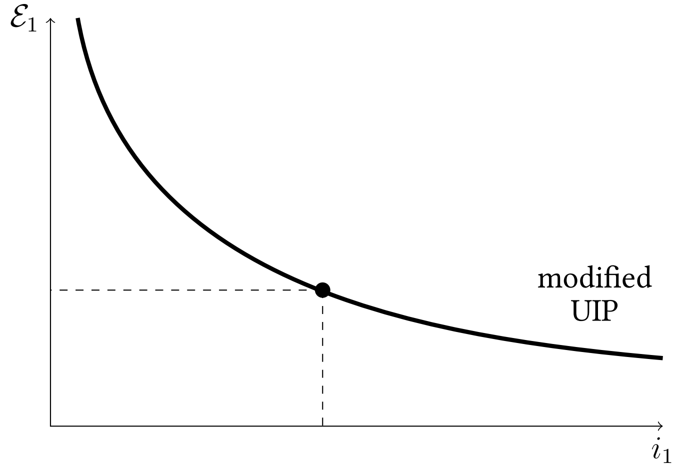
The amended panel D is shown in figure 15. It plots the period-1 monetary policy rate i_1 against the exchange rate $\mathcal{E}_1$.

There is one key relation on the panel.

7*. Modified UIP condition.

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

Figure 15: Panel D. Policy Rate



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 3.2. Since the optimizing global financiers can no longer perfectly arbitrage between local currency and dollar 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:

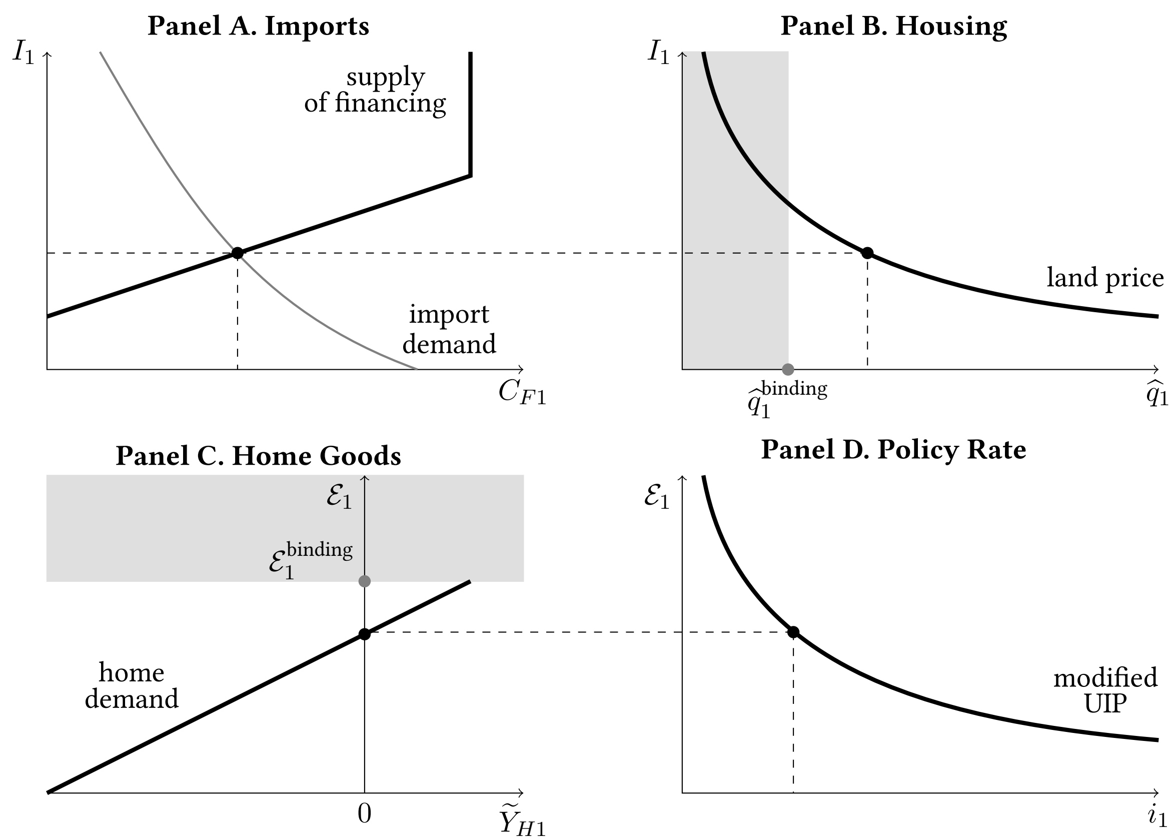
- The modified UIP condition is downward-sloping.
- The modified UIP condition shifts to the right if the expected exchange rate increases.
- The modified UIP condition shifts to the right if the foreign interest rate increases.
- The modified UIP condition shifts to the right if the capital inflow tax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

5.3 The Complete Diagram

Putting together all the elements described in this section, figure 16 shows the complete IPF 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 16: IPF Diagram With All Financial Frictions



The associated system of equations is as follows:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 diagram to use.

6 Policy Mixes With Financial Frictions

In this section, we use the version of the IPF diagram with financial frictions to illustrate some possible policy responses to the shocks shown in figure 1. The addition of financial frictions enables the diagram 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 IPF diagram differently for different countries and consider different policy mixes.

As we explore the shocks, notice that the lessons from section 4 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.[28] 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 4, 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 commodity price 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.

[28] The discussion in this paragraph draws on Basu et al. (2023). The IPF diagram offers different policy mixes as options but it cannot prove the optimal mix.

6.1 Commodity Price Shock

We consider a permanent adverse commodity price 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.[29]

Remark 5. Macroeconomic adjustment is desirable.

Figure 17 illustrates the shock on the IPF diagram. 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.

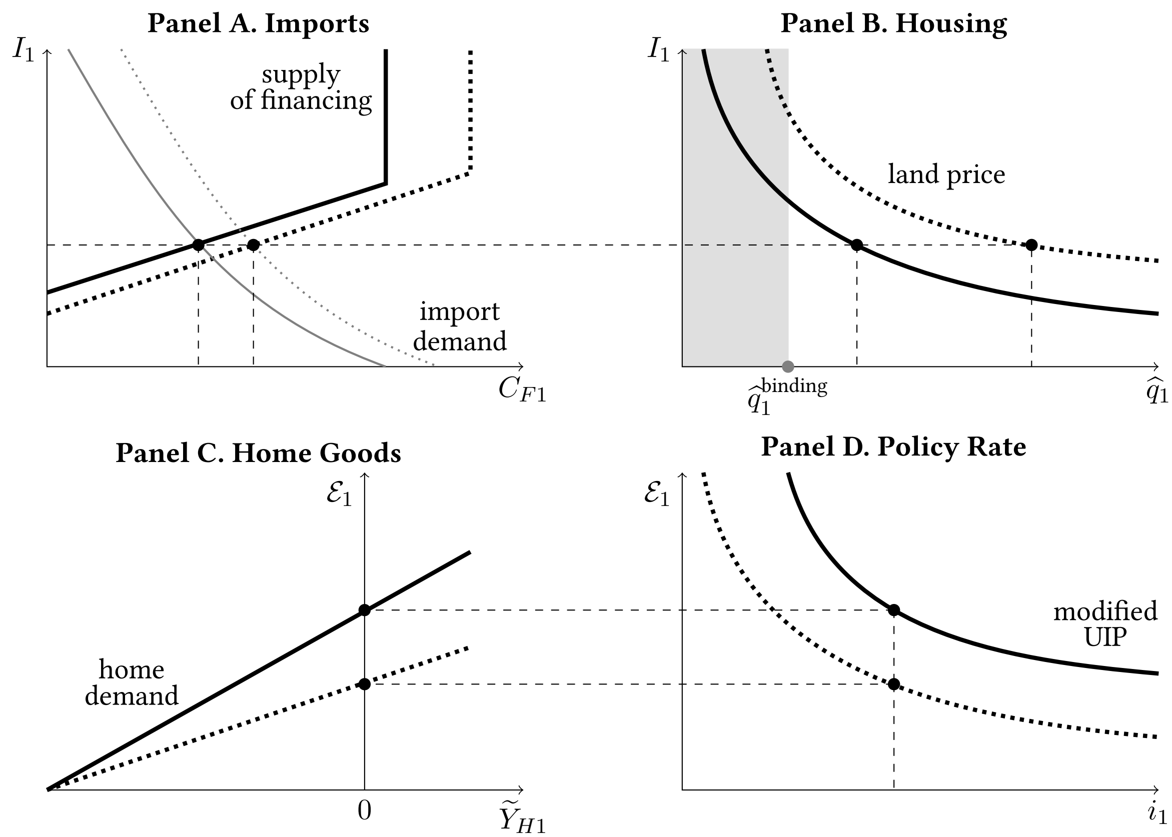
- The upward-sloping part of the supply curve shifts up and to the left because X decreases. *Equation (1a*) establishes that the leftward shift is equal to the decrease in X. Equation (1b*) indicates that the kink moves even more to the left because of the additional impact of the increase in $\mathcal{E}_1$ 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 $\varphi_1 = \theta_{HH1} = 0$.*

[29] 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 17: Commodity Price Shock with Shallow FX Markets



<u>Panel B.</u> 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 $\widehat{q}_1^{\text{binding}}$.*

<u>Panel C.</u> 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.

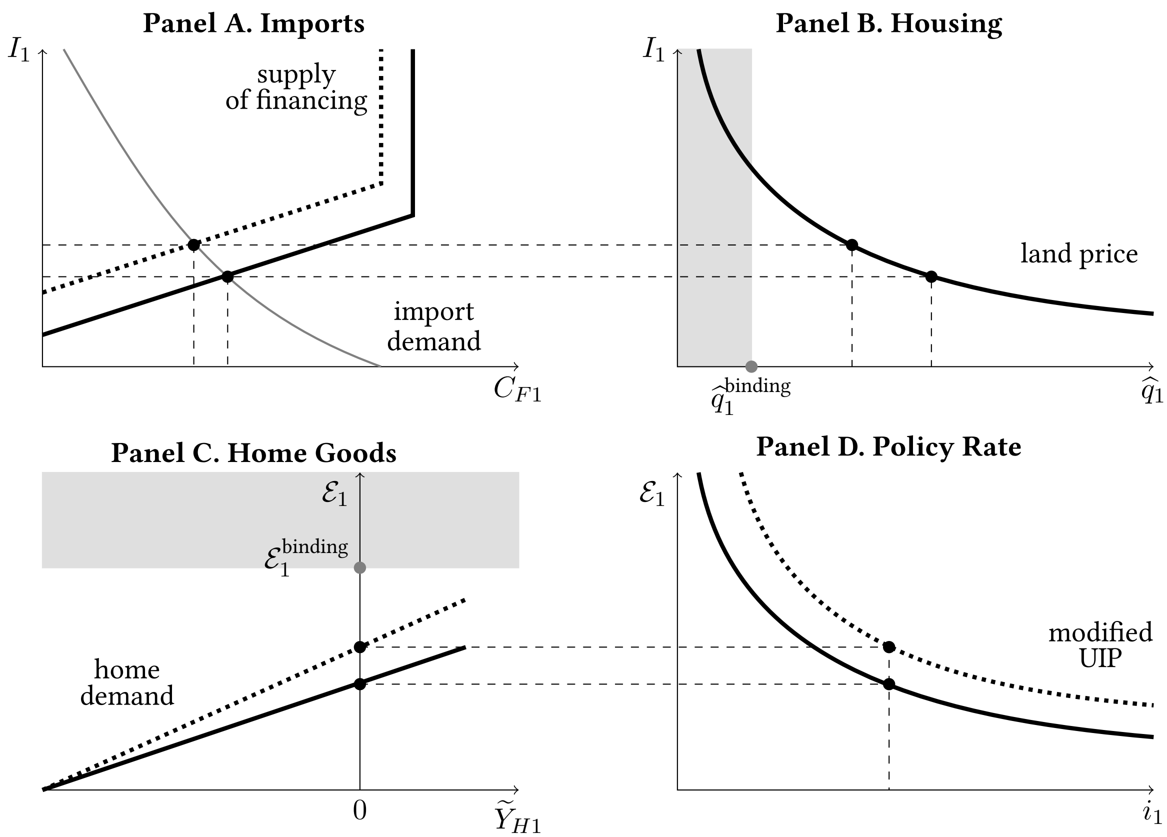
Remark 6. Resisting the shock using FX intervention may be costly.

Figure 18 shows some possible consequences of trying to resist macroeconomic adjustment by selling FX reserves, i.e., $FXI_1 < 0$. The dotted lines show the post-shock positions of the curves from figure 17, while the solid lines show their post-shock positions when sterilized FX intervention is added.

Panel A. Period-1 imports increase and the external financing rate decreases, but period-2 imports decrease.

- The upward-sloping part of the supply curve shifts down and to the right because $FXI_1 < 0$. *Equation (1a*) indicates that the rightward shift is equal to the absolute value of* FXI_1*. Equation (1b*) indicates that the kink moves to the right because of the decrease in* $\mathcal{E}_1$ *from panel C.*
- This shift increases C_{F1} and decreases I_1. *Since the demand curve is downward-sloping,* C_{F1} *increases by less than the absolute value of* FXI_1*, so* $C_{F1} + FXI_1$ *decreases. Correspondingly, unlike figure 17 where* $B_2 = 0$*, the FX intervention generates* $B_2 > 0$ *and* $B_2 + FXI_1 < 0$*. Equation (2c*) indicates that* $\mu_1 < 1$*.*
- The FX intervention has a costly side-effect: it generates a carry loss and decreases C_{F2}. *The carry profits term* $-FXI_1(1-\lambda)\Gamma(B_2 + FXI_1)$ *in equation (2b*) is negative.*[30] *These carry losses and the interest payments on* B_2 *cause* C_{F2} *to decrease. Equation (2a*) indicates that the demand curve is shifted to the right by the decrease in the premium externality term in the denominator, but it is shifted to the left by the carry loss. We plot a country where the demand curve does not shift.*

Figure 18: Using FX Intervention to Resist a Commodity Price Shock



- 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 decrease in I_1 increases $\widehat{q}_1$ for a given land price curve.
- The shift in the land price curve and the eventual change in $\widehat{q}_1$ are ambiguous. *In equation (3*), C_{F2} decreases but $\mu_1 < 1$ from panel A. We plot a country where the land price curve does not shift, so $\widehat{q}_1$ increases.*
- The gray zone shifts to the left because C_{F1} increases. *Equation (4*) indicates that the increase in C_{F1} from panel A causes a decrease in $\widehat{q}_1^{\text{binding}}$.*

[30] Given the assumed initial conditions, there is no external premium to begin with, so the carry losses are zero for a small intervention and increase as the intervention size increases. For a country which begins with a positive external premium, the carry losses would be larger.

- Welfare is unaffected because the domestic borrowing constraint is not binding to begin with. *There could be a welfare improvement if instead, this constraint were binding.*

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

- The demand curve rotates clockwise because C_{F1} increases. *The increase in C_{F1} from panel A enters equation (5a*).*
- $\mathcal{E}_1$ appreciates to set $\widetilde{Y}_{H1} = 0$. *Equations (5a*)-(5b*) establish this result. From equation (5c*), $\mathcal{E}_2$ depreciates.*
- 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 change in the policy rate is ambiguous.

- i_1 may increase or decrease. *In equation (7*), the modified UIP condition may shift to the left as I_1 decreases and $\mu_1 < 1$ from panel A, although the increase in $\mathcal{E}_2$ from panel C may offset some of this shift. In addition, the decrease in $\mathcal{E}_1$ increases i_1. We plot a country where the policy rate does not change.*

Combining the two remarks above, the IPF diagram illustrates that resisting a fundamental shock using sterilized FX intervention breaks consumption smoothing and can generate carry losses. As a result, future import consumption is hurt, and the exchange rate depreciation is not avoided but postponed. The take-away is that the diagram does not necessarily recommend the use of additional tools such as sterilized FX intervention, capital controls, and domestic macroprudential measures as soon as there are financial frictions. The interaction of the shock and the frictions is important, and it may be that none of those additional tools are useful to a first order, even when frictions exist.

In the above diagrams, the FX market is shallow, but we have assumed that the domestic and external borrowing constraints are not binding. Nevertheless, we have shown that the shock moves the country closer to the zone in which the domestic borrowing constraint is binding. Moreover, if we set $B_1 > 0$, the shock could also move the country closer to the zone in which the external borrowing constraint is binding. Readers can consider versions of the IPF diagram in which these constraints bind. The above analysis can be used to show that in such cases, FX intervention may possibly improve welfare by mitigating these constraints.

6.2 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 6.1.

Remark 7. 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 19 illustrates the shock on the IPF diagram. 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 19: U.S. Monetary Tightening; Standard Policy Tools

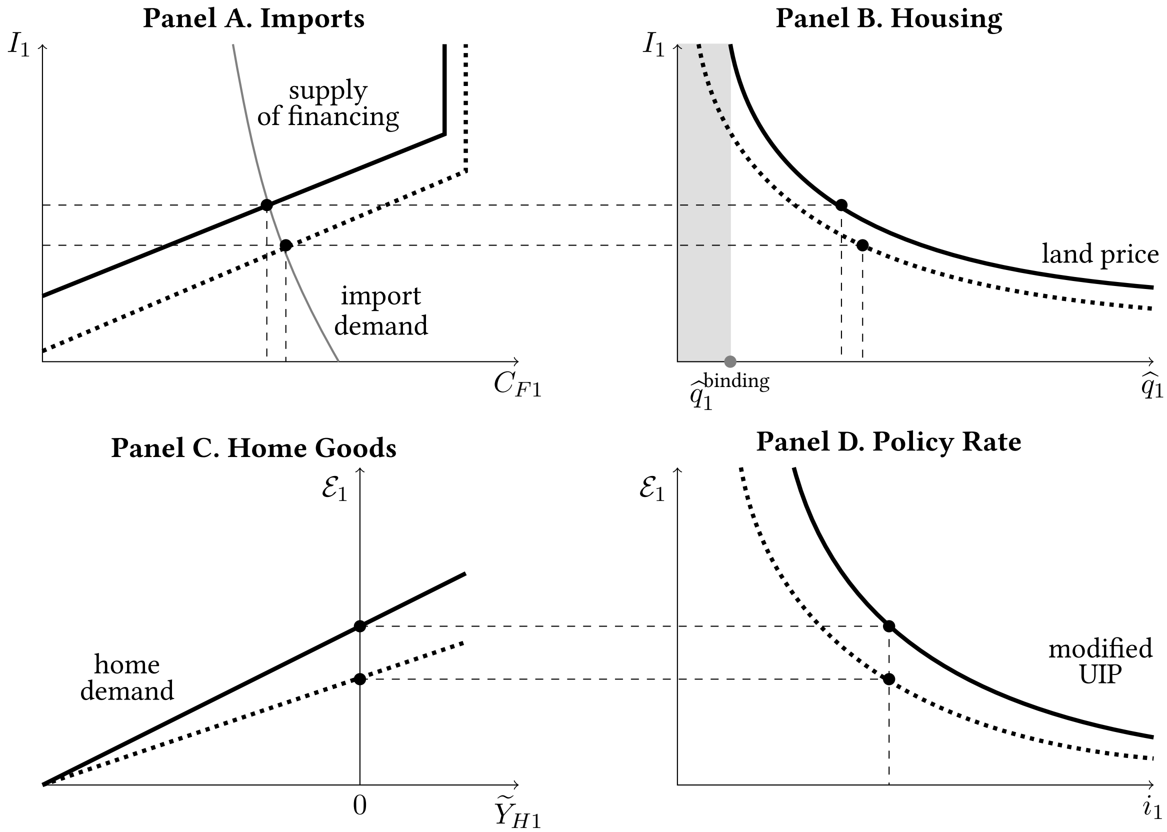
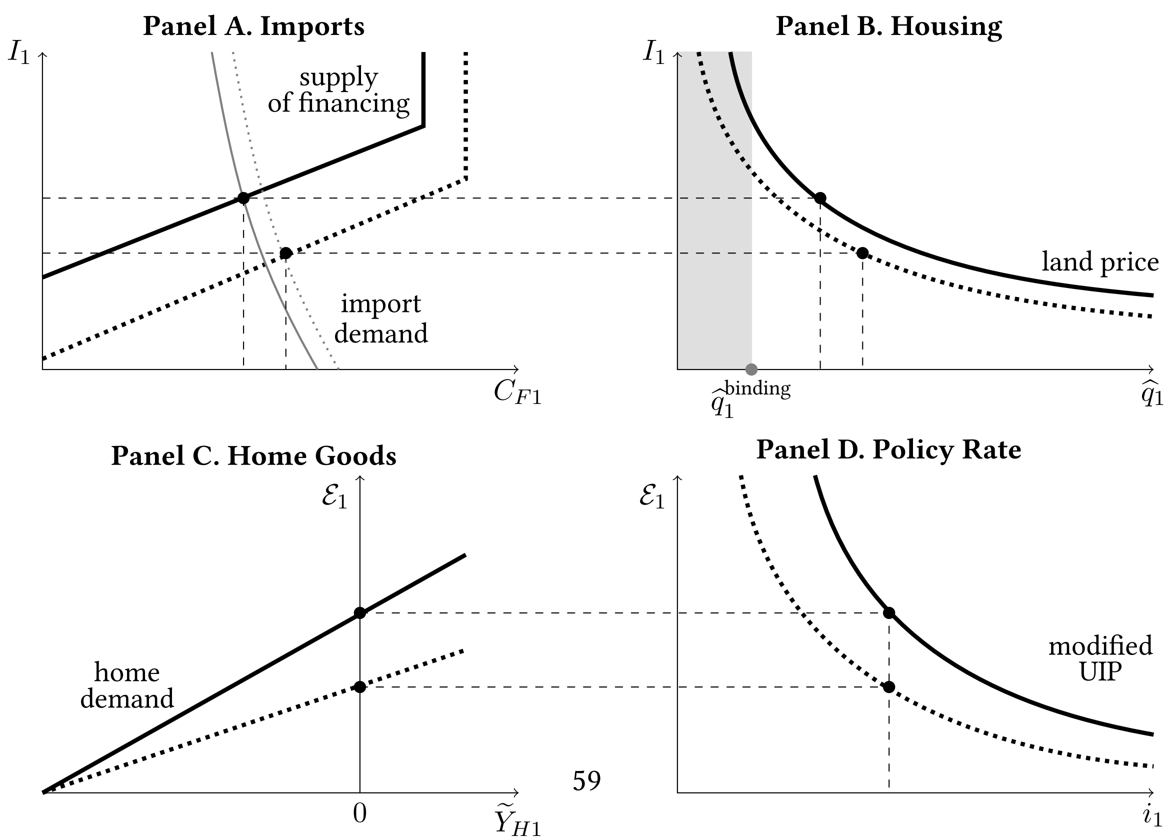


Figure 20: U.S. Monetary Tightening; Adding FX Intervention



- 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 $\widehat{q}_1^{\text{binding}}$.*

<u>Panel C.</u> 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 $B_2 < 0$.*

<u>Panel D.</u> 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.*

Remark 8. FX intervention can help increase the adjustment.

Figure 20 shows how FX intervention can be used to increase the macroeconomic adjustment to the shock. 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 adds sterilized FX accumulation to the policy mix.

We establish how the policymaker can use FX intervention to push the country to the outcome seen in figure 10 of section 4.2, where financial frictions were absent. Instead of using FX sales to resist the shock, the policymaker would need to use FX accumulation, i.e., $FXI_1 > 0$, to reinforce the shock. This tool can replicate the outcome in section 4.2 by making the relevant equations in section 5.3 identical to their counterparts in section 3.3.

Panel A. The decrease in period-1 imports and the increase in the external financing rate are reinforced by FX accumulation.

- The upward-sloping part of the supply curve shifts up because $FXI_1 > 0$. *Equation (1a*) indicates that the leftward shift is equal to the absolute value of* FXI_1. *Equation (1b*) indicates that the kink moves to the left because of the further increase in* $\mathcal{E}_1$ *from panel C.*
- The FX intervention shifts the demand curve to the left. $FXI_1 > 0$ *enters equations (2a*)-(2b*).*
- C_{F1} decreases and I_1 increases by more because $FXI_1 > 0$. *Before the shock, the economy had* $B_2 + FXI_1 = 0$. *In figure 19, the decrease in* C_{F1} *caused* $B_2 + FXI_1 < 0$. *Any leftward shift in the supply curve generated by the FX accumulation causes a further decrease in* C_{F1} *by less than the amount of the shift, so* $C_{F1} + FXI_1$ *increases. To replicate figure 10, the intervention must be used until* $B_2 + FXI_1 = 0$ *is restored. The carry profits from this intervention are zero because the premium is eliminated. Combining this intervention with* $\widetilde{Y}_{Ht} = 0$ *from panel C, the outcome becomes the same as in figure 10. Equation (2c*) indicates that* $\mu_1 = 1$.
- There is no need for an ex post capital inflow tax or household macroprudential tax. *Since* $B_2 + FXI_1 = 0$ *and* $\mu_1 = 1$, *equation (2d*) becomes identical to equation (2d).*

Panel B. The land price decreases relative to its pre-shock value.

- The analysis in figure 10 continues to apply. *Since* $\mu_1 = \Delta = 1$ *from panel A, equation (3*) becomes identical to equation (3).*
- We assume that the economy does not enter the gray zone. *Equation (4*) indicates that relative to their pre-shock values, the decrease in* C_{F1} *from panel A causes an increase in* $\widehat{q}_1^{\text{binding}}$.

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

- The demand curve rotates further anticlockwise because C_{F1} decreases further. *The further decrease in* C_{F1} *from panel A enters equation (5a*).*
- $\mathcal{E}_1$ depreciates more to set $\widetilde{Y}_{H1} = 0$. *Equations (5a*)-(5c*) become identical to equations (5a)-(5c).*
- 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 returns to its pre-shock value.

- The analysis in figure 10 continues to apply. *Since* $\mu_1 = 1$ *and* $I_1 = (1 + i_1^*)$ *from panel A, equation (7*) becomes identical to equation (7).*

Combining the two remarks above, we derive the following insight. The financial friction of shallow FX markets dampens the effect of this financial fundamental shock: while the external financing rate does increase with the dollar interest rate, the increase is mitigated because of the reduced premium associated with the reduced external debt. Relative to the case without financial frictions, the magnitudes of the changes in imports are smaller if only the policy rate and exchange rate flexibility are used. If the policymaker desires more adjustment, sterilized FX accumulation can ensure more reduction in imports and external debt in period 1.

We have again assumed that the FX market is shallow but the domestic and external borrowing constraints are not binding. Notice however that the shock moves the country closer to the zone in which the domestic borrowing constraint is binding. Readers can show that if this constraint becomes binding, it may become useful to sell rather than accumulate FX. If we set $B_1 > 0$, the shock may move the country closer to or further from the zone in which the external borrowing constraint is binding.

6.3 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.[31] We assume that the starting point of the economy is the same as in section 6.1.

Remark 9. Standard policy tools cannot prevent macroeconomic destabilization.

Figure 21 illustrates the shock on the IPF diagram. 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*

[31] 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.

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 10. 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 22 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 21, 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 21, 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}.*

Figure 21: Taper Tantrum; Standard Policy Tools

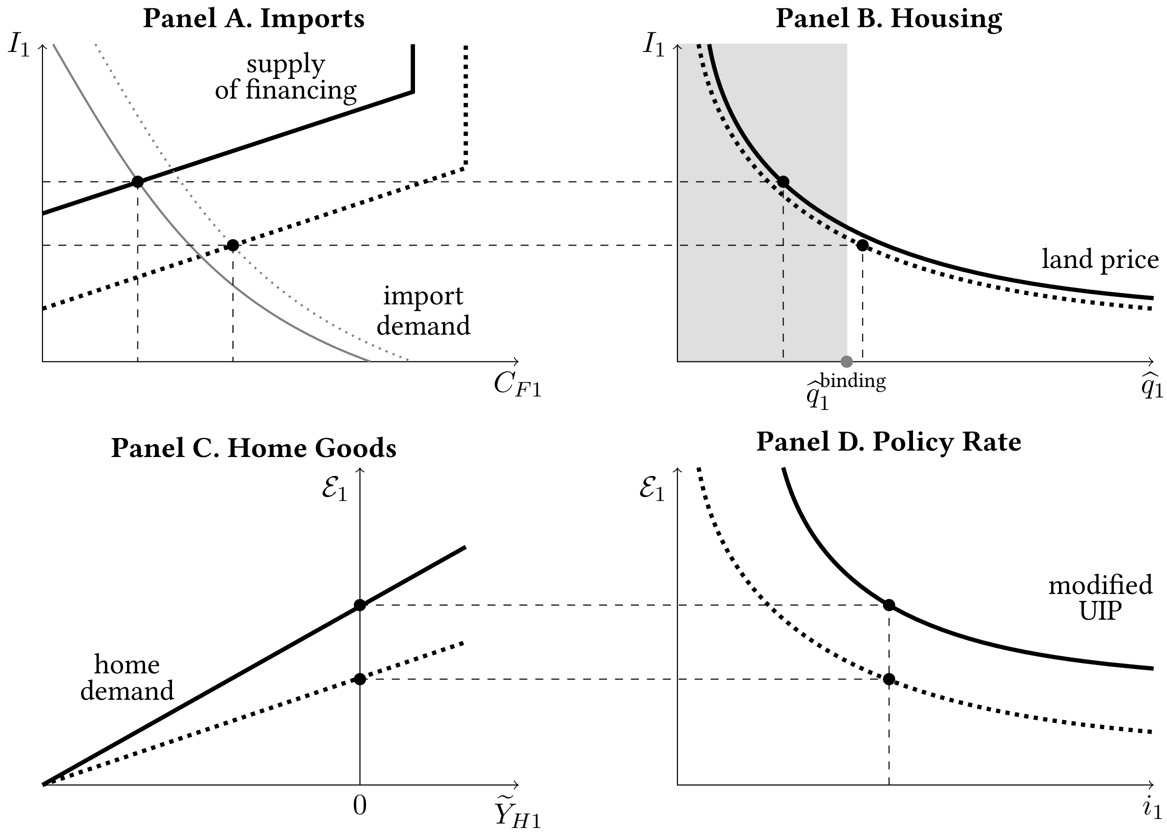


Figure 22: Taper Tantrum; Adding FX Intervention

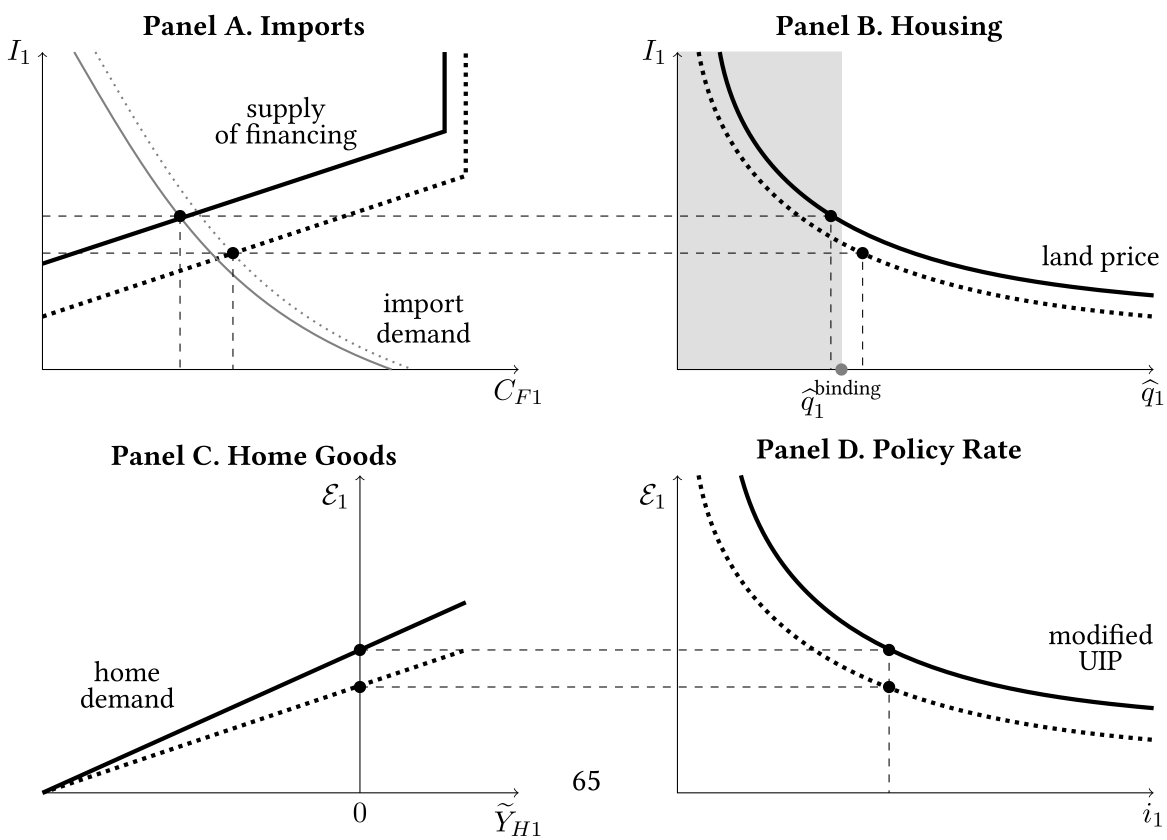
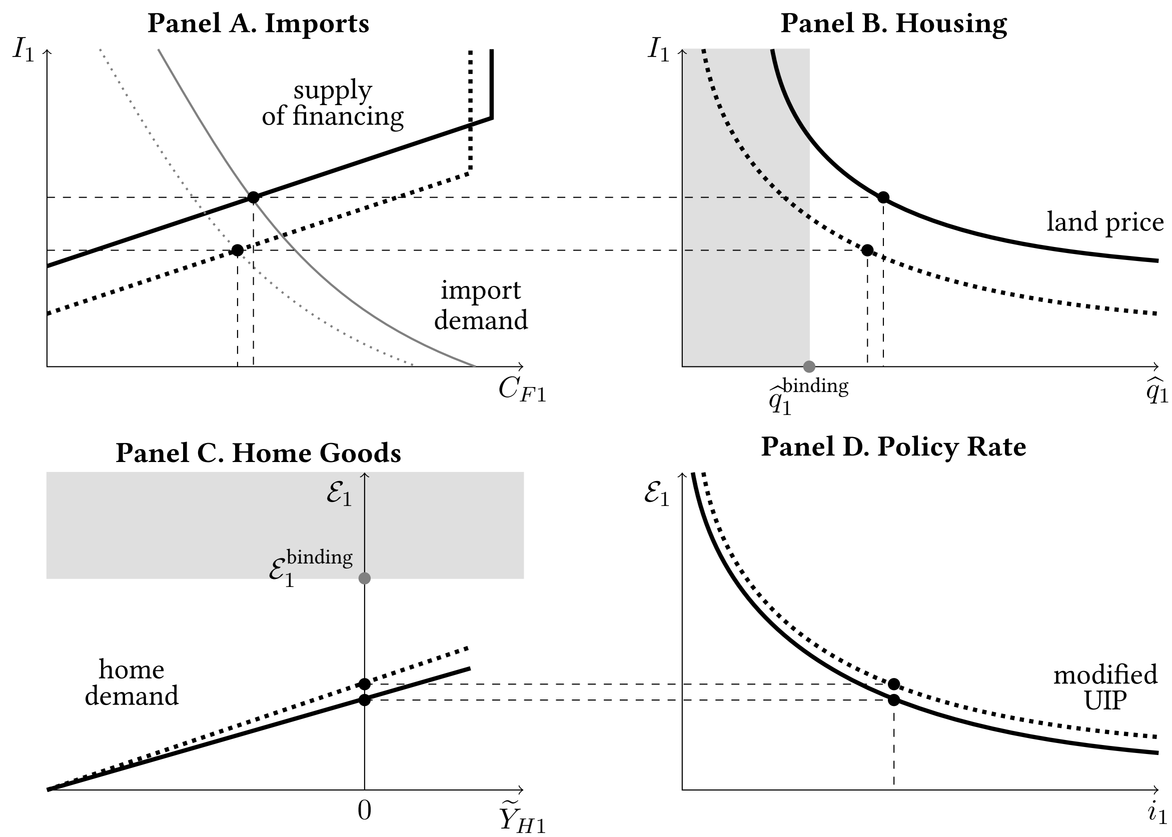


Figure 23: Taper Tantrum; Adding FX Intervention and Capital Controls



- 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 21. 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:*

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

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.*
- 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 23 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. The IPF diagram 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. (2023) 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 22. *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:*

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

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 6.2, it actually amplifies the effect of the non-fundamental outflow shock. And while resisting the fundamental commodity price shock using FX sales generated a carry loss in section 6.1 and would have impeded the adjustment of imports in section 6.2, using FX sales to resist the non-fundamental outflow shock actually generates a carry profit and helpfully stabilizes imports.

6.4 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: $C_{F1} = C_{F2} = X - Z_1 \frac{I_1}{1+I_1}$.

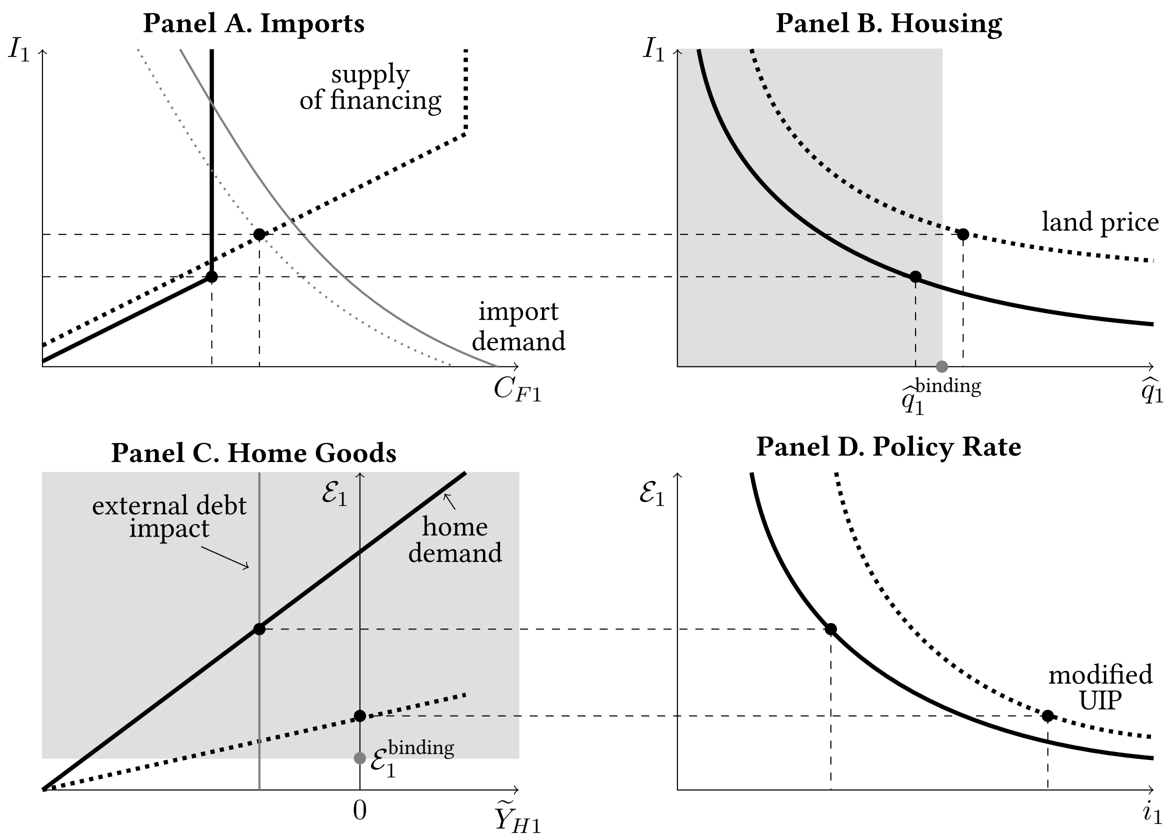
Remark 11. Financial stability concerns may rationalize ex ante capital controls.

Figure 24 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 24: 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 12. 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 24, 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.*

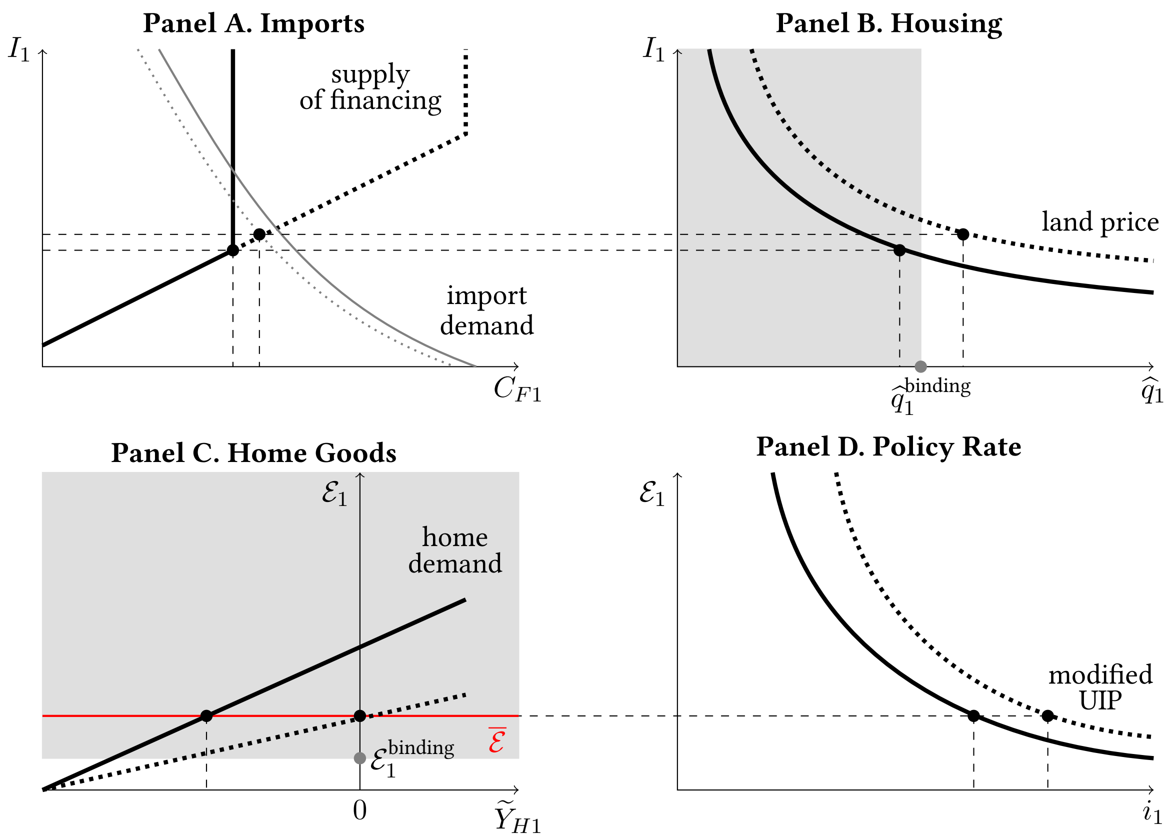
Panel D. There is less "interest rate defense".

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

Remark 13. Countries with fixed exchange rates may also need ex ante capital controls.

Figure 25 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. Relative to the floating regime case in figure 24, the interlinkage between panels A and C related to the amplification of the external borrowing constraint no longer exists, because there is no exchange rate depreciation. Instead, it is the fixed exchange rate

Figure 25: Sudden Stop Shock with Fixed Exchange Rate Regime



rather than the gray zone which causes economic distortions in panel C. The analysis changes as follows.

Panel A. The decrease in period-1 imports is mitigated by the fixed exchange rate.

- The decrease in κ_H still has an impact effect on the kink of the supply curve that decreases C_{F1} and I_1 and increases C_{F2}. *Equations (1a*)-(1b*) and (2b*) establish these outcomes.*
- However, there is no amplification mechanism through an exchange rate depreciation, so the kink does not move further to the left. *The decrease in C_{F1} has no effect on $\mathcal{E}_1$ in panel C. Correspondingly, there is no further decrease of C_{F1} via equation (1b*).*

Panel B. The domestic borrowing constraint may be less severe ex post, so the case for ex ante macro-prudential 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. There is a negative home output gap, so ex ante capital controls may still be 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*).*

- $\widetilde{Y}_{H1}$ is more negative than in the floating regime. *Equations (5a*)-(5b*) establish this result. If we assume that the immediate impact of the shock would tend to depreciate* $\mathcal{E}_1$ *in figure 24 even before any amplification mechanism begins, it follows that if a depreciation is not possible,* $\widetilde{Y}_{H1}$ *becomes even more negative. Equation (5c*) indicates that* $\widetilde{Y}_{H2} > 0$*.*

- Ex ante restrictions on capital inflows can improve welfare. *They can decrease* B_1 *and thereby make the external borrowing constraint less severe or no longer binding ex post via equation (1b*). From equations (5a*)-(5b*), if* C_{F1} *decreases by less in panel A, the demand curve rotates anticlockwise by less in panel C, so* $\widetilde{Y}_{H1}$ *becomes less negative.*

Panel D. The policy rate decreases relative to its pre-shock value.

- The modified UIP condition shifts to the left because external debt decreases. *Equation (7*) incorporates* $\varphi_1 = 0$ *and the decreases in* I_1 *and* μ_1 *from panel A, and the unchanged* $\mathcal{E}_2$ *from panel C.*

- i_1 decreases at the fixed exchange rate $\mathcal{E}_1 = \overline{\mathcal{E}}$.

Overall, there is a case for ex ante debt regulations in countries with large unhedged FX mismatches on external debt. For these countries, policy tools become constrained ex post, once a sudden stop shock has struck: capital inflow taxes become ineffective, while the policy rate is not loosened all the way to stabilize the home output gap. Therefore, instead of relying solely on ex post tools, there is a case for ex ante capital inflow regulations to reduce external FX debt, and a case for ex ante domestic macroprudential measures to reduce the housing sector's domestic debt.

The higher is the local currency fraction of the external debt, the less salient are the external and domestic borrowing constraints after the same shock, and the weaker is the case for ex ante capital controls or macroprudential measures.

6.5 Differences from the IS-LM Diagram

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

The IPF diagram 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: the IPF diagram 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 commodity price shock, the addition of the single friction of shallow FX markets does not alter the outcomes in the IPF and IS-LM diagrams that were discussed in section 4.3. The reason is that in both diagrams, the post-policy outcome featured no change in the trade balance and external debt. In the IPF diagram 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 4.3 highlighted that an external debt reduction is recommended by the IPF diagram; by contrast, if we assume that home output is stabilized in the IS-LM diagram, external debt does not change. Introducing the friction of shallow FX markets causes a further divergence between the diagrams. The IS-LM diagram's previous outcome remains feasible, because the unchanged external debt means an unchanged external premium. In the IPF diagram, 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 the IPF and IS-LM diagrams. In the IPF diagram, the shocks can cause one or both constraints to become binding. The IS-LM diagram 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, the IPF and IS-LM diagrams 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 the IPF diagram 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. The IPF diagram indicates that different policies could be used. Because our diagram 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, the IPF diagram can generate a contractionary depreciation, breaking from the IS-LM diagram. 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 diagram.

Finally, the combination of financial frictions in our IPF diagram means that readers have more flexibility in tailoring and/or amending its application than is typically possible for the IS-LM diagram. 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 the IPF diagram 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.

7 The IPF Diagram With Fiscal Policy

In this section, we introduce fiscal policy into the IPF diagram. After describing the fiscal tools of interest in this paper, we incorporate them into the framework already described above.

Our normative advice on fiscal policy will be partial. We explore how any changes in fiscal policy alter the normative trade-offs described in the previous sections. We do not consider all the costs and benefits of fiscal policy adjustments, which may extend beyond those earlier normative trade-offs. Readers will have to consider those when deciding whether fiscal policy should be part of the policy mix.

Fiscal policy may be difficult to adjust owing to the need for the policymaker to overcome political obstacles. Nevertheless, this policy tool may be an option in some countries and after some (perhaps large) shocks.[32]

7.1 Model Overview

We add fiscal policy to the model described in section 5.1 and the financial intermediation structure shown in figure 2. The IPF approach described here is based on the model in Basu et al. (2024); we relegate to appendix A.2 the technical details and approximations tracing out the connection between the diagram in this paper and the system of equations in that previous paper.

Our fiscal tools of interest are three categories of government spending:

- Purchase of imports, G_{Ft}.
- Purchase of home goods, G_{Ht}.
- Purchase of housing services, G_{Rt}, and/or period-1 transfers to the housing sector, T_{GR}.

The amended IPF diagram will explain how changes in government spending alter the normative trade-offs described in the previous sections. It will show that each category of spending has a different impact on macroeconomic variables. We assume that all spending is financed via lump-sum taxes on households, which simplifies the approach by excluding any additional impacts from distortive tax tools.[33]

[32] In case you are eager for a preview of the complete IPF diagram for this section, it is depicted in figure 27 below.

[33] If such distortive tax tools are available, the model's advice for them would be tied to the results in previous sections. Specifically, such tools should be adjusted to support any previously-recommended capital inflow taxes and macroprudential measures, e.g., if a loosening of macroprudential measures on households is required to boost imports, a reduction in the consumption tax could also help.

In practice, whether to use fiscal policy or not after a shock will depend on several factors that the diagram is agnostic about, including the purpose of the government spending and how quickly and costlessly the spending can be adjusted. Basu et al. (2024) go beyond the diagram and derive optimal fiscal policy by assuming that the spending is on welfare-improving public goods. This assumption means that fiscal adjustments may generate substantial welfare costs beyond the scope of the diagram.

7.2 Construction of the Diagram

Next, we go one by one through the four panels which were described in section 5.2, adding in the elements related to fiscal policy. As we do so, we add apostrophes 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"

The amended panel A takes the same visual form as in figure 12. But the addition of fiscal policy may alter the position of both of the curves on this panel, which in turn changes households' imports C_{F1} in period 1 and the external financing rate I_1 between periods 1 and 2. Fiscal policy affects the import demand curve even in the absence of financial frictions, and it has additional effects on both the demand and supply curves if financial frictions are present.

Relative to section 5.2, we amend every key relation on this panel by adding a term for the government spending on imports G_{F1} alongside each term representing households' imports C_{F1}. The reason is that this category of government spending accrues to foreign firms, so it affects the economy's external debt. As we mentioned before, the consumption of imports worsens the trade balance and causes an increase in external debt. Now that both households and the government purchase imports, the sum of imports $C_{F1} + G_{F1}$ in period 1 determines the economy's total external debt at the end of period 1, B_2.

If the government fully finances its purchases of imports in each period via lump-sum taxes on households in the same period, the government has no debt of its own, and B_2 is equal to the households' external debt. If the government issues debt subject to the condition that its imports are financed in net present value by lump-sum taxes, B_2 is equal to the sum of the households' and the government's external debt, netting out any assets from any debt. To ensure that our terminology captures both of these cases, we label B_2 as the total external debt at the end of period 1. We also label B_1 as the inherited total external debt from the end of period 0, and Z_1 as the dollar value of the period-1 interest repayments on that debt. Given our functional forms for the frictions, the split of external debt between households and the government will not matter for macroeconomic outcomes: what will matter is the total external debt.

Government spending on home goods and support for the housing sector does not affect B_2. Such spending constitutes income for households within the same economy, because the spending accrues to domestic firms and the households own all the domestic firms. As a result, if the government imposes lump sum taxes on households to finance this spending, the households receive an exactly offsetting increase in income and do not change their external debt. Alternatively, if the government issues its own external debt to finance the spending, households use their higher income to purchase foreign assets which offset the increase in the government's external debt.

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

1'. Supply of external financing to purchase imports:

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

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

Equations (1a') and (1b') show that the supply curve for external financing is unaffected by fiscal policy in the absence of financial frictions, but it is affected by fiscal policy if financial frictions are present.

Equation (1a') shows that if the FX market is shallow, the position of the upward-sloping part of the supply curve is shifted by fiscal policy. Government spending on imports G_{F1} affects total external debt and thereby the quantity of debt which the optimizing global financiers have to be induced to hold. If these financiers lend to domestic banks in local currency and require a premium to do so, i.e., if $(1 - \lambda)\,\Gamma > 0$, I_1 is pushed further above $(1 + i_1^*)$ when G_{F1} increases.

Equation (1b') adapts the friction of the external borrowing constraint such that the maximum amount of lending B_2^{binding} applies to the total external debt. This choice of functional form has two implications. First, the inherited debt B_1 is now increasing in the ex ante government spending on imports, so the kink of the supply curve moves to the left if that ex ante spending increases. Second, when the constraint binds, transfers between the government and households cannot loosen the constraint. To loosen the constraint on households' imports C_{F1} in period 1, the government spending on imports G_{F1} in that period must decrease. Accordingly, the kink of the supply curve moves to the right if G_{F1} decreases.

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, FX intervention, and fiscal policy.
- 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, shifts down if the policymaker decumulates FX reserves, and shifts up if government spending on imports increases.
- 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.
- The kink moves to the left if the ex ante and/or ex post government spending on imports increases.

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

2'. Demand for imports:

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

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

The addition of fiscal policy means that equations (2a') and (2b') now incorporate the impact of the government's purchases of imports on the total external debt.

Equation (2a') is affected by the addition of fiscal policy only if the FX market is shallow and some of the external debt is in local currency, i.e., $(1-\lambda)\,\Gamma > 0$. In this case, the premium externality now depends on the government spending on imports G_{F1}, because that spending now affects B_2. Irrespective of FX market depth, there is also a new exponent $1+\nu$ on the productivity level A_1. However, this new exponent does not qualitatively change the equation, so we will defer explaining it until we discuss panel C below.

Whether there are financial frictions or not, the economy's budget constraint (2b') is altered by fiscal policy. It now incorporates the fact that export income must be used to pay not just for households' imports C_{Ft} but also for the government spending on imports G_{Ft}. The implication is that an increase in the government spending on imports in any period causes a reduction in the net present value of income available to finance the households' imports in all periods. Correspondingly, the demand curve for households' imports shifts to the left.

As described in sections 3.2 and 5.2, 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. If the policymaker is constrained in the use of these tools, the demand curve will be to the left or to the right 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}. In that case, we can set $\varphi_1 = \theta_{HH1} = 0$.

The expression for the premium adjustment factor is as follows:

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

where B_2 now also depends on the government spending on imports G_{F1}.

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:

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

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 demand curve shifts to the left if government spending on imports increases.

The amended panel A augments the intertemporal theory of the current account with fiscal policy alongside the frictions of shallow FX markets and the external borrowing constraint. Changes in the government spending on imports G_{Ft} directly shift the demand and supply curves for households' imports C_{Ft} on panel A. By contrast, changes in the other categories of government spending $\{G_{Ht}, G_{Rt}, T_{R1}\}$ do not directly shift these curves. They may indirectly shift them if they alter the home output gaps $\widetilde{Y}_{Ht}$ and/or the exchange rate $\mathcal{E}_1$ on panel C. As in section 5.2, changes in those values of $\widetilde{Y}_{Ht}$ and $\mathcal{E}_1$ may cause shifts in the demand and supply curves on panel A.

Using the above equations, we can conduct three policy experiments.

First, if the government spending on imports $\{G_{F1}, G_{F2}\}$ is held unchanged, the households' consumption of imports $\{C_{F1}, C_{F2}\}$ is unchanged as well, even if the government changes its lump-sum taxes and transfers to households. Those taxes and transfers do not show up in equations (1a')-(1b') and (2a')-(2b'), so they do not affect the intersection of the curves on panel A.

The upshot is that a form of Ricardian equivalence holds. Suppose that the government makes an extra lump-sum transfer to households and issues the same amount of extra debt in period 1. Since $\{C_{F1}, C_{F2}\}$ remain unchanged, the transfer has no effect on B_2, although it does affect the split of B_2 between households' external debt and the government's external debt. If the external borrowing constraint is not binding, the households save the transfer, recognizing that they will be taxed more by that amount in period 2. If the external borrowing constraint is binding, that constraint remains unchanged because it is affected by the total external debt, not the split of that debt; as a result, the transfer again does not affect the economy.

Second, a permanent increase in government spending on imports causes a permanent decrease in households' consumption of imports, leaving aside any spillover effects from panel C. Equations (2a')-(2b') indicate that the demand curve shifts to the left, whether there are financial frictions or not. If the FX market is shallow, equation (1a') indicates that the upward-sloping part of the supply curve shifts up and to the left; and if the external borrowing constraint (1b') is binding, the kink of the supply curve moves left and reduces households' imports. Given all of these shifts, $\{C_{F1}, C_{F2}\}$ decrease. Conversely, the policymaker can increase $\{C_{F1}, C_{F2}\}$ by permanently reducing $\{G_{F1}, G_{F2}\}$.

Third, the impact of a tilting of the path of $\{G_{F1}, G_{F2}\}$ over time depends on the financial friction of shallow FX markets. Let us consider a fiscal front-loading which increases G_{F1} and decreases G_{F2}

but does not alter the net present value $G_{F1} + \frac{G_{F2}}{I_1}$. We assume that there is no external borrowing constraint and that $\widetilde{Y}_{Ht} = 0$.

If the FX market is deep and/or all external debt is in dollars, i.e., $(1-\lambda)\,\Gamma = 0$, the policy has no effect on $\{C_{F1}, C_{F2}\}$. Equation (1a') establishes that $I_1 = (1 + i_1^*)$, so the supply curve is unaffected by the policy. Equations (2a')-(2b') establish that at this unchanged value of I_1, the previous allocation of $\{C_{F1}, C_{F2}\}$ is still the solution. The intersection point of the curves on panel A does not change.

However, if the FX market is shallow and some of the external debt is in local currency, i.e., $(1-\lambda)\,\Gamma > 0$, the same policy has a different impact. Equation (1a') implies that the supply curve shifts up and to the left, while equations (2a')-(2b') indicate that the premium externality term may shift the demand curve to the left as well. As a result, the intersection point of the curves on panel A shifts to the left, and there is a decrease in C_{F1}. Conversely, the policymaker can increase C_{F1} by postponing government spending on imports from period 1 to 2.

Panel B. Housing

"Global financial cycle in credit"

The amended panel B takes the same visual form as in figure 13, 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.

But the addition of government support for the housing sector has two effects on the panel. First, whether financial frictions are present or not, such support may alter the position of the land price curve. Second, such support may alter the position of the gray zone, which represents the financial friction of the domestic borrowing constraint. As a result, fiscal policy can help determine whether this constraint is binding, and whether there is a role for other ex ante and ex post policy tools to support the land price.

Government spending on imports and home goods do not directly shift the curves on panel B. However, they may affect the outcome of panel A—and if so, that outcome spills over and shifts the curves on panel B.

There is one key relation on the panel.

3'. Land price:

$$\widehat{q}_1 = \frac{(1-\varphi_1)}{\mu_1 \Delta} \frac{C_{F2} + G_{R2}}{I_1}. \tag{3'}$$

Equation (3') represents the amended expression for the land price. Relative to section 5.2, the equation has a new term G_{R2} in the numerator, representing the dollar value of government spending on housing services in period 2. The reason is that such spending increases the dollar value of housing rents in period 2, which in turn increases the dollar value of the land price in period 1. In practice, the policymaker can support the land price today by making a credible announcement of future support for the housing sector.

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.
- The land price curve shifts to the right if the government promises to increase its spending on housing services in period 2.

The above mechanism is present irrespective of the existence of financial frictions. Of course, as in section 5.2, the normative case for the policymaker to support the land price depends on whether the financial friction of the domestic borrowing constraint is binding. We turn next to this constraint.

Once we add the domestic borrowing constraint, there is a gray zone on the panel where the constraint binds, and fiscal policy can alter the position of this zone.

4'. Point at which domestic constraint binds.

$$\widehat{q}_1^{\text{binding}} = \widehat{q}_1^{\text{binding}}\left(\underset{(-)}{\kappa_q}, \underset{(+)}{B_1^{\text{housing}}}, \underset{(-)}{C_{F1} + G_{R1}}, \underset{(-)}{T_{GR}}\right). \tag{4'}$$

Equation (4') explains the amended position of the gray zone.

Relative to section 5.2, the expression has two new terms. The term G_{R1} is the dollar value of government spending on housing services in period 1, and the term T_{GR} is the dollar value of the lump-sum transfers to the housing sector in that period. Both forms of fiscal support to the housing sector relax the domestic borrowing constraint and shift the gray zone on the panel to the left. Government spending on housing services in period 1 increases the housing rents in the same period, which provides the housing sector with resources to pay down its inherited debt and to reduce its debt rollover needs. Lump-sum transfers to the housing sector directly reduce how much the sector needs to borrow on domestic credit markets.

If there is a risk that the domestic borrowing constraint may become binding after a shock, such ex post fiscal support can improve welfare alongside the ex ante macroprudential measures on the housing sector described in section 5.2. These tools all shift the gray zone to the left, and it would typically be optimal for the policymaker to use a combination of them. Ex ante macroprudential measures can reduce the inherited housing sector debt B_1^{housing}, but they do not provide ex post help. Ex post lump sum transfers do constitute such help, but they may not always be feasible in the magnitudes required. Moreover, the expectation of such transfers may stimulate the housing sector to borrow more ex ante, pushing up B_1^{housing} and partially mitigating the leftward shift of the gray zone.

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.
- The gray zone shifts to the left if government spending on housing services and/or lump sum transfers to the housing sector increase in period 1.

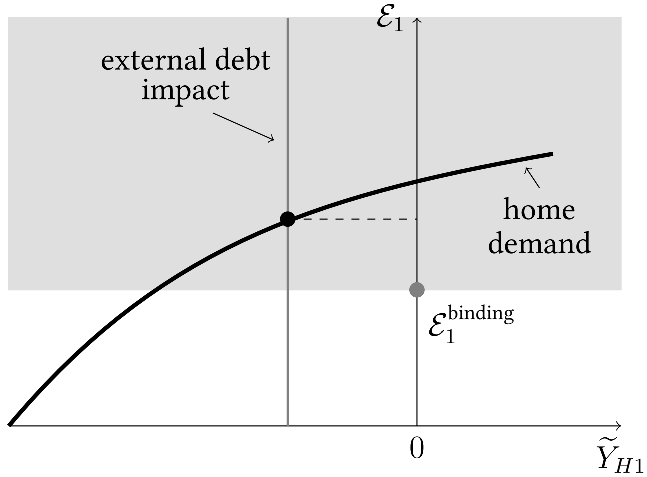
Panel C. Home Goods

"Aggregate demand stabilization via the exchange rate"

The amended panel C is shown in figure 26, plotting the exchange rate $\mathcal{E}_1$ against the home output gap $\widetilde{Y}_{H1}$ in period 1. Relative to section 5.2, the government spending on home goods in period 1, G_{H1}, changes the shape and position of the demand curve under certain conditions. These conditions are related to labor supply and unrelated to financial frictions, and we explain them below.

Government spending on imports and support for the housing sector do not directly shift the curves on panel C. However, the period-1 government spending on imports G_{F1} does shift the position of the gray zone on the panel. Additionally, the government spending on imports $\{G_{F1}, G_{F2}\}$ affects the outcome of panel A, which spills over and shifts the curves on panel C.

Figure 26: Panel C. Home Goods



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

5'. Demand for home goods.

$$\widetilde{Y}_{H1} = C_{F1}\mathcal{E}_1 \left(C_{F1}\mathcal{E}_1 + G_{H1} + Y_{XH}\right)^{\nu} - \alpha_H A_1^{1+\nu}, \tag{5a'}$$

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

As in section 5.2, the demand curve is the only relation needed to derive the outcome of panel C in two cases: first, a country with a fixed exchange rate regime; and second, a country with a floating exchange rate regime where the external borrowing constraint is never binding.

However, the inclusion of fiscal policy alters the expression for $\widetilde{Y}_{H1}$, and thereby the shape of the demand curve. The reason is as follows.

If the government purchases home goods G_{H1}, it stimulates the home output of these goods. The impact on households' consumption of these goods depends on whether the economy faces labor supply constraints or not. Labor supply constraints can be defined as whether employing an additional unit of labor to produce more output causes an increase in the marginal disutility of labor, which then filters through to a jump in real wages. There are no labor supply constraints if the marginal disutility of labor is unaffected by the quantity of output. In this case, welfare is optimized by producing more of the goods and satisfying the government's demand without any impact on households' consumption. There are labor supply constraints if the marginal disutility of labor is increasing in the quantity of output. In this case, output should not be increased too much.[34] As a

[34] This normative recommendation incorporates welfare considerations related to home goods consumption and the

result, if the government purchases home goods, households' consumption should be reduced.

This argument is incorporated into equation (5a'), the new expression for the home output gap $\widetilde{Y}_{H1}$. Relative to section 5.2, the key difference lies in the first term on the right hand side: the previous term $C_{F1}\mathcal{E}_1$ is now multiplied by an expression which represents the marginal disutility of labor.

The parameter ν governs how the marginal disutility of labor is affected by the quantity of output. If $\nu = 0$, the marginal disutility is unaffected by the quantity. This assumption is the one that was used in sections 3.2 and 5.2, and it ensured that the expression in the brackets could be removed. With this assumption, any increase in G_{H1} can be fully accommodated via additional output, with no effect on households' consumption. Correspondingly, G_{H1} has no effect on panel C.

However, in this section, we allow for the possibility that $\nu > 0$, i.e., that the marginal disutility is increasing in the quantity of output. The marginal disutility depends on how much labor is used in total, which is related to the total output of home goods. This output level is given by the term in the brackets, which sums over home goods consumed by households $C_{F1}\mathcal{E}_1$, those consumed by the government G_{H1}, and the quantity of exports of home-produced tradable goods Y_{XH}.[35]

With this functional form, some key qualitative results from sections 3.2 and 5.2 remain true. The households' home goods demand curve remains upward-sloping (albeit now concave), and it shifts in the same directions as before when there are changes in imports C_{F1} and productivity A_1. The new exponent $1 + \nu$ on the A_1 term has no qualitative effect.

The main difference relative to previous sections is that if $\nu > 0$, the boost to home output from an increase in G_{H1} is now visible on panel C. From equation (5a'), such an increase rotates the demand curve for home goods clockwise around its intersection with the horizontal axis. Because of this boost to home output, $\widetilde{Y}_{H1}$ is set to zero at a lower exchange rate $\mathcal{E}_1$. The economic argument is as follows. The increase in G_{H1} causes an increase in the marginal disutility of labor. As argued above, output should not be increased too much in such a case. To prevent output increasing too much, households' consumption of home goods should be reduced. To have a lower level of households' consumption of home goods alongside the same level of imports, it must be that imports are made cheaper. That change in relative price is achieved via an exchange rate appreciation.

As a corollary, notice that government spending on imports G_{F1} and on home goods G_{H1} may now have opposite effects on the exchange rate and home output gap. We combine equations (5a')

labor market, but not related to the desirability of the government spending itself. Readers need to judge that desirability depending on the specific context.

[35] As described in section 3.2, this export quantity is fixed under dominant currency pricing.

and (5b') to make the argument.

First, consider a floating exchange rate regime, where the optimal monetary policy is to set $\mathcal{E}_1$ such that $\widetilde{Y}_{H1} = 0$. Since an increase in G_{F1} reduces households' imports C_{F1} in panel A, it causes the home goods demand curve to rotate anticlockwise in panel C, which in turn generates an exchange rate depreciation. By contrast, an increase in G_{H1} causes the home goods demand curve to rotate clockwise if $\nu > 0$, which generates an exchange rate appreciation as explained above.

Next, consider a fixed exchange rate regime, where the exchange rate is fixed at $\mathcal{E}_1 = \overline{\mathcal{E}}$. In such a regime, an increase in G_{F1} causes the intersection of the home demand curve and the $\overline{\mathcal{E}}$ line to move to the left, i.e., it pushes $\widetilde{Y}_{H1}$ below zero. By contrast, an increase in G_{H1} causes the intersection to move to the right, i.e., it pushes $\widetilde{Y}_{H1}$ up. After a shock that causes a negative home output gap, an increase in G_{H1} can push the gap back towards zero.

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.
- The demand curve rotates clockwise if government spending on home goods increases and the economy faces labor supply constraints.
- For a fixed exchange rate regime, the home output gap depends on the level at which the exchange rate is fixed.

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

6'. Debt limit impact from depreciation.

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

$$\widetilde{Y}_{H1} = -T + (1 - \lambda) B_1 L \text{ if floating regime and binding external constraint.} \tag{6b'}$$

Equations (6a') and (6b') capture the financial friction of the external borrowing constraint. These equations are relevant in a country with a floating exchange rate regime where the external borrowing constraint does sometimes bind.

Relative to section 5.2, the amended equation (6a') now includes G_{F1}, the government spending on imports in period 1. Specifically, the term measuring the period-1 trade balance is amended to

$(X_1 - C_{F1} - G_{F1})$. This insertion makes the equation consistent with equation (1b') from panel A. A reduction in G_{F1} causes a reduction in external debt B_2 and thereby loosens the external borrowing constraint. Correspondingly, $\mathcal{E}_1^{\text{binding}}$ increases.

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.
- 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 the shape and position of the home demand curve are also altered in period 2. We do not plot $\widetilde{Y}_{H2}$ on the panel.

$$\widetilde{Y}_{H2} = \mathcal{E}_2 C_{F2} \left(\mathcal{E}_2 C_{F2} + G_{H2} + Y_{XH}\right)^{\nu} - \alpha_H A_2^{1+\nu}, \tag{5c'}$$

$$\text{where} \begin{cases} \widetilde{Y}_{H2} = 0 & \text{if floating regime} \\ \mathcal{E}_2 = \overline{\mathcal{E}} & \text{if fixed regime.} \end{cases}$$

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

For a sudden stop shock, the panel reveals that the tightness of the external borrowing constraint can be affected by the government spending on home goods. If $\nu > 0$, an increase in G_{H1} causes a clockwise rotation of the home goods demand curve in panel C. Correspondingly, the policymaker reduces $\mathcal{E}_1$, which in turn can loosen the external borrowing constraint in panel A.

Panel D. Policy Rate

"Monetary policy decision"

The amended panel D takes the same visual form as in figure 15, plotting the period-1 monetary policy rate i_1 against the exchange rate $\mathcal{E}_1$. But the addition of fiscal policy alters the position of the key relation on this panel if the FX market is shallow.

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') looks the same as in section 5.2. However, if the FX market is shallow, the modified UIP condition will now depend on the government spending on imports G_{F1}. Specifically, an increase in G_{F1} causes the modified UIP condition to shift to the right. The reason is that it increases the economy's total external debt, which in turn increases both the external financing rate I_1 and the premium adjustment factor μ_1 from panel A.

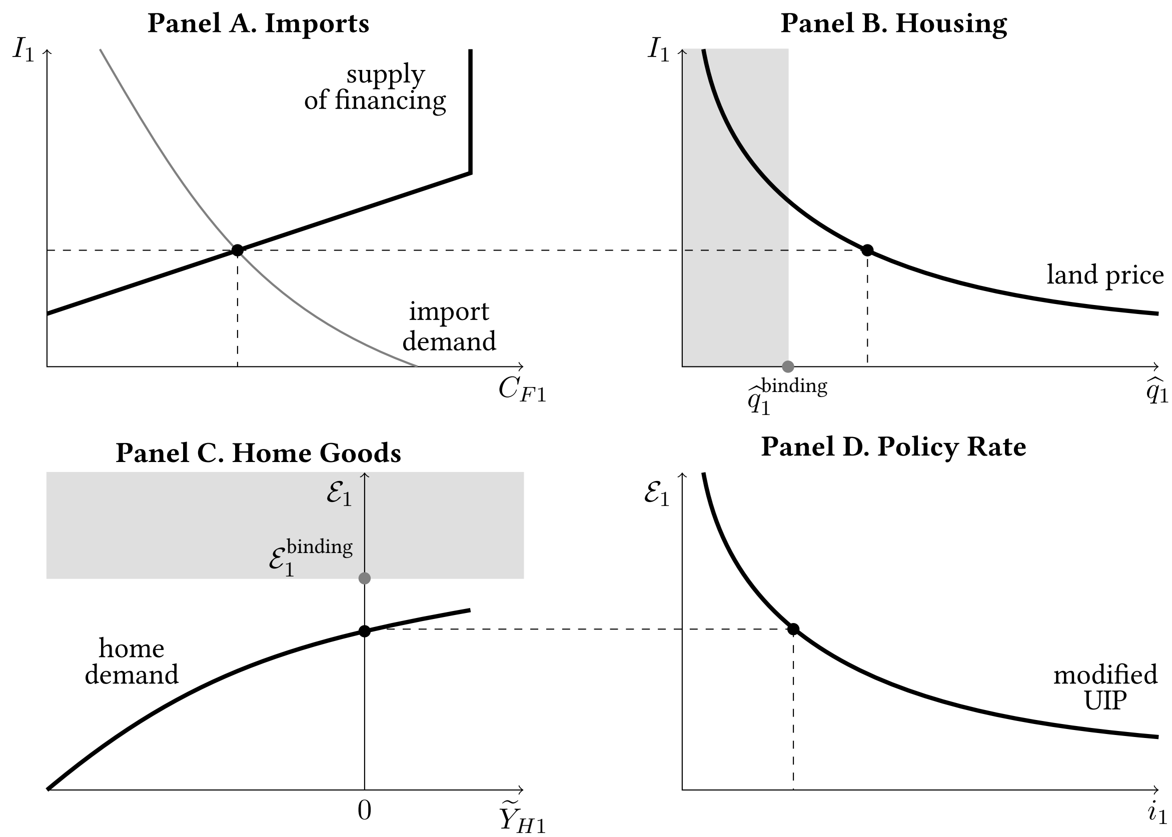
Summarizing the above discussion, we obtain the following take-aways:

- 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 total external debt, FX accumulation, or a non-fundamental capital outflow shock.

7.3 The Complete Diagram

Putting together all the elements described in this section, figure 27 shows the complete IPF diagram for a country with fiscal policy and 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 27: IPF Diagram With Fiscal Policy and All Financial Frictions



The associated system of equations is as follows:

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

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

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

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

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

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

$$\widehat{q}_1 = \frac{(1-\varphi_1)}{\mu_1\Delta}\frac{C_{F2} + G_{R2}}{I_1} \tag{3'}$$

$$\widehat{q}_1^{\text{binding}} = \widehat{q}_1^{\text{binding}} \left(\underset{(-)}{\kappa_q}, \underset{(+)}{B_1^{\text{housing}}}, \underset{(-)}{C_{F1} + G_{R1}}, \underset{(-)}{T_{GR}} \right) \tag{4'}$$

$$\widetilde{Y}_{H1} = C_{F1}\mathcal{E}_1 \left(C_{F1}\mathcal{E}_1 + G_{H1} + Y_{XH} \right)^{\nu} - \alpha_H A_1^{1+\nu}, \tag{5a'}$$

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

$$\widetilde{Y}_{H2} = \mathcal{E}_2 C_{F2} \left(\mathcal{E}_2 C_{F2} + G_{H2} + Y_{XH} \right)^{\nu} - \alpha_H A_2^{1+\nu}, \tag{5c'}$$

$$\text{where} \begin{cases} \widetilde{Y}_{H2} = 0 & \text{if floating regime} \\ \mathcal{E}_2 = \overline{\mathcal{E}} & \text{if fixed regime.} \end{cases}$$

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

$$\widetilde{Y}_{H1} = -T + (1-\lambda) B_1 L \text{ if floating regime and binding external constraint.} \tag{6b'}$$

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

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.

8 Policy Mixes With Fiscal Policy

In this section, we use the version of the IPF diagram with fiscal policy and financial frictions to illustrate some possible uses of government spending tools.

Our approach is as follows. For each of the shocks shown in figure 1, we pick as our starting point one of the diagrams already presented in sections 4 or 6. On top of the policy mix in that diagram, we add specific fiscal policy changes and show how they alter the normative trade-offs and thereby the final macroeconomic outcomes.

Of course, this approach implies that we plot only one combination of financial frictions and available policy tools for each shock. Readers should draw the IPF diagram differently for different countries and consider different policy mixes.

8.1 Commodity Price Shock

We consider a permanent adverse commodity price shock, i.e., we assume that $X_1 = X_2 = X$ and that there is a decrease in X. We return to the case of a country with a fixed exchange rate regime and no financial frictions, which was one of the cases considered in section 4.1. In particular, the FX market is deep and there are no domestic or external borrowing constraints.

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 $\beta I_1 = \beta(1 + i_1^*) = 1$. Third, we assume that in the absence of the shock, the country would have $G_{F1} = G_{F2} = G_F > 0$ and $G_{Ht} = G_{Rt} = 0$. 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: $C_{F1} = C_{F2} = X - G_F$. Fourth, we assume that $\nu > 0$, which makes the home demand curve concave on panel C. Finally, we assume that equation (2d') holds.[36]

Remark 14. Fiscal adjustments may be especially useful in a peg.

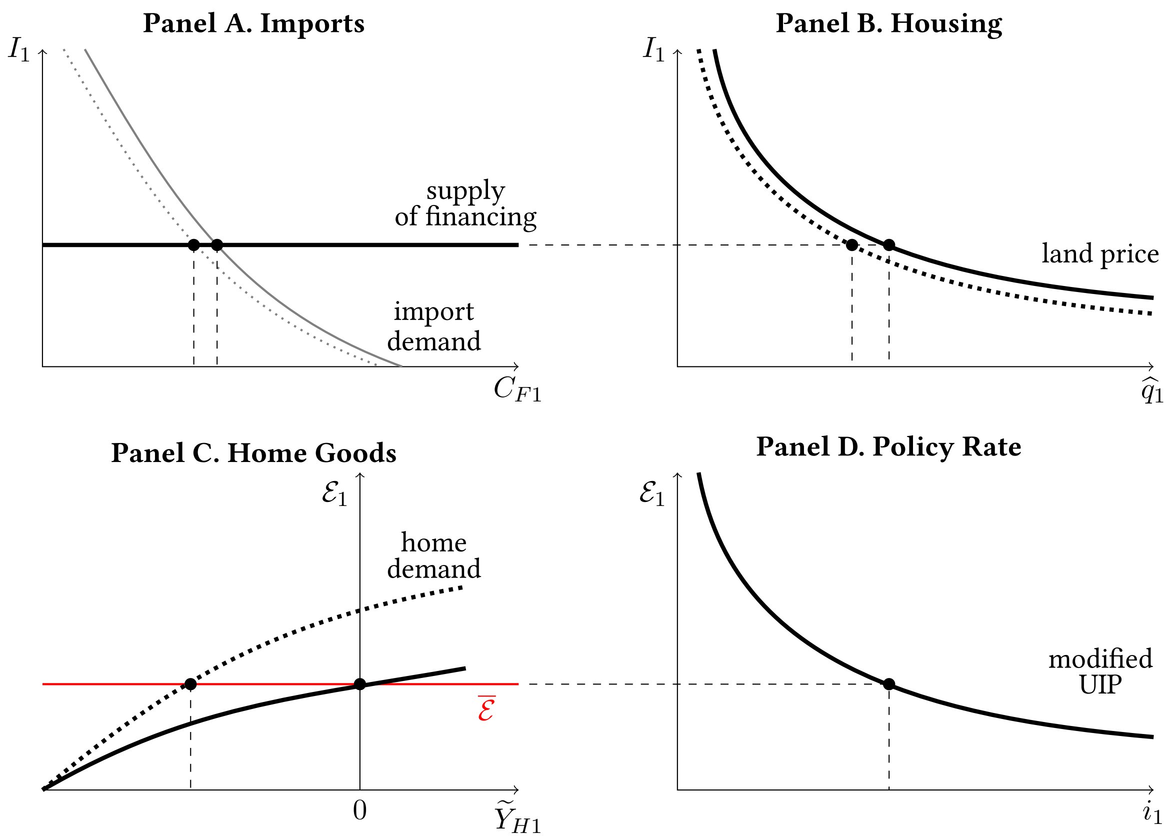
Figure 28 illustrates the shock on the IPF diagram. In all the panels, the dotted lines show the positions of the curves which result from the policy mix used in figure 9 of section 4.1. The solid lines show the positions after the following fiscal adjustments: first, the policymaker decreases the government spending on imports G_F; and second, they increase the government spending on home goods G_{Ht} until $\widetilde{Y}_{Ht} = 0$. The impact of these adjustments is as follows.

<u>Panel A.</u> Households' imports increase, while the external financing rate is unchanged.

- The supply curve is unchanged. *Equation (1a') is unaffected.*
- The demand curve shifts to the right because G_F decreases. *For this fixed regime, the use of G_{Ht} will ensure that $\widetilde{Y}_{Ht} = 0$ in panel C. Then equations (2a')-(2b') establish that $C_{F1} = (X - G_F)\frac{(1+I_1)}{(1+\beta)I_1}$, which means that the decrease in G_F shifts the demand curve to the right. At $I_1 = (1 + i_1^*) = \frac{1}{\beta}$, we derive $C_{F1} = C_{F2} = X - G_F$, so the rightward shift is equal to the decrease in G_F.*
- C_{F1} increases and I_1 is unchanged. *C_{F1} increases by the same amount as the decrease in G_F.*
- There is no need for an ex post capital inflow tax or household macroprudential tax. *Since $\widetilde{Y}_{Ht} = 0$, equations (2c')-(2d') yield $\mu_1 = 1$ and permit $\varphi_1 = \theta_{HH1} = 0$.*

[36] 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 28: Commodity Price Shock with Fixed Exchange Rate Regime and Fiscal Policy



Panel B. The land price increases.

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

Panel C. The home output gap is zero.

- The demand curve rotates clockwise because C_{F1} increases and G_{H1} increases. *The increase in C_{F1} from panel A and the increase in G_{H1} both enter equation (5a').*
- $\widetilde{Y}_{H1} = 0$ can be achieved while maintaining $\mathcal{E}_1 = \overline{\mathcal{E}}$. *Equations (5a')-(5b') establish this result. From equation (5c'), $\widetilde{Y}_{H2} = 0$ can also be achieved as a result of the increase in C_{F2} from panel A and an increase in G_{H2}. Setting $A_1 = A_2 = A$, the necessary government spending is as follows:*

$$G_{H1} = G_{H2} = G_H = \left(\frac{\alpha_H A^{1+\nu}}{\overline{\mathcal{E}}\,(X - G_F)}\right)^{\frac{1}{\nu}} - \overline{\mathcal{E}}\,(X - G_F) - Y_{XH}.$$

Panel D. The policy rate is unchanged.

- The modified UIP condition is unchanged. *Equation (7') incorporates the findings from panels A and C that $\varphi_1 = 0$, I_1 is unchanged, $\mu_1 = 1$, and $\mathcal{E}_2 = \overline{\mathcal{E}}$.*
- i_1 is unchanged. *In equation (7'), $\mathcal{E}_1$ is also fixed.*

Overall, while it may be difficult to make fiscal adjustments after all external shocks, such adjustments may be especially useful after a permanent adverse commodity price shock. For countries with both floating and fixed exchange rate regimes, a permanent decrease in the government spending on imports can help mitigate the decrease in the households' consumption of imports, while keeping both the trade balance and external debt in period 1 at zero. For countries with a fixed exchange rate regime, an increase in the government spending on home goods can be a useful additional tool to help stabilize the home output gap. Readers should weigh these benefits against any costs of fiscal adjustment that are beyond the scope of the diagram.

8.2 U.S. Monetary Tightening

We consider the effect of an increase in the dollar interest rate i_1^*. We again return to the case of a country with a fixed exchange rate regime and no financial frictions, which was one of the cases considered in section 4.2. In particular, the FX market is deep and there are no domestic or external borrowing constraints. We assume that the starting point of the economy is the same as in section 8.1, except the following changes: $G_F = 0$ and $G_{H1} = G_{H2} = G_H > 0$.

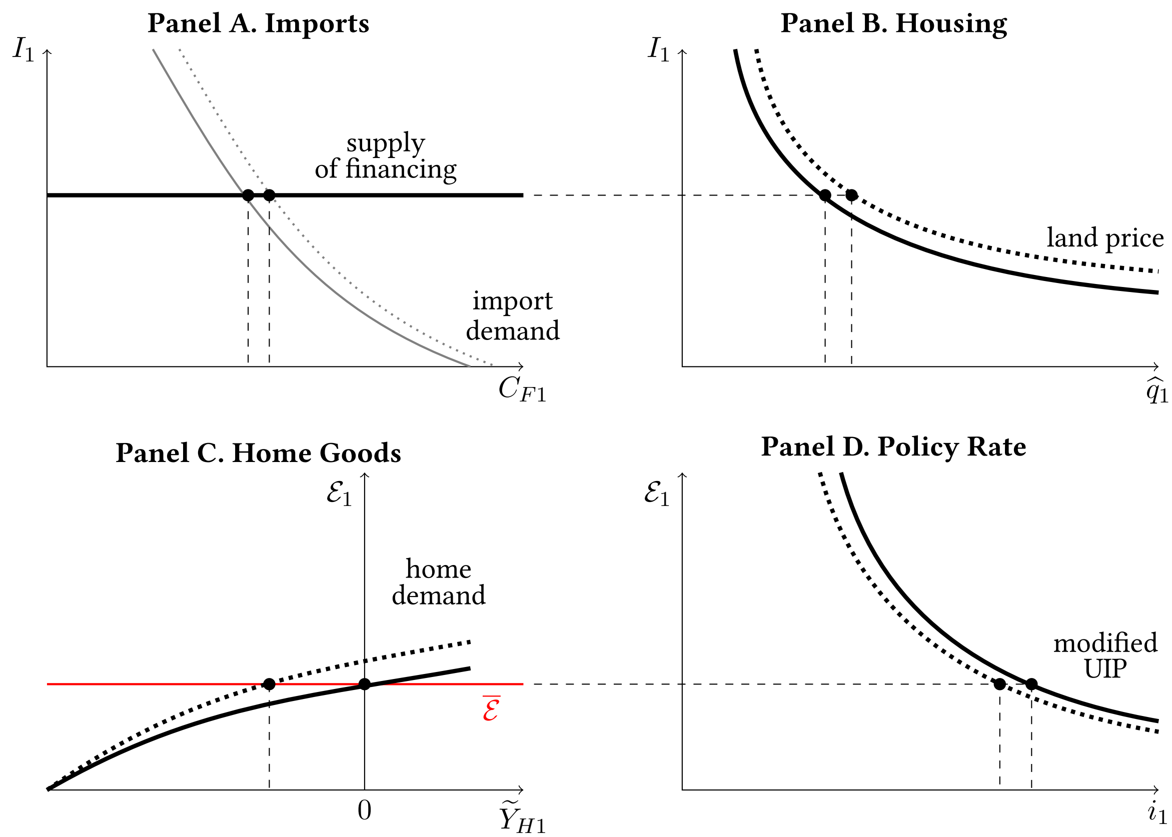
Remark 15. Speedy fiscal adjustments can replace ex post capital controls in a peg.

Figure 29 illustrates the shock on the IPF diagram. In all the panels, the dotted lines show the positions of the curves which result from the policy mix used in figure 11 of section 4.2. The solid lines show the positions after the following fiscal adjustment: the policymaker sets the government spending on home goods G_{Ht} such that $\widetilde{Y}_{Ht} = 0$ in periods 1 and 2. The impact of this adjustment is as follows.

Panel A. Households' period-1 imports decrease and the external financing rate increases by the same amount as in the floating regime case.

- The supply curve is not changed by the fiscal adjustment. *Equation (1a') indicates that the curve remains at the same post-shock position shown in figure 11.*
- The demand curve shifts to the left, to its position in figure 10. *For this fixed regime, the use of G_{Ht} will ensure that $\widetilde{Y}_{Ht} = 0$ in panel C. 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 29: U.S. Monetary Tightening with Fixed Exchange Rate Regime and Fiscal Policy



- C_{F1} decreases by more because of the fiscal adjustment, while I_1 is not changed by it. *C_{F1} decreases and C_{F2} increases by the same amount as in figure 10, i.e., by more than in figure 11.*
- There is no need for an ex post capital inflow tax or household macroprudential tax. *Since $\widetilde{Y}_{Ht} = 0$, equations (2c')-(2d') yield $\mu_1 = 1$ and permit $\varphi_1 = \theta_{HH1} = 0$.*

Panel B. The land price decreases by the same amount as in the floating regime case.

- I_1 is not changed by the fiscal adjustment.
- The land price curve shifts to the left, to its position in figure 10. *Equation (3) incorporates the change in C_{F2} and $\varphi_1 = 0$ from panel A. The post-shock land price follows $\widehat{q}_1 = X\frac{\beta(1+I_1)}{(1+\beta)I_1}$.*
- $\widehat{q}_1$ decreases by more because of the fiscal adjustment.

Panel C. The home output gap is zero.

- The demand curve rotates clockwise because the increase in G_{H1} counters the impact of the decrease in C_{F1}. *Equation (5a') indicates that the larger decrease in C_{F1} from panel A tends to cause the curve to rotate anticlockwise by more, so the increase in G_{H1} must be large enough to ensure that the curve rotates clockwise in the end.*

- $\widetilde{Y}_{H1} = 0$ can be achieved while maintaining $\mathcal{E}_1 = \overline{\mathcal{E}}$. *Equations (5a')-(5b') establish this result. From equation (5c'),* $\widetilde{Y}_{H2} = 0$ *can also be achieved because the policymaker can decrease* G_{H2} *to more than offset the impact of the larger increase in* C_{F2} *from panel A. Setting* $A_1 = A_2 = A$, *the needed government spending is as follows:*

$$G_{Ht} = \left(\frac{\alpha_H A^{1+\nu}}{\overline{\mathcal{E}} C_{Ft}}\right)^{\frac{1}{\nu}} - \overline{\mathcal{E}} C_{Ft} - Y_{XH},$$

  which means that $G_{H1} > G_{H2}$.

Panel D. The policy rate increases until it is equal to i_1^*.

- The modified UIP condition shifts to the right because there is no more ex post capital inflow subsidy. *Equation (7') incorporates the findings from panels A and C that* $\varphi_1 = 0$, $I_1 = (1 + i_1^*)$, $\mu_1 = 1$, *and* $\mathcal{E}_2 = \overline{\mathcal{E}}$.
- i_1 increases to i_1^*. *In equation (7'),* $\mathcal{E}_1$ *is also fixed.*

For this fundamental shock, the addition of fiscal policy may make capital controls unnecessary. In section 4.2, we showed that for a country with a fixed exchange rate regime and no financial frictions, there may be a case for the ex post use of a capital inflow tax to cushion the home output gap, although the gap remains non-zero at the final allocation. Figure 29 shows that if fiscal policy can be adjusted quickly enough, the case for such capital controls can be eliminated and the home output gap can be set to zero.

It is unlikely that new fiscal legislation can be passed as quickly as changes in U.S. monetary policy are undertaken. Nevertheless, the above diagram offers two insights. First, automatic fiscal stabilizers that adjust the government spending on home goods to cushion the home output gap may be useful to manage this shock if the policymaker wishes to avoid capital controls. Second, if a U.S. monetary tightening is persistent enough, there may be enough time for the policymaker to stabilize home output by legislating additional changes in the government spending of home goods along the lines of what is shown in the diagram. Both of these insights are subject to the caveat that the costs of frequent fiscal policy adjustments are not in the diagram, and they may be large.

8.3 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 becomes binding because of the shock.

We make the following assumptions. First, we assume that the country has constant export income, i.e., $X_1 = X_2 = X$, and 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 $\beta I_1 = 1$. Third, we assume that in the absence of the shock, the country would have $G_{F1} = G_{F2} = G_F > 0$ and $G_{Ht} = G_{Rt} = 0$. 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: $C_{F1} = C_{F2} = X - G_F$. Fourth, we assume that $\nu > 0$, which makes the home demand curve concave on panel C. Finally, we assume that equation (2d') holds.

Remark 16. Ex post policy tools can make fiscal adjustments unnecessary.

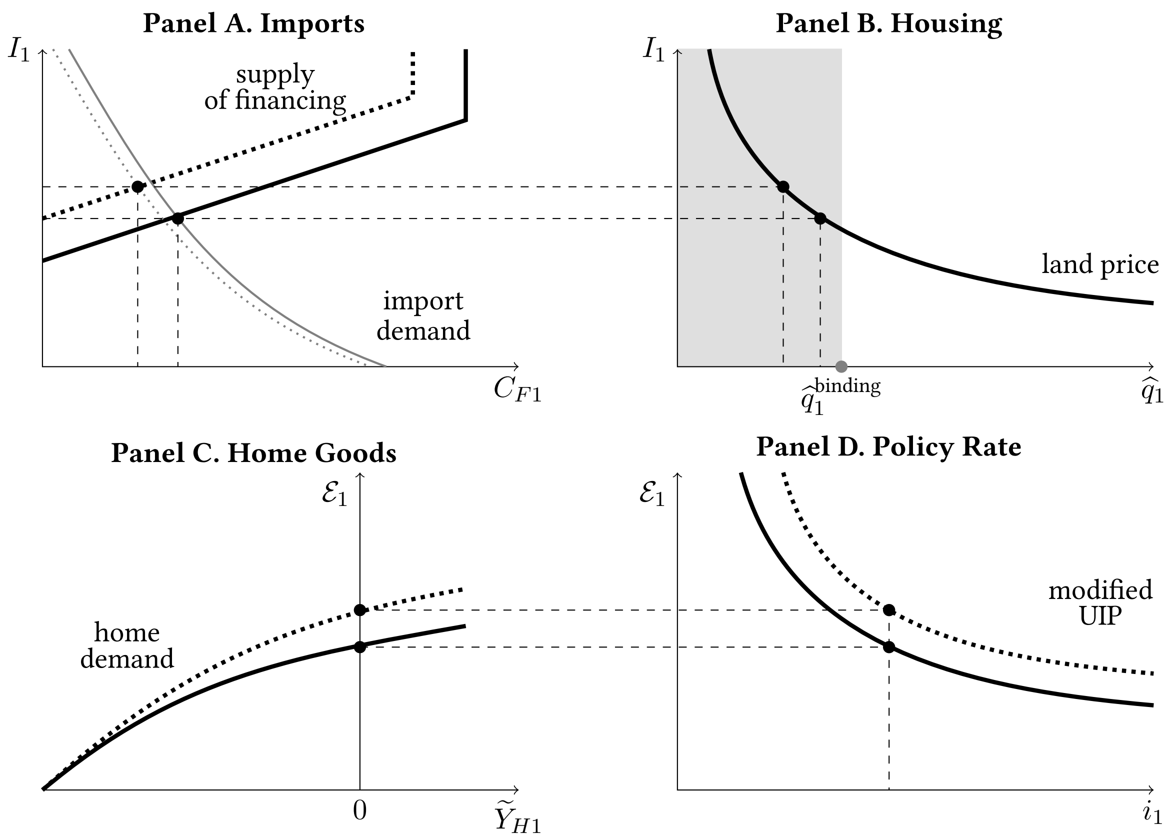
Since this shock is non-fundamental rather than fundamental, the benefit of adding fiscal policy to the policy mix may be low. Figure 23 of section 6.3 shows that the ex post use of FX intervention and/or capital controls can already help stabilize imports, cut the transmission of global financing conditions to domestic borrowing constraints, and reduce the need to alter monetary policy and the exchange rate. With macroeconomic stabilization already achieved through the use of these tools, there may be little need to alter fiscal policy. Basu et al. (2024) provide the proof of this result.

Remark 17. A fiscal contraction may be useful if the additional tools are unavailable.

Next, consider a country in which FX intervention and capital controls are not available, so the economy remains destabilized after the shock as in figure 21 of section 6.3. If so, an imperfect (and likely costly) macroeconomic stabilization can be achieved via a fiscal back-loading, which decreases the period-1 government spending on imports G_{F1} and increases the period-2 spending G_{F2} without altering the net present value $G_{F1} + \frac{G_{F2}}{I_1}$.

Figure 30 illustrates the shock on the IPF diagram. In all the panels, the dotted lines show the positions of the curves which result from the policy mix used in figure 21. The solid lines show the positions after the fiscal adjustment described above.

Figure 30: Taper Tantrum; Standard Policy Tools and Fiscal Policy



Panel A. Households' period-1 imports increase and the external financing rate decreases.

- The fiscal adjustment shifts the upward-sloping part of the supply curve down and to the right. *Equation (1a') indicates that relative to panel A in figure 21, the supply curve shifts to the right by the decrease in G_{F1}. Equation (1b*) indicates that the kink moves even more to the right because of the additional impact of the decrease in $\mathcal{E}_1$ from panel C, but the kink does not affect the outcome of the panel.*
- This change increases C_{F1} and decreases I_1. *Before any fiscal adjustment is undertaken, the shock causes $B_2 = C_{F1} + G_{F1} - X < 0$ and $B_2 - S_1 > 0$. The fiscal back-loading decreases B_2. We assume that the back-loading is limited and does not alter the sign of these inequalities. The adjustment decreases C_{F2}.*
- The fiscal adjustment has a beneficial side-effect: it shifts the demand curve to the right, which further increases C_{F1}. *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'), so the decrease in B_2 shifts the demand curve to the right.*
- 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') establishes that a subsidy, i.e., $\varphi_1 < 0$ and/or $\theta_{HH1} < 0$, would be appropriate:*

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

Since these tools are not available, the demand curve remains to the left of where it should be.

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 fiscal adjustment decreases I_1, which in turn causes an increase in $\widehat{q}_1$ for a given land price curve.
- The shift in the land price curve is ambiguous, and $\widehat{q}_1$ may indeed increase because of the fiscal adjustment. *In equation (3'), C_{F2} and μ_1 both decrease from panel A. We plot a country where the land price curve is unchanged and $\widehat{q}_1$ increases.*
- The fiscal adjustment shifts the gray zone to the left. *Equation (4') indicates that $\widehat{q}_1^{\text{binding}}$ decreases because C_{F1} increases in panel A.*
- Ex post, the domestic borrowing constraint is less severe. *We plot a country where the economy remains in the gray zone.*
- The case for ex ante macroprudential measures on the housing sector is decreased when ex post fiscal adjustment is available to handle premium spikes.

Panel C. The exchange rate appreciates and the home output gap remains at zero.

- The demand curve rotates clockwise because the fiscal adjustment increases C_{F1}. *The increase in C_{F1} from panel A enters equation (5a').*
- $\mathcal{E}_1$ appreciates to set $\widetilde{Y}_{H1} = 0$. *Equations (5a')-(5b') establish this result. From equation (5c'), $\mathcal{E}_2$ depreciates because of the fiscal adjustment.*
- 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 change in the policy rate is ambiguous.

- The shift in the modified UIP condition is ambiguous because the external premium decreases but $\mathcal{E}_2$ increases. *In equation (7'), the decreases in I_1 and μ_1 from panel A shift the condition to the left while the increase in $\mathcal{E}_2$ from panel C shifts the condition to the right.*

- i_1 may increase or decrease. *Equations (5a')-(5c') are combined with equation (7') and the households' Euler condition. We plot a country where the policy rate does not change.*

Combining the two remarks above, we derive the following insights. First, if the ex post use of FX intervention and/or capital controls is possible, fiscal policy appears to offer little additional benefit in addressing the non-fundamental outflow shock. This result is fortunate: premium spikes are small-to-moderate shocks which strike relatively frequently, so addressing them via fiscal policy would require frequent adjustments which are likely both unrealistic and costly in ways that are not captured in the diagram. Second, if the shock is large and persistent enough for there to be time for a fiscal response, and if FX intervention and capital controls are not available, back-loading government spending on imports may become necessary. Unfortunately, the fiscal adjustment does not earn carry profits as an FX intervention would.

8.4 Sudden Stop Shock

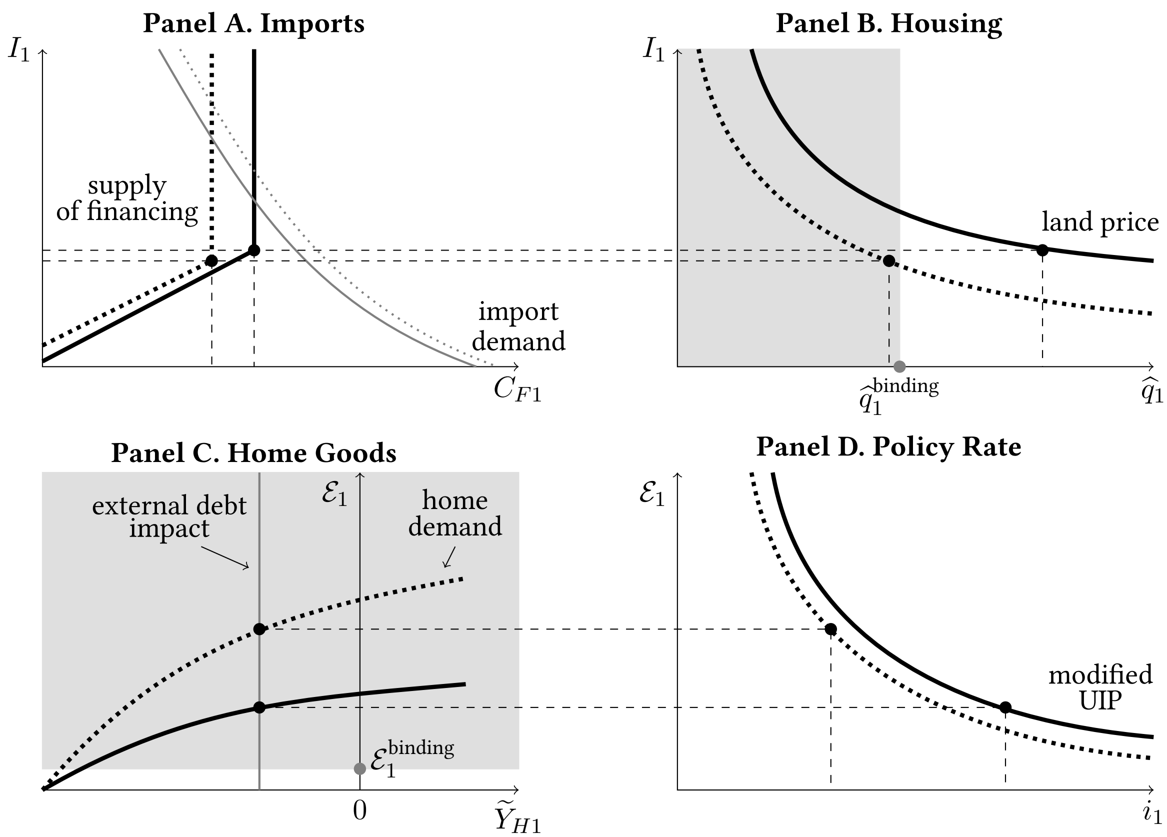
We consider the effect of a sudden stop shock, i.e., a decrease in the external pledgability of domestic collateral κ_H that in turn causes the external borrowing constraint to bind in panels A and C. We consider a country with a floating exchange rate regime. It has shallow FX markets and some of the external debt is in local currency, i.e., $(1-\lambda)\,\Gamma > 0$. We assume that external debt is mostly dollar-denominated, i.e., λ is near 1. 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 $\beta\,[I_1 + (1-\lambda)\,\Gamma B_2] = 1$. Third, we assume that in the absence of the shock, the country would have $G_{F1} = G_{F2} = G_F > 0$ and $G_{Ht} = G_{Rt} = 0$. 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: $C_{F1} = C_{F2} = X - G_F - Z_1\frac{I_1}{1+I_1}$. Finally, we assume that $\nu > 0$, which makes the home demand curve concave on panel C.

Remark 18. Fiscal policy can mitigate the severity of the sudden stop.

Figure 31 illustrates the shock on the IPF diagram. In all the panels, the dotted lines show the positions of the curves which result from the policy mix used in figure 24 of section 6.4. The solid lines show the positions after the following fiscal adjustments: first, the policymaker decreases the period-1

Figure 31: Sudden Stop Shock with Floating Exchange Rate Regime and Fiscal Policy



government spending on imports G_{F1}; second, they provide period-1 lump-sum transfers to the housing sector, $T_{R1} > 0$, and set a positive government spending on housing services in period 2, $G_{R2} > 0$; and third, they set a positive period-1 government spending on home goods $G_{H1} > 0$. The impact of these adjustments is as follows.

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

- The decrease in G_{F1} causes both the upward-sloping part of the supply curve and its kink to shift to the right. *Equations (1a')-(1b') indicate that the shift is equal to the magnitude of the decrease in G_{F1}.*
- The appreciation of $\mathcal{E}_1$ causes a small leftward shift in the upward-sloping part of the supply curve but a further rightward movement in the kink. *The decrease in $\mathcal{E}_1$ from panel C increases 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 right.*
- C_{F1} and I_1 both increase while C_{F2} decreases. *C_{F2} is determined by equation (2b').*

- The demand curve shifts to the left but does not determine outcomes. *We continue to set* $\varphi_1 = \theta_{HH1} = 0$.

Panel B. If the domestic borrowing constraint is no longer binding ex post, there is no case for 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, we assume that the decrease in Δ and increase in G_{R2} are so large that the curve shifts substantially to the right and $\widehat{q}_1$ increases. *In equation (3'), the decrease in* C_{F2} *and increase in* μ_1 *from panel A shift the curve to the left, but the decrease in* Δ *and increase in* G_{R2} *shift the curve to the right. We assume that the policymaker ensures that the latter impact dominates.*
- Ex post, the domestic borrowing constraint may no longer be binding because $\widehat{q}_1$, C_{F1}, and T_{GR} all increase. *Alongside the increase in* $\widehat{q}_1$ *above, equation (4') indicates that* $\widehat{q}_1^{\text{binding}}$ *decreases because* C_{F1} *increases in panel A and the policymaker sets* $T_{GR} > 0$.
- There may be no case for ex ante macroprudential measures on the housing sector. *The reason is that we assume that the economy is no longer in the gray zone ex post. In practice, how much the case for ex ante tools decreases depends on whether the housing sector increases* B_1^{housing} *ex ante in anticipation of the ex post government support for the sector.*

Panel C. The exchange rate appreciates and the home output gap is still negative.

- The demand curve rotates clockwise because C_{F1} increases and G_{H1} increases. *The increase in* C_{F1} *from panel A and the increase in* G_{H1} *both enter equation (5a').*
- $\mathcal{E}_1$ appreciates but $\widetilde{Y}_{H1} < 0$ remains. *Equation (6b') remains on the panel because we assume that the economy remains in the gray zone. Correspondingly,* $\widetilde{Y}_{H1}$ *does not change. The motivation for increasing* G_{H1} *is to appreciate the exchange rate in panel C such that the external borrowing constraint (1b') is relaxed in panel A. From equation (5c'),* $\mathcal{E}_2$ *depreciates because* C_{F2} *decreases in panel A.*
- Ex post, the gray zone shifts down because the trade balance worsens. *Because of the decrease in* $\mathcal{E}_1$*, equation (1b') indicates that the increase in* C_{F1} *exceeds the decrease in* G_{F1} *from panel A. As a result, it causes the value of* $\mathcal{E}_1^{\text{binding}}$ *to decrease in equation (6a').*
- Ex ante restrictions on capital inflows remain welfare-improving. *However, ex post fiscal policy now shares the burden in terms of mitigating the impact of the external borrowing constraint.*

<u>Panel D.</u> The policy rate increases.

- The modified UIP condition shifts to the right. *Equation (7') incorporates the increases in* I_1 *and* μ_1 *from panel A and the increase in* $\mathcal{E}_2$ *from panel C.*
- i_1 increases further because of the decrease in $\mathcal{E}_1$.

Overall, we have illustrated how a mix of ex post fiscal adjustments can mitigate some of the consequences of sudden stops. A full-blown sudden stop occurs relatively rarely, and it is typically severe enough such that fiscal policy is actively considered as part of the policy mix. Correspondingly, some of the fiscal adjustments illustrated in the diagram may be relevant in practice. The IPF diagram cannot prove the optimal mix of ex ante and ex post fiscal policy during a sudden stop. That task is undertaken in Basu et al. (2024).

8.5 Differences from the IS-LM Diagram

The (occasional) inclusion of fiscal policy in an amended IPF diagram enables readers to clarify and then go beyond some traditional results on fiscal policy from the IS-LM model. We focus on two topics in this section: first, the positive impact of fiscal policy; and second, how fiscal policy compares to additional tools like capital controls and FX intervention.

Our first key observation is that the IS-LM diagram includes one kind of government spending tool while the IPF diagram includes three such tools with different positive impacts.

In the IPF diagram, an increase in the government spending on home goods has a similar impact to that of a traditional fiscal expansion in the IS-LM diagram. Both are directed towards home output and tend to increase it. After that, the macroeconomic impact depends on the monetary policy assumption. In IS-LM diagrams with an upward-sloping LM curve, the fixed money supply in the money market means that for market clearing to be maintained, an expansion in home output must cause an increase in the interest rate. The associated exchange rate appreciation chokes off some or all of that increase in output.[37] In the IPF diagram, money supply is not fixed, which means that many policy rates and post-shock outcomes are feasible. If there are labor supply constraints, the home output expansion is regarded as undesirably large by the policymaker, who then increases the policy rate to mitigate some but not all of that increase in output.

However, not all government spending is on home goods in practice. Recognizing the heterogeneity of fiscal tools, the IPF diagram additionally allows for government spending on imports and support for the housing sector.

[37] The magnitude of the home output contraction caused by the exchange rate appreciation is larger if the fiscal expansion is more persistent. If the fiscal expansion is permanent, it causes an appreciation and no change in home output.

An increase in the government spending on imports tends to cause a depreciation in the IPF diagram, i.e., the exchange rate moves in the opposite direction to the one in the IS-LM diagram. The reason is that the import revenues accrue to foreign firms rather than domestic firms. Correspondingly, using lump sum taxes on domestic households to finance the government spending on imports causes a reduction in the income available for those households to purchase imports of their own. If households' imports decrease, a depreciation is needed to stabilize home output.

By contrast, the government support for the housing sector stimulates domestic asset prices, but since it does not alter the output of home-produced tradable goods, it does not affect the exchange rate.

Our second key observation is that the IPF diagram goes beyond the the IS-LM diagram by allowing readers to consider the relative roles of fiscal policy and additional tools like capital controls and FX intervention.

The IPF diagram illustrates that for countries with fixed exchange rate regimes, the benefit of using capital controls after shocks may be tied to the availability of fiscal policy. If fiscal policy is perfectly flexible and sets all home output gaps to zero, capital controls may not be useful. If fiscal policy is not available, the IPF diagram agrees with the IS-LM diagram that home output is destabilized after shocks. However, removing fiscal policy does not necessarily make an ex post capital inflow tax useful. Such a tax redistributes aggregate demand between periods. Accordingly, the tax is useful only if the home output gap is temporarily destabilized in this period relative to future periods, as in the case of the U.S. monetary tightening shock. The tax is not useful if home output gaps are expected to be equally negative for all future periods, as in the case of the commodity price shock.

For countries with financial frictions, the IPF diagram allows readers to experiment with adding fiscal policy to different combinations of all the other policy tools. For the non-fundamental outflow shock, it appears unrealistic to expect fiscal policy to respond quickly enough to address the shock. Moreover, ex post capital controls and FX intervention may be able to target the source of the macroeconomic destabilization more directly. For the sudden stop shock, it appears that ex post fiscal policy can in practice help address some of the symptoms of the shock. Ex ante capital inflow regulations may also retain a role in reducing the FX mismatches which are the root cause of the economy's vulnerability to the shock.

9 Connecting Different Literatures

Since the IPF diagram 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).[38] 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).

The diagram 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 diagram sheds light on a growing literature regarding whether countries can retain monetary and financial 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,

[38] 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.

and financial 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).

The diagram 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, the diagram 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, the diagram 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 expansion 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. The IPF diagram 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.

10 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 IPF diagram 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.

The IPF diagram is kept as simple as possible, but no simpler. The reason is that for the IPF diagram to be useful in policymaking, it has to overcome the shortcomings of the existing Mundell-Fleming approach. Specifically, we have designed the diagram 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 diagram balances the need for visual tractability on the one hand, and the growing sophistication of EMDE policy frameworks on the other.

We have used the IPF diagram 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 IPF 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.

11 References

[1] Basu, Suman S., Emine Boz, Gita Gopinath, Francisco Roch, and Filiz Unsal, 2023, "Integrated Monetary and Financial Policies for Small Open Economies," IMF Working Paper No. 23/161.

[2] Basu, Suman S., Emine Boz, Gita Gopinath, Francisco Roch, and Filiz Unsal, 2024, "Fiscal Policy in an Integrated Policy Mix for Small Open Economies," mimeo.

[3] 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.

[4] 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.

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

[6] 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.

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

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

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

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

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

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

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

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

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

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

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

[18] 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.

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

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

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

[22] 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.

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

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

[25] 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.

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

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

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

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

[30] 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.

[31] 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.

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

[33] 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.

[34] 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.

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

[36] 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.

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

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

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

A APPENDIX

A.1 Relation of IPF Diagram to Basu et al. (2023)

In this section, we provide the technical details and approximations needed to derive the IPF diagram panels A-D in section 5 (of which section 3 is a special case) from the system of equations in Basu et al. (2023). In that paper, the maximization problem for the constrained efficient allocation is given by equations (1)-(7) and the first order conditions (FOCs) are given by equations (8)-(18).

Panel A. Imports

Equations (1a*)-(1b*) come from the external financing part of Basu et al. (2023). We obtain equation (1a*) by combining the Gamma equation (5) from Basu et al. (2023) with the definition $I_t = \lambda\left(1+i_t^*\right)+\left(1-\lambda\right)\eta_{t+1}$. We set $FXI_0 = 0$ because in the IPF diagram, we are interested in FX intervention between periods 1 and 2, but not between periods 0 and 1. In the expression for B_2, we augment the term C^* (which represents the income from the exports of produced tradable goods in each period) to obtain the term X_1 (which represents the combined income from the exports of produced tradable goods and commodities in period 1).

Rearranging the algebra yields the following expression for the period-1 external debt repayments Z_1:

$$Z_1 = B_1\left[\lambda\left(1+i_0^*\right)+\left(1-\lambda\right)\eta_1\right] \text{ with } \eta_1 \equiv \left(1-\varphi_0\right)\left(1+i_0\right)\frac{\mathcal{E}_0}{\mathcal{E}_1},$$

where φ_t is the capital inflow tax between periods t and $t+1$, i_t is the monetary policy rate between periods t and $t+1$, and η_{t+1} is the gross return (expressed in dollar value) on external local currency debt between periods t and $t+1$. The above expression indicates that Z_1 is increasing in B_1 and $\frac{1-\lambda}{\mathcal{E}_1}$. Correspondingly, we impose the reduced-form approximation for Z_1 in equation (1b*).

We obtain equation (1b*) by taking a reduced-form generalization of equation (3) in Basu et al. (2023). Specifically, we allow the functional form of the external debt limit to deviate from the one shown in equation (3) from that paper, but we maintain the assumption that the external debt limit is increasing in κ_H and decreasing in $\mathcal{E}_1$.

Equations (2a*)-(2d*) come from the import consumption FOCs and external budget constraint in Basu et al. (2023). The relevant FOCs are contained in equation (12) from that paper. We obtain equation (2a*) by dividing the FOC for $t=2$ by the one for $t=1$, combining the result with equation (10) from that paper, normalizing the consumption shares of home goods and imports $\alpha_H = \alpha_F = \frac{1}{3}$, and imposing the special case when the domestic and external borrowing constraints are not binding. We define:

$$\widetilde{Y}_{Ht} = -\alpha_H A_t \tau_{Ht} \text{ with } \tau_{Ht} \equiv \left(1-\frac{1}{A_1}\frac{C_{H1}}{\alpha_H}\right),$$

where τ_{Ht} is the aggregate demand wedge in period t. Although equation (2a*) is derived assuming that the domestic borrowing constraint does not bind, for the IPF diagram we assume as an approximation that it holds even if that constraint does bind. By contrast, if the external borrowing constraint becomes binding, the period-1 import consumption C_{F1} is determined by the kink of equation (1b*) and not by the Euler condition (2a*).

Rearranging the external budget constraint (2) from Basu et al. (2023) and substituting the expression for Z_1 from above, we obtain:

$$C_{F2} = C^* + \left(C^* - C_{F1} - Z_1\right)I_1 - FXI_1\left(1-\lambda\right)\left[\eta_2 - \left(1+i_1^*\right)\right].$$

The last term in the above expression represents the profit or loss from FX intervention. Replacing η_2 in that term by using the Gamma equation (5) from Basu et al. (2023), and replacing C^* with X_t (i.e., augmenting the export revenues with the income from commodities in periods 1 and 2), we obtain equation (2b*).

We obtain equation (2c*) by defining $\mu_1 \equiv \frac{\eta_2}{I_1}$ and combining the Gamma equation (5) and the definition of I_t from Basu et al. (2023).

We obtain equation (2d*) by combining equations (10), (12), and (33) from Basu et al. (2023), imposing the special case when the domestic and external borrowing constraints are not binding. Although equation (2d*) is derived assuming that the domestic borrowing constraint does not bind, for the IPF diagram we assume as an approximation that it holds even if that constraint does bind. By contrast, if the external borrowing constraint binds, equation (2d*) is no longer applicable because households borrow at a separate borrowing interest rate above the policy rate. In that case, we set $\varphi_1 = \theta_{HH1} = 0$.

The result $\tau_{H2} = 0$ in equation (8) of Basu et al. (2023) is true only in a floating exchange rate regime. It implies that $\widetilde{Y}_{H2} = 0$. Our IPF diagram applies to countries with either floating or fixed exchange rate regimes, so it deviates from that paper and allows for $\widetilde{Y}_{H2} \neq 0$.

Panel B. Housing

Equations (3*)-(4*) come from the domestic credit market part of Basu et al. (2023). We obtain equation (3*) by combining the equation $\widehat{q}_1 = \frac{C_{F2}}{\chi_2}$ with the definitions $\eta_2 \equiv (1-\varphi_1)(1+i_1)\frac{\mathcal{E}_1}{\mathcal{E}_2}$, $\chi_2 \equiv (1+\rho_1)\frac{\mathcal{E}_1}{\mathcal{E}_2}$, and $\Delta \equiv \frac{(1+\rho_1)}{(1+i_1)}$, where χ_2 is the dollar value of the domestic financing rate between periods 1 and 2, and ρ_1 is the domestic borrowing interest rate between those periods.

We obtain threshold (4*) from the domestic borrowing constraint (6) in Basu et al. (2023). For the IPF diagram, we evaluate that equation assuming that the constraint does not bind, i.e., we set $k_0^{Linear} = k_1^{Linear} = 1$. Normalizing the consumption share of housing $\alpha_R = \frac{1}{3}$, we can derive that the dollar value of the housing rent in period t is equal to C_{Ft}. For the diagram, we relabel B_{R1}^{Linear} as B_1^{housing} to obtain:

$$\chi_1 B_1^{\text{housing}} - C_{F1} \leq \kappa_q \widehat{q}_1.$$

From this expression, we can derive the threshold for $\widehat{q}_1^{\text{binding}}$ as follows:

$$\widehat{q}_1^{\text{binding}} = \frac{\chi_1 B_1^{\text{housing}} - C_{F1}}{\kappa_q}.$$

This threshold is decreasing in κ_q, increasing in B_1^{housing}, and decreasing in C_{F1}. For the IPF diagram, we allow the functional form of the domestic borrowing constraint to deviate from the one in equation (6) from Basu et al. (2023), but we assume that the comparative statics of $\widehat{q}_1^{\text{binding}}$ with respect to κ_q, B_1^{housing}, and C_{F1} are preserved. Correspondingly, we obtain the reduced-form approximation (4*).

The threshold $\widehat{q}_1^{\text{binding}}$ above is calculated assuming that the domestic borrowing constraint does not bind. If it does bind, we nevertheless assume as an approximation for the IPF diagram that the comparative statics of the threshold are preserved. Moreover, if the constraint binds, we highlight a role for ex ante debt taxes on the housing sector by drawing on the discussion of equations (17)-(18) in Basu et al. (2023).

Panel C. Home Goods

Equations (5a*)-(5c*) and (6b*) come from the home consumption part of Basu et al. (2023). From that paper, the consumption of home goods and imports are related as follows in all periods: $C_{Ht} = C_{Ft}\mathcal{E}_t$, where we have normalized the consumption shares $\alpha_H = \alpha_F = \frac{1}{3}$ and the home goods price $P_H = 1$. The latter normalization is always valid for a floating exchange rate regime; it is also valid for a fixed exchange rate regime provided that the peg is selected optimally in period 0, which we assume to be true. Using the definition of the home output gap $\widetilde{Y}_{Ht}$ above, we obtain:

$$\widetilde{Y}_{Ht} = C_{Ft}\mathcal{E}_t - \alpha_H A_t.$$

For a country with a floating exchange rate regime, the next step is to use the FOCs for the exchange rate decision, represented by equations (8) and (9) from Basu et al. (2023). Setting $FXI_0 = 0$ in that equation and imposing that the domestic borrowing constraint does not bind, we obtain:

$$\widetilde{Y}_{H1} = -T + (1-\lambda) B_1 L \text{ and } \widetilde{Y}_{H2} = 0$$

$$\text{with } T = \frac{\Psi_B \kappa_H A_1}{\beta I_0 \mathcal{E}_1} \text{ and } L = A_1 \eta_1 \left[z_1 - \frac{\mathbb{E}_0 [z_1 \eta_1]}{\mathbb{E}_0 \eta_1} \right],$$

where Ψ_B is the multiplier on the external borrowing constraint and z_1 is the marginal value of a dollar. T is positive if the external borrowing constraint is binding. L is positive if there is a negative shock to the dollar wealth of the country which drives up z_1 relative to the case in which there is no such shock. If $(1-\lambda)\,B_1 L$ is positive, there is an incentive to depreciate away the dollar value of local currency debt repayments after the negative shock.

For the IPF diagram, we make the following approximations. When the external borrowing constraint is not binding, we assume that the monetary policy objective is to use exchange rate flexibility to set the home output gap to zero in period 1. We set $\widetilde{Y}_{H1} = 0$ because in addition to the condition $T = 0$, we also impose $L = 0$ to simplify the problem. By contrast, when the external borrowing constraint is binding, we consider that both T and L are positive. In other words, only when this constraint is binding, do we consider external debt to be high enough to justify distorting the exchange rate decision. For the diagram, we assume T and L to be positive constants instead of going through the more formal analysis in Basu et al. (2023); this sign restriction is sufficient to derive the policy implications that we highlight. Finally, although the above equation is derived assuming that the domestic borrowing constraint does not bind, we assume as an approximation that it holds even if that constraint does bind.

The above arguments produce the versions of equations (5a*)-(5c*) and (6b*) that apply to a country with a floating exchange rate regime.

Equation (6a*) comes from equation (1b*) that we derived above. For the IPF diagram, we assume that an exchange rate depreciation tightens this constraint. If so, there exists a threshold $\mathcal{E}_1^{\text{binding}}$ such that the external borrowing constraint binds when the exchange rate is above $\mathcal{E}_1^{\text{binding}}$. Equation (1b*) indicates that this threshold is increasing in κ_H, decreasing in B_1, and decreasing in the trade deficit $(C_{F1} - X_1)$. Accordingly, we can establish the reduced-form approximation represented by equation (6a*). If the external borrowing constraint binds, we highlight a role for ex ante capital inflow taxes by drawing on the discussion of equations (13)-(14) in Basu et al. (2023).

Turning to a country with a fixed exchange rate regime, the exchange rate FOCs are replaced by the condition $\mathcal{E}_t = \overline{\mathcal{E}}$ in all periods.

Panel D. Policy Rate

Equation (7*) comes from combining the definitions of η_2 and μ_1 above.

A.2 Relation of Fiscal Policy Extension to Basu et al. (2024)

The amended IPF diagram panels A-D in section 7 are derived from the system of equations in Basu et al. (2024). The algebraic manipulations and corresponding approximations from appendix A.1 should be applied again, but this time to Basu et al. (2024) instead of to Basu et al. (2023). In addition, while Basu et al. (2024) treat government spending levels as endogenous and optimized, we treat them as exogenous for the IPF diagram. Below, we combine a brief summary of the approach for each panel with a focus on those elements which diverge the most from those in appendix A.1.

Panel A. Imports

Equations (1a')-(1b') come from the external financing part of Basu et al. (2024), and equations (2a')-(2d') come from the import consumption FOCs and external budget constraint in that paper. G_{Ft} is the government spending on imports (in dollars). The definition of $\widetilde{Y}_{Ht}$ is amended:

$$\widetilde{Y}_{Ht} = -\alpha_H A_t^{1+\nu} \tau_{Ht} \text{ with } \tau_{Ht} \equiv \left(1 - \frac{1}{A_t}\frac{C_{Ht}}{\alpha_H} N_t^{\nu}\right) \text{ and } N_t = \frac{1}{A_t}\left[C_{Ht} + G_{Ht} + \frac{C^*}{P_X}\right],$$

where N_t is employment, G_{Ht} is government spending on home goods (in local currency), and $\frac{C^*}{P_X}$ is the export volume of produced tradable goods.

Panel B. Housing

Equations (3')-(4') come from the domestic credit market part of Basu et al. (2024). For the IPF diagram, we relabel g_{Rt} as G_{Rt}, representing the dollar value of government spending on housing services.

Panel C. Home Goods

Equations (5a')-(5c') and (6b') come from the home consumption part of Basu et al. (2024), while equation (6a') comes from equation (1b'). The exchange rate regime determines whether the exchange rate FOCs are relevant or not. Using the amended definition of the home output gap $\widetilde{Y}_{Ht}$ above, we obtain:

$$\widetilde{Y}_{Ht} = C_{Ft}\mathcal{E}_t \left(C_{Ft}\mathcal{E}_t + G_{Ht} + \frac{C^*}{P_X} \right)^{\nu} - \alpha_H A_t^{1+\nu}.$$

For the IPF diagram, we relabel $\frac{C^*}{P_X}$ as Y_{XH}, representing the quantity of exports of home-produced tradable goods.

Panel D. Policy Rate

Equation (7') comes from combining the definitions of η_2 and μ_1.

PUBLICATIONS

An Integrated Policy Framework (IPF) Diagram for International Economics

Working Paper No. WP/2024/038