The Hegemon’s Dilemma.*

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Abstract
I study the policy dilemma faced by a large open economy (the hegemon) that issues assets in high international demand, in a world with endogenous limited financial market participation and nominal rigidities. On the one hand, foreign demand for hegemon assets allows financially active households in the hegemon to borrow at favourable rates and increase consumption. On the other hand, because of nominal rigidities, capital inflows to the hegemon distort relative prices in world goods markets, giving rise to an aggregate demand externality which results in involuntary unemployment. Macroprudential policies that restrict capital inflows can be unilaterally optimal for the hegemon. The welfare trade-off worsens if the hegemon’s imports are priced in domestic currency and if capital inflows are countercyclical.

JEL Codes: E44, E63, F33, F40, G15

Preliminary and incomplete. Please do not circulate.

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1 Introduction

The United States is central to the international monetary system (IMS) as issuer of safe and liquid assets and provider of insurance to foreign countries. Due to high international demand, U.S. safe assets command a premium which peaks during financial crises and times of heightened global uncertainty. These equilibrium price movements are necessary to incentivize US households, firms and the government to issue sufficient liabilities to satisfy international demand. As a result, the international allocation of capital is increasingly biased towards the U.S, as documented in Maggiori, Neiman, and Schreger (2018). The continued stability of the IMS therefore depends on the willingness of the U.S. to absorb countercyclical capital inflows and sustain a larger deficit.

This paper focuses on the domestic policy dilemma faced by a large open economy (the hegemon) that issues international reserve assets and, as a result, experiences inefficient capital inflows. While a major benefit from issuing an asset in high international demand is that domestic agents can borrow at lower rates, thus enjoying an ‘exorbitant privilege’, this benefit accrues only to agents participating in financial markets. On the other hand, inefficient capital inflows appreciate the nominal exchange rate and, in the presence of nominal rigidities, distort relative goods’ prices. This gives rise to an aggregate demand externality which results in involuntary unemployment. Domestically, this leads to a divergence in the fortunes of financially active and inactive households. I assess the welfare implications of an increase in international demand for U.S. assets, as a result of international financial market frictions, and I analyse the unilateral optimal macroprudential policy, assuming the foreign policy stance is passive. I dub the resulting policy-tradeoff as the hegemon’s dilemma.

The starting point of my analysis is an Arrow-Debreu economy where, de facto, there are enough traded assets to fully insure agents against idiosyncratic risks (at both the household and country level). However, agents are unable to achieve perfect risk sharing due to financial market frictions. International financial markets are segmented, but there exists a continuum of competitive financiers who can intermediate capital flows at a stochastic cost, which is asymmetric across domestic and foreign liabilities. I show that the resulting wedge is captured by deviations from the covered interest rate parity (CIP), see Du, Im, and Schreger (2018) and Jiang, Krishnamurthy, and Lustig (2018), and on average, there is excess demand for U.S. assets. The stochastic wedge introduces distributional consequences and generates the equilibrium incomplete market outcomes which lie at the heart of the mechanisms explored in this paper. I show empirically that deviations from CIP are associated with an increase in total credit to the non-financial sector in the U.S. relative to the panel of G10 currency economies, driven by times of heightened economic uncertainty, see Figure 1 (left panel).

\footnote{Triffin (1961) proposed a related dilemma, recently revisited by Farhi and Maggiori (2016), pertaining to the issuance of international assets. The issuing country enjoys consumption gains by running a persistent deficit but eventually erodes international confidence, and its position in the IMS, by over-borrowing. In contrast, I assess the conditions required for these consumption gains to improve aggregate welfare. The dilemma I consider is domestic, in response to capital inflows which arise due to international financial asymmetries, but can have large international consequences.}
Domestically, households must pay a fixed cost to adjust their portfolios and are subject to idiosyncratic income shocks such that in every period some households choose not participate in financial markets, as in Alvarez, Atkeson, and Kehoe (2002). Using the Survey of Consumer Finances, I show that limited financial market participation is strongly supported by the data, and proxies for financial market participation suggest a significant fall following the financial crisis, see Figure 1 (right panel). Risk sharing between financially active households is perfect within countries and imperfect across countries. Following an improvement in the financial terms of trade (financiers’ intermediation costs for U.S. debt fall relative to foreign debt), the hegemon faces a policy dilemma: whether to allow domestic financially active households to benefit from lower borrowing costs and enjoy higher consumption at the expense of higher aggregate unemployment or to restrict capital inflows and minimize the aggregate demand externality.  

I focus on macroprudential policy rather than monetary policy primarily because the latter is likely to be subject to a zero lower bound during episodes of heightened global uncertainty when CIP deviations peak. Additionally, if capital is allowed to flow freely, flexible exchange rates do not necessarily grant monetary policy independence if there are CIP deviations, see Rey (2015) who argues that the traditional Mundellian trilemma collapses to a dilemma. As a result, macroprudential policy and capital controls addressing international financial asymmetries can be necessary to enable monetary policy to pursue domestic stabilization. 

Driving the policy trade-off is an aggregate demand externality: in the presence of nominal rigidities, the nominal exchange rate appreciation associated with an increase in consumption by

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2 This policy trade-off transcends the specific economic application and arises in a variety of environments with limited financial market participation and nominal rigidities.

3 A number of papers advocate the use of capital controls based on second-best arguments such as in Jeanne and Korinek (2010) and surveyed in Farhi and Werning (2013) amongst others. Additionally, in the standard Alvarez, Atkeson, and Kehoe (2002) model with a cash-in-advance constraint, inflation inflicts a tax on inactive households and is distorting.
financially active households in the hegemon country distorts relative goods’ prices and may ultimately result in domestic unemployment. If domestically produced goods and foreign imports are substitutes, there is downward pressure on domestic wages but a fall does not materialize due to downward wage rigidities. Since households who do not participate in financial markets cannot borrow and increase their consumption, the marginal benefit of inefficient capital inflows, associated with higher consumption of active households, can be negative for inactive households. As a result, the socially optimal level of consumption for active households is lower and the optimal policy for the hegemon is to either restrict capital inflows via capital taxation or correct the relative price of non-traded goods using monetary policy or subsidies. The socially optimal level of capital inflows is decreasing in the degree of wage rigidity, the atemporal elasticity of substitution between traded and non-traded goods (imports vs. domestically produced), the Pareto weight attached to inactive household consumption and, importantly, is increasing in the measure of active households. I derive the key results analytically in a reduced model with production in the non-traded sector and autarkic consumption allocations of each good for inactive households, and I then illustrate the dilemma in a calibrated model with production of differentiated tradable goods. I solve the model using global techniques to deal with the occasionally binding nominal wage rigidities and the solution is fully non-linear to correctly account for welfare considerations the cyclical implications of shocks.

I highlight three features of markets which exacerbate the trade-offs faced by the U.S., in light of inefficient capital inflows: i) financial market participation rates for the U.S. fell following the financial crisis, ii) the majority of international trade in goods is invoiced in U.S. dollars and iii) CIP deviations, which proxy excess demand for U.S assets, are countercyclical. First, limited financial market participation worsens the policy dilemma, since only financially active households adjust their consumption upwards following an improvement to the financial terms of trade, leaving financially inactive households worse off due to involuntary unemployment. As a result, only governments with a sufficiently high measure of financial market participation have an incentive to pursue hegemony and sustain capital inflows. Additionally, following a sharp fall in financial market participation, such as the one experienced by the U.S. in 2007, see Figure 1 (right panel), the balance of incentives can shift in favour of financial protectionism.4

Secondly, the United States is uniquely positioned in international goods markets, as well as financial markets. As documented in Casas et al. (2016), most of international trade in goods is invoiced in U.S. dollars. In section 4, I contrast the welfare benefits for the large open economy issuing international assets under different pricing regimes: producer currency pricing (PCP), where U.S imports are priced in foreign currency and dominant currency pricing (DCP), where U.S. imports are priced in dollars and pass-through is low in the short and medium run. I show that the welfare costs associated with inefficient capital inflows are higher under DCP, despite aggregate demand externalities being smaller. There are two key forces at play. On the one hand, under DCP, there is no expenditure switching by home households away from domestically

4Within country variations in financial market participation may further complicate policy due to political and distributional consequences. Chien and Morris (2017) use tax data to show large differences in financial market participation across states.
produced goods. As a result, the fall in domestic employment and output is smaller than in the PCP case. On the other hand, exchange rate pass-through to imports is zero, therefore the buying power of hegemon households is lower under DCP than PCP. In calibrations, the latter effect dominates. Gopinath and Stein (2018) rationalise the joint dominance of the dollar in international capital markets and trade invoicing, from the perspective of a small open economy (SOE), arguing that households in a SOE facing imports priced (with rigidities) in dollars, are willing to pay a premium to hold assets which pay out in the same currency. I highlight that from the perspective of the large open economy issuing the international assets and the currency of trade invoicing, this complementarity is undesirable.

Finally, in stark contrast to a small open economy where any distortion to intertemporal allocations is inefficient, in a large open economy, capital flows could improve or worsen dynamic efficiency depending on future economic growth and the evolution of aggregate demand externalities. Maggiori (2011), Du, Im, and Schreger (2018) and Jiang, Krishnamurthy, and Lustig (2018) amongst others, find that the safety premium on U.S. dollars is countercyclical. I show that if the associated capital inflows are countercyclical, even households who are financially active and benefit from capital inflows during downturns, are not allocating their consumption efficiently across time because they do not internalize traditional terms of trade externalities. As a result, the price U.S households pay for imports is relatively higher in periods when import demand is high. This provides a new dimension to the analysis of Gourinchas, Rey, and Govil-lot (2018) who argue that the U.S., as well as enjoying an ‘exorbitant privilege’ in the form of higher portfolio returns, faces an ‘exorbitant duty’ by providing insurance in periods of global stress.

**Literature.** Thematically, this paper belongs to an emerging literature on the international monetary system. Farhi and Maggiori (2016) describe a stylized model where a government issues assets monopolistically, at a safety premium but the model lacks a general equilibrium framework. Gabaix and Maggiori (2015) and Maggiori (2017) analyze two country models with international financial frictions which distort risk sharing but do not study optimal policy. This paper is also related to Rey (2015), and a growing subsequent literature, who discusses the global financial cycle, a common driver of financial variables and argues that there is scope for welfare-improving capital controls.

I bridge the gap to the literature on international risk sharing and optimal policy in open economies. I build on canonical models of international risk sharing such as Backus and Smith (1993) and Corsetti and Pesenti (2001) amongst many others, and I introduce international market segmentation in the spirit of Gabaix and Maggiori (2015). I further introduce to the model domestic financial frictions, building on Alvarez, Atkeson, and Kehoe (2002) who consider a model where households are subject to idiosyncratic endowment shocks and must pay a fixed cost to participate in financial markets. Their model is extended to include traded goods in Cociuba and Ramanarayanan (2017) who undertake a quantitative exercise on international consumption co-movement. While the literature has argued that domestic financial frictions result in asymmetric international risk sharing, see, for example, Mendoza, Quadrini, and RiosRull
(2009) and Maggiori (2017), these papers take domestic financial frictions as given. I highlight the interplay between domestic and international financial frictions and the implications for the domestic policy.

The hegemon government maximizes domestic welfare subject to an international competitive equilibrium. A number of papers study optimal policy in open economies. Schmitt-Grohé and Uribe (2016) and Farhi and Werning (2013) study macroprudential policies to address aggregate demand externalities in depth, in variety of environments, but do not consider large open economies or financial market segmentation. Corsetti, Dedola, and Leduc (2018) analyse monetary response to inefficient capital inflows using a second-order Taylor approximation with exogenously incomplete markets internationally markets, but do not consider domestic financial market frictions. As in Costinot, Lorenzoni, and Werning (2014), henceforth CLW, the hegemon is able to manipulate the terms of trade dynamically, and in the complete markets environment I study, unilaterally tilt the wealth distribution. While CLW focus on price distortions across endowed traded goods, I analyze a production economy featuring aggregate demand externalities. Methodologically, these papers draw heavily on the optimal taxation literature and, in particular, the primal approach presented in Lucas and Stokey (1983).

The paper is organised as follows. In section 2, I set up the general model. In section 3, I employ simplifying assumptions and derive analytical results and in section 4 I study optimal policy. Section 5 presents a quantitative model. Section 6 provides supporting evidence on CIP deviations and the international allocation of credit. Section 7 concludes.

2 Model economy

There are two countries, home and foreign, \( i \in \{H, F\} \). Time is discrete and infinite. Each country consists of a unit measure of households. The aggregate state of the economy is summarised by \( s^t = (s_0, ..., s_{t-1}, s_t) \) and the corresponding density is denoted by \( f(s^t) \). Households are also subject to idiosyncratic shocks and the idiosyncratic state is summarised by, \( \nu^t = (\nu_0, ..., \nu_{t-1}, \nu_t) \) with corresponding density \( g(s^t) \).

**Preferences and market structure.** Household preferences are given by,

\[
\sum_{t=0}^{\infty} \int_{s^t \in S^t} \int_{\nu^t \in V^t} \beta^t \left[ u(c(s^t, \nu^t)) - \psi(l(s^t, \nu^t)) \right] f(s^t) g(\nu^t) ds^t d\nu^t
\]

where \( c = g(c_{NT}, \{c_{T,i}\}) \), for a concave \( g(.) \), denotes the consumption of a composite bundle of non-traded and traded goods indexed by \( i \leq I \), \( u \) is a twice differentiable, strictly increasing and concave function satisfying \( \lim_{c \downarrow 0} u(c) = \infty \); and \( \beta \in (0, 1) \) is the discount factor. I begin by assuming utility is additively separable in consumption and leisure. The agent supplies labour at a convex disutility \( \psi(.) \). The preferences of the agent abroad are analogous, with foreign variables denoted by an asterisk.

Trade in this economy occurs in two separate locations, a goods market and as asset market, as in Alvarez, Atkeson, and Kehoe (2002). In the goods market, households earn wages, receive
their endowments and purchase goods. In the asset market, households trade in a complete set of one period Arrow-Debreu securities that are contingent on both the idiosyncratic and aggregate state, receive profits from ownership of (financial) firms and lump sum transfers from the government. Arrow-Debreu securities are in zero net supply and are denominated in households’ domestic currency. Households must pay a fixed cost $\gamma(s^t)$, in terms of consumption goods, to transfer money between accounts. The fixed cost captures collateral requirements and search frictions in asset markets, which could disincentivize households from using financial markets to reallocate consumption across time and states. Each household faces the following sequential budget constraint in the goods market,

$$p(s^t) \cdot [c(s^t, \nu^t) - y(s^t, \nu^t)] \leq z(s^t, \nu^t) \left[ \tau(s^t, \nu^t) - p(s^t) \cdot \gamma(s^t) \right], \quad (2)$$

where $z(s^t, \nu^t)$ is an indicator variable which is equal to one if the government consumes more or less than its current income, and zero otherwise, $p \in \mathbb{R}^{I+1}$ is a vector of goods prices and $c \in \mathbb{R}^{I+1}$ is the vector of consumption of each good variety, $y \in \mathbb{R}^{I+1}$ is the income or endowment of each variety, and $\tau(s^t, \nu^t)$ is the transfer from the households’ asset market account. In the asset market households face the following constraint,

$$\tau(s^t, \nu^t) \leq -x(s^t, \nu^t)(1 + \tau^x(s^t, \nu^t)) + \int_{s^t}^{s^{t+1}} \int_{\nu^t+1} \tau(s^{t+1}, \nu^{t+1}) x(s^{t+1}, \nu^{t+1}) ds^{t+1} d\nu^{t+1} + \tau^G(s^t, \nu^t) + \pi(s^t),$$

where $q$ is the relative price of consumption across periods, $x$ are holdings of Arrow Debreu securities traded internationally, $\tau^x$ is a capital inflow tax, $\tau^G$ is a lumpsum transfer from the government and $\pi$ are profits from ownership of financial firms.\textsuperscript{5} Households are subject to a no-Ponzi condition, $\lim_{t \to \infty} -x(s^t) \geq 0$. Finally, to make all households in each country identical at period 0, I endow them with $B_0(\nu^t)$ units of domestic government debt which are claims to period 0 consumption, as in Alvarez, Atkeson, and Kehoe (2002) and Cociuba and Ramanarayanan (2017). In this period there is only trade in assets and not goods.

**Government.** The government is subject to the following budget constraint,

$$\int_{\nu^t} \tau^G(s^t, \nu^t) g(\nu^t) d
u^t \leq \int_{\nu^t} x(s^t, \nu^t) \tau^x(s^t, \nu^t) g(\nu^t) d\nu^t + \int_{s^t}^{s^{t+1}} q(s^{t+1}) ds^{t+1} - B(s^t). \quad (3)$$

where $B(s^{t+1})$ are government bond issuances. A continuum of competitive domestic financial intermediaries buy government debt, which is contingent on the aggregate state only, and sell idiosyncratic insurance to households who trade only in claims contingent on their own endowment. As long as financial intermediation is not constrained by enforcement frictions

\textsuperscript{5}Note that since the lump sum transfer is in households’ asset account, fiscal policy is non-distortionary despite the domestic market segmentation, in contrast to Alvarez, Atkeson, and Kehoe (2002).
domestically, no arbitrage yields \( q(s^{t+1}) = \int_{\nu^{t+1}} q(s^{t+1}, \nu^{t+1}) g(\nu^{t+1}) \).

**Intertemporal household optimization.** I denote inactive household allocations by a superscript \( NA \), and active household allocations by a superscript \( A \). Inactive households consume autarkic allocations, \( z(s^t, \nu^t) = 0 \),

\[
 p(s^t) \cdot c^{NA}(s^t, \nu^t) = p(s^t) \cdot y^{NA}(s^t, \nu^t) \quad \forall s^t \in S^t, \ \nu^t \in V^t. \tag{4}
\]

Abstracting from taxes, the sequence of budget constraints for the active home households can be written as,

\[
 \sum_{t=0}^{\infty} \int_{s^t \in S^t} \int_{\nu^t \in V^t} q(s^t) p(s^t) \left[ c^A(s^t, \nu^t) - y^A(s^t, \nu^t) - \gamma(s^t) + \pi(s^t) \right] g(\nu^t) ds^t \leq 0. \tag{5}
\]

The intertemporal optimization problem for active households is summarised by the following Lagrangean,

\[
 \mathcal{L} = \beta u(c^A(s^t, \nu^t)) g(\nu^t) f(s^t) - \zeta q(s^t) p(s^t) \left[ c^A(s^t, \nu^t) - y^A(s^t, \nu^t) - \gamma(s^t) + \pi(s^t) \right] g(\nu^t)
\]

where \( c^A = g(c_{NT}, \{c_{i,t}^A\}) \) denotes consumption of active households. Individual households do not internalize how their consumption and savings behaviour affects the profits accruing to financial intermediaries.\(^7\) The first order condition with respect to consumption yields the price of an Arrow-Debreu security in any state,

\[
 q_0(s^t) p_i(s^t) \zeta = \beta' u'(c^A(s^t, \nu^t)) g'_i(c^A_i(s^t, \nu^t)) f(s^t), \quad \forall i \leq I, \ \forall s^t \in S^t. \tag{6}
\]

Normalising \( q_0(s_0) = 1 \), implies \( \zeta = u'(c^A(s_0, \nu_0)) g'_i(c^A_i(s_0, \nu^t))/p_i(s_0) \). Since asset prices are independent of the idiosyncratic state, households that participate in domestic financial markets will share idiosyncratic risk fully and \( c^A(s^t, \nu^t) = c^A(s^t) \ \forall s^t \in S^t, \nu^t \in V^t \). There is a representative active household in each country. Asset prices in the economy are determined by the consumption of active households only.\(^8\)

**Intratemporal optimization.** In each period households form their consumption baskets optimally. The Lagrangean characterizing households’ optimal intratemporal consumption allocations, surpressing state notation for convenience, is given by,

\[
 \mathcal{L} = g(c_{NT}, \{c_{i,t}\}) - \xi \left[ PC - \sum_{i=1}^{l} p_{Ti,c_{Ti}} - p_{NTc_{NT}} \right],
\]

\(^6\)Details in Appendix B.

\(^7\)I denote by \( \gamma, \pi \) the vector of cost and profits allocations in terms of individual goods varieties.

\(^8\)Cociuba and Ramanarayanan (2017) show that this can explain differences in implied risk sharing by consumption and asset prices.
The first order condition is given by,
\[ \nabla g(c_{NT}, \{c_i\}) = \xi p, \]
Assuming that the final consumption good aggregator is homothetic implies the following static demand equations,
\[ c_{NT} = h \left[ \frac{P}{P_{NT}} \right] C, \quad c_i = h \left[ \frac{P}{p_i} \right] C, \quad \forall \; i \leq I \]
for some increasing and differentiable function \( h \). The division of the fixed cost across traded goods \( \{\gamma_i\} \) and non-traded goods \( \gamma_{NT} \) is analogous. The home consumer price index is given by,
\[ P = \min \{p \cdot c : g(c_{NT}, \{c_{T,i}\}) = 1\}, \quad (7) \]
and \( P^* \) is the foreign analogue. It is also convenient to consider a homothetic aggregator for a composite tradable good, such that,
\[ c_T = h \left[ \frac{P}{P_T} \right] C, \]
where the price aggregator \( p_T \) is defined analogously to the aggregate price level. I let \( e(s^t) \) denote the nominal exchange rate defined as the cost of foreign currency in domestic currency terms. The law of one price holds for tradable goods, \( p_i^* e = p_i, \; i \leq I \) but does not hold in terms of the final consumption basket due to asymmetric preferences and the inclusion of non-traded goods in the consumption basket. Foreign country maximization is analogous, with variables denoted by \( (\ast) \).

**Limited market participation.** In equilibrium only a measure \( a = 1 - F(\nu) + F(\bar{\nu}) \) of households in each country choose to participate in asset markets, where \( (\nu, \bar{\nu}) \) are the roots of the following equation,
\[ h(s^t, \nu^t; \Gamma) = u(c^A(s^t)) - u(c^{NA}(s^t, \nu^t)) - \left( \psi(t^A(s^t)) - \psi(t^{NA}(s^t, \nu^t)) \right) \]
\[ -u'(c^A(s^t)) (c^A(s^t) - c^{NA}(s^t, \nu^t) + \gamma(s^t)) \]
\[ \bar{\nu} \text{ cost of foregone future consumption} \]

The net gains to financial market participation are given by \( h(s^t, \nu^t) \). The first two terms compare the utilities from consumption for a household if active and if inactive. The third term captures the difference in associated disutilities from labour. The final term accounts for the future cost of transferring \( \tau(s^t, \nu^t) \) for consumption today. Households which experience sufficiently low, or sufficiently high idiosyncratic endowment shocks will choose to participate. The economy converges to the representative agent case when \( \gamma \downarrow 0 \) resulting in \( a \uparrow 1 \).
**Market clearing.** In the traded sector, market clearing requires,

\[
\int_{\mu' \in VT} [c_{T,i}(s', \nu') + z(s', \nu') \gamma_{T,i}(s') ] g(\nu') d\nu' + \int_{\mu' \in VT} [c_{T,i}(s, \nu') + z^*(s', \nu') \gamma^*_{T,i}(s') ] g(\nu') d\nu' \leq y_{T,i}(s') + y^*_{T,i}(s') = Y_{T,i}(s') \quad \forall \, i \leq I, \; s' \in S', \quad (9)
\]

whilst non-traded goods clear country by country,

\[
\int_{\mu' \in VT} [c_{NT}(s', \nu') + z(s', \nu') \gamma_{NT}(s') ] g(\nu') d\nu' \leq Y_{NT}(s') \quad \forall \, s' \in S', \quad (10)
\]

\[
\int_{\mu' \in VT} [c_{NT}(s, \nu') + z^*(s', \nu') \gamma^*_{NT}(s') ] g(\nu') d\nu' \leq Y^*_{NT}(s') \quad \forall \, s' \in S', \quad (11)
\]

where \( \{\gamma_{T,i}\}_{i \leq I}, \gamma_{NT} \) are shares of the fixed cost paid in each good type. Additionally, \( P(s')C(s') = M(s') \), where \( M(s') \) is the domestic nominal money supply and \( P^*(s')C^*(s') = M^*(s') \) is the foreign analogue. In contrast to Alvarez, Atkeson, and Kehoe (2002), money serves the role of a unit of account but is not modelled explicitly, to abstract from additional frictions. International asset market clearing is discussed below.

### 2.1 International financial markets and intermediation.

International financial markets are segmented but there exists a continuum of competitive, financial intermediaries who trade in a complete set of assets, in zero net supply, with domestic and foreign households, denominated in their respective currencies.\(^9\) Households are selected at random to manage financial intermediaries in each period. Let \( f(s') = q(s')x(s') \) denote capital inflows to the hegemon and \( f^*(s') = q^*(s')x^*(s')e(s_0) \) denote capital inflows to the foreign country.

**Assumption 1.** Financiers pay a cost \( \omega\left(f(s'), f^*(s')\right) \) to intermediate capital flows across borders. Let \( \omega_f(f(s'), f^*(s')) , \omega_{f^*}(f(s'), f^*(s')) \) be the partial derivatives of the cost function with respect to home and foreign capital flows respectively. Then, \( \omega_f(f(s'), f^*(s')) < \omega_{f^*}(f(s'), f^*(s')) \).

I capture international financial market asymmetries by assuming that hegemon debt flows are cheaper to intermediate across borders. This could reflect safety, liquidity or regulatory differences across assets.\(^10\) In equilibrium, prices adjust such that financiers are willing to intermediate all capital flows and markets clear. Financiers’ profits are rebated to home and foreign households according to shares \( \eta \) and \((1 - \eta)\) respectively. For tractability, I assume the ownership share is proportional to the change in total borrowing costs faced by households in each country, which I denote by \( \tilde{\eta} \) and, as a result, financial frictions are isomorphic to a

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\(^9\)International financial market segmentation can be motivated by information asymmetries, commitment problems and differences in time zones amongst other explanations. Similar to domestic market frictions, it can be modelled as a large fixed cost which excludes households from international markets.

\(^10\)In particular, the cost function captures limited enforcement frictions, which differ across assets, such as those widely used in the literature, see Kiyotaki and Moore (1997), Mendoza, Quadrini, and Ríos-Rull (2009) and Gabaix and Maggiori (2015) amongst others.
Figure 2: Market structure.

capital inflow tax from the perspective of households.\footnote{Consider the case where $\eta < \tilde{\eta}$. In this case, if intermediation costs resemble a capital subsidy for hegemon households, this subsidy is financed by a lump sum tax that is disproportionately borne by foreign households, as in Farhi and Werning (2012).}

Financiers trading in securities at time $t$, that pay off at time $t+1$, face the following profit maximization problem,

$$V_t = \max_{\{x_t(s^{t+1})\}} \int_{s^{t+1} \in S^{t+1}} D(s^{t+1}) \left\{ \left[ q^*_t(s^{t+1}) \frac{e(s_t)}{e(s^{t+1})} - q_t(s^{t+1}) \right] x_t(s^{t+1}) - \omega \left( q(s^{t+1})x(s^{t+1}), -q^*(s^{t+1}) \frac{e(s_t)}{e(s^{t+1})}x(s^{t+1}) \right) \right\} ds^{t+1},$$

where I have imposed clearing of capital flows $x(s^{t+1}) = -x^*(s^{t+1})e(s^{t+1})$ for each future state and $D(s^{t+1})$ is a stochastic discount factor constructed as the average of home and foreign stochastic discount factors, proportionally to the ownership structure.\footnote{Generally, $D(s^{t+1}) = \eta D(s^{t+1}) + (1 - \eta) D^*(s^{t+1})$. Under complete markets, the ownership structure does not matter since financially active households in both countries agree on the valuation of capital flows. If markets were incomplete, the covariance of the constructed stochastic discount factor and capital flows would be relevant.} However, in complete markets, a risk neutral financier’s objective function coincides with the objective function of financially active risk averse households who own it, as in Malamud and Schrimpf (2018). If financial intermediation was frictionless ($\omega(.) = 0$), the financiers’ optimality condition yields the uncovered interest rate parity, $q_t(s^{t+1}) = q^*_t(s^{t+1})(e(s_t)/e(s^{t+1}))$ and borrowing costs are equated across households in different countries. Allowing for asymmetric intermediation costs, the financiers’ maximization results in the following no-arbitrage condition,

$$q^*_t(s^{t+1}) \frac{e(s_t)}{e(s^{t+1})}(1 + \omega^*(s^{t+1})) = q_t(s^{t+1})(1 + \omega_f(s^{t+1})) \quad \forall \ s^{t+1} \in S^{t+1},$$

where $\omega_f(s^{t+1}) < \omega^*(s^{t+1})$. In equilibrium, the asymmetry in intermediation costs across assets leads to an adjustment in intertemporal prices across countries so as to encourage borrowing by hegemon households (capital inflows). I define the financial terms of trade,
\( \Gamma(s^t) = [q(s^t)] [g^*(s^t)(e(s_0)/e(s^t))]^{-1} \) as the ratio of the relative price of current consumption units in terms of future consumption units, in the hegemon vis-a-vis the foreign country. An improvement in the financial terms of trade \( \Gamma \uparrow \) is defined as a reduction in borrowing costs in the hegemon, relative to the foreign country. Since financial intermediation is costly, financiers make a loss which is borne by households through negative profits. Combining the Euler conditions of both countries using the financiers’ no arbitrage equation yields the international risk sharing condition,\(^{13}\)

\[
\frac{u'(c^A(s^{t+1}))}{u'(c^{A*}(s^{t+1}))} \frac{P^*(s^{t+1})e(s^{t+1})}{P(s^{t+1})} \xi^{-1}(s^t) = \Gamma(s^t) \quad \forall s^t \in S^t, \tag{13}
\]

where \( \xi = \frac{P(s^t)e(s^t)u'(c^{A*}(s^t))}{P(s^t)u'(c^A(s^t))} \).

Costly financial intermediation introduces a stochastic wedge to the international risk sharing condition and distorts exchange rate dynamics. Fluctuations in the stochastic wedge have distributional consequences, both across active households in the hegemon vis-a-vis the foreign country, and across active and inactive households within countries. Under assumption 1, financial intermediation tilts the wealth distribution in favour of active households in the hegemon. Since intermediation costs do not arise as a result of exchange rate risk, these are reflected in the data as covered interest rate parity deviations (CIP). In particular, even if I allow financiers to hedge exchange rate risk using forward fx swaps in a frictionless market, (12) is unchanged. A key contribution of this paper is to evaluate the domestic macroeconomic consequences of such intermediation frictions, as reflected in the data by CIP deviations. In section 5.2, I discuss in detail the mapping to CIP deviations in the data and the estimation for the process \( \{\Gamma_t\} \).\(^{14}\)

3 Financial terms of trade and financial market participation

**Competitive equilibrium.** A competitive equilibrium is a set of stochastic processes for allocations \( \{c(s^t, \nu^t), c^*(s^t, \nu^t), x(s^t, \nu^t), x^*(s^t, \nu^t), \pi(s^t, \nu^t), \pi^*(s^t, \nu^t), y(s^t, \nu^t), y^*(s^t, \gamma(s^t), \gamma^*(s^t)\}, \)
participation choices \( z(s^t, \nu^t), z^*(s^t, \nu^t) \) satisfying (8), transfers \( \{\tau(s^t, \nu^t), \tau^*(s^t, \nu^t)\} \), prices \( \{p(s^t), p^*(s^t), q(s^t), q^*(s^t), e(s^t)\} \) and taxes, \( \{\tau^G(s^t, \nu^t), \tau^{G*}(s^t, \nu^t), \tau^{\pi}(s^t, \nu^t), \tau^{\pi*}(s^t, \nu^t)\} \) such that for all \( t \geq t_0, s^t \in S^t \) (i) active households maximize (1) subject to (5) and inactive maximize (1) subject to (4) given \( z(s^t, \nu^t) = 0 \), taking prices as given; foreign households undertake the analogous maximization abroad; market clears for goods; home and foreign bond markets clear and international Arrow Debreu markets clear. Proposition 1 summarises the conditions sufficient for a competitive equilibrium.

\(^{13}\)To do so, I also use the relationship \( P = p_i/g_i(C) \forall i \leq I \).

\(^{14}\)In contrast, if I assume that intermediation costs arise as a result of exchange rate risk, then the relevant mapping in the data are uncovered interest rate parity deviations, which are substantially larger. However, the results would be qualitatively unchanged.
Proposition 1 (Implementability)
If \( \eta = \bar{\eta} \), any feasible competitive equilibrium must satisfy the implementability condition,
\[
\sum_{t=0}^{\infty} \int_{s^t \in S^t} \int_{\nu^t \in V^t} u^t(c^{A}(s^t)) \nabla g^*(c^{A}(c^A(s^t))) f(s^t) : [c^A(s^t) - y^A(s^t) - \gamma(s^t)] \int_{\rho(c^A(s^t))}^{} \rho(c^{A}(s^t)) \left[ c(s^t, \nu^t) - y(s^t, \nu^t) - \gamma(s^t) \right] ds^t = 0. \tag{14}
\]

The consumption of inactive households, non-traded goods, domestic bonds and profits do not appear in the consolidated budget constraint because they never cross borders.\(^{15}\) The growth of relative consumption amongst active households across countries is fully summarised by the risk sharing condition (13) which is necessary and sufficient. Starting from a symmetric equilibrium, an increase in the price of future consumption (relative to abroad) tilts the wealth distribution in favour of current consumption by hegemon households.

Proposition 2 (Active households’ wealth distribution)
Active households’ consumption \( c^A(s^t) \) is strictly increasing in the financial terms of trade \( \Gamma(s^t) \).

Households in the hegemon country face a lower interest rate and increase their borrowing and current consumption leading to capital inflows. Consequently, fluctuations in the financial terms of trade influence households’ choice to participate in financial markets.

Lemma 3 (Financial market participation and the financial terms of trade)
Assume employment is rationed uniformly such that \( l^A(s^t) = l^{NA}(s^t, \nu^t), \forall \nu^t \in V^t \). The measure of active households \( a(s^t) \) is increasing in the financial terms of trade \( \Gamma(s^t) \), as long as the marginal active household is a borrower.

Households increase borrowing and current consumption following an improvement in the financial terms of trade, therefore increasing the net gains to financial market participation (8) for any inactive household that chooses to become a borrower. In general, there are some inactive households who will choose to participate and borrow because of the higher consumption, and some active households who were previously saving but will now find it optimal to remain inactive in order to save. If the idiosyncratic wealth distribution has more mass to the right of \( \nu(s^t) \) than \( \bar{\nu}(s^t) \), participation in financial markets will rise. Figure 6 in Appendix C illustrates the participation choice as a function of both idiosyncratic consumption of an inactive agent \( (c^{NA}(s^t, \nu^t)) \), which is pinned down by the sum of wages and the endowment each period, and the consumption of active agents \( (c^A(s^t)) \), which is derived from international risk sharing and depends on the financial terms of trade \( \Gamma(s^t) \). For a given \( c^A(s^t) \), a household will participate in financial markets in order to borrow (save) if its autarkic allocation \( (c^{NA}(s^t)) \) is too low (high).

\(^{15}\)In general, the implementability constraint is given by,
\[
\sum_{t=0}^{\infty} \int_{s^t \in S^t} \int_{\nu^t \in V^t} u^t(c^{A}(s^t)) \nabla g^*(c^{A}(c^A(s^t))) f(s^t) : [c^A(s^t) - y^A(s^t) - \gamma(s^t)] \int_{\rho(c^A(s^t))}^{} \rho(c^{A}(s^t)) \left[ c(s^t, \nu^t) - y(s^t, \nu^t) - \gamma(s^t) \right] ds^t = 0,
\]

which collapses to (13) because inactive households consume autarkic allocations. This is analogous to the implementation constraints in Werning (2007) when there is an infinite number of household types and no initial wealth.
Households who face negative returns to financial market participation choose to remain inactive. Differences in labour supply across active and inactive households can affect participation choice, but will be inconsequential in an economy where employment is rationed uniformly.

Through the lens of the model, the large fall in financial market participation observed in the U.S. following the financial crisis is not an equilibrium outcome to fluctuations in the financial terms of trade, but rather is attributable to an increase in the cost of financial market participation $\gamma$. While fluctuations in $\Gamma$ shift financial market participation across borrowers and lenders, an increase in $\gamma$ can account for the fall in both borrower and lender participation, see Figure 1 (right panel). In particular, the increase in $\gamma$ may be associated to the collapse of the housing bubble post 2007 which reduced the collateral available to households.

### 3.1 Financial terms of trade and aggregate demand externalities

Inefficient capital inflows, stimulated by international financial market asymmetries, drive an appreciation of the hegemon currency. In this section, I extend the model to feature production subject to nominal rigidities and I draw a tight link between capital inflows and a growing recent literature on aggregate demand externalities as a motive for macroprudential policies, see Schmitt-Grohé and Uribe (2016), Farhi and Werning (2017) and Fornaro and Romei (2018), amongst others.

I begin by considering a ‘reduced’ model with production in the non-traded sector and an endowment of a single traded good as in Schmitt-Grohé and Uribe (2016), henceforth SGU.

**Production.** Households provide labour with convex disutility (1). Firms are perfectly competitive and are endowed with linear technology to produce $NT$ goods, using homogeneous labour which is competitively provided by households,

$$Y_{NT}(s^t) = A(s^t) \int l(s^t, \nu^t)g(\nu^t)d\nu^t. \tag{15}$$

Firms choose the amount of labour they wish to hire to maximize their profits,

$$\max_{L(s^t)} p_{NT}(s^t)Y_{NT}(s^t) - w(s^t)L(s^t),$$

where $L(s^t) = \int l(s^t, \nu^t)g(\nu^t)d\nu^t$. The firms’ first order condition implies, $p_{NT}(s^t) = \frac{w(s^t)}{A(s^t)}$.

While the model does not feature any product price rigidities, the prices of produced goods inherit rigidities from wages.

**Nominal rigidities.** I assume wages are downwards rigid in nominal (currency) terms and therefore the economy is demand constrained in some states of the world. In particular, only a share $\gamma^w$ of wage contracts can be renegotiated downwards in each period as in Jo (2019). The wage restriction in the economy is summarised by,

$$w(s^t) = \begin{cases} 
\gamma^w w^{\text{flex}}(s^t) + (1 - \gamma^w)w_{t-1} & \text{if } w(s^t) < w_{t-1}, \\
w^{\text{flex}}(s^t) & \text{if } w(s^t) \geq w_{t-1},
\end{cases}$$

14
where $w^{\text{flex}}(s^t)$ is the wage that clears the labour market. The economy always satisfies the slackness condition,

$$\left( w(s^t) - \left[ \gamma_w w^{\text{flex}}(s^t) + (1 - \gamma_w)w_{t-1} \right] \right) \left( L^*(s^t) - \frac{Y_{NT}(s^t)}{A(s^t)} \right) = 0,$$

where $L^*(s^t) = \int \nu l(s^t, \nu) g(\nu) d\nu$ is the aggregate labour supply determined by households’ intratemporal Euler conditions. Periods of involuntary unemployment, $(L^*-Y_{NT}(s^t)/A_{NT}(s^t)) > 0$ must be accompanied by a binding wage rigidity. In this case, firms produce to accommodate demand,

$$Y_{NT}(s^t) = \int_{\nu^t \in V} c_{NT}(s^t, \nu^t) g(\nu^t) d\nu^t,$$

and I assume employment is rationed uniformly across households $l^*(s^t, \nu^t) = l(s^t)$, which implies a wedge in households’ consumption-leisure Euler equation, given by,

$$\tau_c(s^t, \nu^t) = 1 - \left( \frac{d\psi(s^t, \nu^t)}{dl(s^t)} / \frac{\partial u(s^t, \nu^t)}{\partial c_{NT}(s^t, \nu^t)} \right) \geq 0.$$

In contrast, in periods when the wage rigidity is not binding, the economy is in full employment. Both firms and workers take wages as given there is no forward looking behaviour in wage setting.\(^{16}\)

To derive analytical results, I assume that wages are perfectly rigid ($\gamma_w = 1$), $A = 1$ and inactive households consume autarkic allocations of each good. In particular, $c^{NA}_{NT} = y^{NA}_{NT}$, which introduces a wedge $\tau_c(s^t, \nu^t) > 0$ in the relative goods demand equation for inactive households. I relax these assumption in section 5 and the results are qualitatively unchanged. The next proposition summarises the sufficient conditions for equilibrium in the model with production subject to nominal wage rigidities. All previously stated results are unchanged by the introduction of production in non-traded goods. Namely, proposition 2 and lemma 3 still go through.

**Proposition 4** (Sufficient condition for a CE with demand externality)

Any feasible competitive equilibrium in a demand constrained economy must satisfy the implementability condition (14) and the effective aggregate demand equation (17).

Consider the demand function for non-traded goods (17) assuming a CES consumption aggregate allocation

\(^{16}\)As noted in Elsby (2009), if workers have market power and set wages to maximize lifetime utility, an endogenous compression of wage increases arises. However, SGU show that in recent boom-bust episodes in the Eurozone periphery, wages rose by by up to 60%, indicating this plays a minor role in business cycle episodes.
gator, under the maintained assumptions above,

\[ c_{NT}(s^t) = a(s^t) \frac{\chi}{1-\chi} \left( \frac{p_T(s^t)}{p_{NT}(s^t)} \right) \frac{1}{1-\theta} c_T^A(s^t) + (1-a(s^t))l(s^t), \]

\[ = \frac{\chi}{1-\chi} \left( \frac{p_T(s^t)}{p_{NT}(s^t)} \right) \frac{1}{1-\theta} c_T^A(s^t). \]

Agents participating in financial markets adjust their consumption path in response to changes in borrowing conditions without internalizing how their choices affect \( p_T(s^t) \) in equilibrium. Due to nominal rigidities, \( p_{NT} \) does not adjust to restore households' optimality resulting in an aggregate demand externality.

**Lemma 5** (Expenditure switching motives in reduced model)

Production in the non-traded sector falls as the consumption of traded goods by active households rises, \( \frac{\delta_{NT}}{\delta c_T} > 0 \), for \( \theta > 1 - (ac_T/c_T) \), or, if \( \tau^c = 0 \), for \( \theta > 0 \). The thresholds converge as \( a \uparrow 1 \).

In equilibrium, an improvement in the financial terms of trade (\( \Gamma \uparrow \)) is associated with a nominal appreciation (\( e \downarrow \)), as active households respond by allocating more consumption to the present \( c_T^A \uparrow \) (see Proposition 2). This appreciation will tend to lower the relative price of imports \( \frac{p_T(s^t)}{p_{NT}(s^t)} \downarrow \) restricting demand for non-traded goods.\(^{17}\) Since the economy is demand constrained due to nominal wage rigidities, aggregate employment falls, in excess of the flex price allocation, to clear the market. As a result, a negative aggregate demand externality arises when the substitution effect dominates, under the condition presented in Lemma 5. Inactive households have a desire to substitute non-traded goods with traded goods, implying \( \tau^c > 0 \). Preventing them to do so implies that traded and non-traded goods must be more substitutable for the substitution effect to dominate in the aggregate, but the discrepancy disappears as \( a \uparrow 1 \). Finally, it is worth noting that starting from a full employment employment equilibrium at time \( t \), while an improvement in the financial terms of trade gives rise to an aggregate demand externality \( \tau_l(s^t, \nu^t) > 0 \), a worsening of the financial terms of trade, which increases demand from non-traded goods, results in no externality since households optimally trade-off consumption and leisure with wages adjusting accordingly. Therefore, aggregate demand externalities in this model are primarily a concern to policy makers faced with capital inflows.

### 4 Optimal hegemon policy

As highlighted in a growing literature on the IMS and the global financial cycle, see Gourinchas and Rey (2005), Rey (2015) and Jiang, Krishnamurthy, and Lustig (2018), the international risk sharing arrangement is asymmetric across countries. In particular, during periods of global

\[^{17}P(s^t)C(s^t) = M(s^t)\) requires that \( p_T(s^t)c_T(s^t) + p_{NT}c_{NT}(s^t) = M(s^t) \). A rise in \( c_T \) must be offset by a fall in \( p_T \) or \( c_{NT} \) if \( p_{NT} \) is rigid. Since for a given price, \( c_{NT} \) is increasing in \( c_T \), \( p_T \) must necessarily be lower in any state of the world where \( c_T \) is higher.\]
uncertainty, there is a flight to safety to the U.S, which results in lower borrowing costs for U.S. households vis-a-vis foreign households. However, I highlights that aggregate demand externalities which arise if prices are sticky can result in a fall in welfare if there is limited financial market participation by households. As a result, macroprudential interventions, in the form of capital inflow taxes, can be unilaterally optimal for the hegemon.

The planner seeks to maximize the lifetime utility of households in the hegemon country only. I solve the planning problem following the primal approach, commonly used in the optimal tax literature, following Lucas and Stokey (1983). As in Costinot, Lorenzoni, and Werning (2014), I assume the hegemon is able to commit at date 0 to a sequence of taxes and the foreign country pursues a passive strategy.

To illustrate the intratemporal dimension of the trade-off, consider a representative agent who consumes aggregate quantities. The derivative of flow utility with respect to $\Gamma$, in any state $s^t$, is given by,

$$\frac{dW}{d\Gamma} = \frac{dc^A_T}{d\Gamma} \left( \frac{\partial u(c)}{\partial c_T} \right) + \frac{dc_{NT}}{d\Gamma} \left( \frac{\partial u(c)}{\partial c_{NT}} - \frac{d\psi}{dl} \frac{dY(l)}{dl} \right), \forall s^t \in S^t. \quad (20)$$

Aggregate welfare is increasing in the consumption of endowed traded goods and produced non-traded goods, and is decreasing in labour supply. Consumption of traded goods is strictly increasing as the financial terms of trade improve ($\Gamma \uparrow$), since in a complete markets environment this will tilt the traded wealth distribution in favour of active households in the hegemon (see Proposition 2), while leaving traded consumption of inactive households unaffected, under the assumption of autarkic allocations. In equilibrium, this is associated with an exchange rate appreciation and the price of traded goods falls. If prices are sticky and domestically produced goods are sufficiently substitutable by imports (see Lemma 5), demand for domestically produced non-traded goods falls. Consequently, in periods when the economy is demand constrained and labour supply is entirely determined by the demand for non-traded goods, involuntary unemployment arises in the economy. Importantly, the gains from tilting the traded wealth distribution $\frac{dc_T}{d\Gamma}$ are scaled down by the measure of active households.

The hegemon’s planning problem is to choose aggregate variables $C(s^t), L(s^t)$ and market weights, given a set of Pareto weights $\{\mu_{\nu^t}, \int \mu_{\nu^t} = 1\}$, to maximize aggregate welfare. Under the maintained assumptions of demand-constrained production in the non-traded sector and autarkic consumption by financially inactive households, aggregate consumption and labour are fully determined by $c^A_T(s^t)$. It therefore suffices for the planner to choose a sequence $\{c^A_T(s^t)\}$

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18 The primal approach to optimal policy prescribes that the government chooses allocations and implementation is dealt with thereafter, whether it be via taxation. In part, this is because there are traditionally many combinations of taxes that can achieve such allocations – as discussed in Chari and Kehoe (1999).

19 CLW show that the optimal sequence of taxes is time consistent if the government can issue debt at all maturities.

20 Market weights $\phi$ are defined as in Werning (2007) such that choices of consumption and labour by a households with income $\nu_{NT}(s^t)$ satisfy $(c(s^t, \nu^t), l(s^t, \nu^t)) = h(c(s^t), l(s^t), \nu^t, \phi)$. 

to maximize,
\[
\sum_{t=0}^{\infty} \int_{s' \in S^t} \int_{\nu' \in V^t} \mu'^{\beta} \left[ u\left(c_T(s', \nu'), c_{NT}(s', \nu')\right) - \psi\left(l(s', \nu')\right)\right] f(s') \, g(\nu') \, ds' \, d\nu' \tag{21}
\]
subject to the implementability condition (14), the slackness condition (16) and the effective aggregate demand equation (19). Under the maintained assumptions, the maximand can be rewritten as,
\[
\sum_{t=0}^{\infty} \int_{s' \in S^t} \beta^t \left[ \mu^A a(s') + \mu^A c_T(s') h\left(\frac{p_T(s')}{p_{NT}(s')}\right) c_T^A(s') + \mu^{NA} \int_{\nu} g(\nu') d\nu' - \psi\left(h\left(\frac{p_T(s')}{p_{NT}(s')}\right) c_T^A(s')\right)\right] f(s') \, ds' \tag{23}
\]
where I have specified that \(\mu^\nu = \mu^A \forall \nu \in [\underline{\nu}, \bar{\nu}]\) and \(\mu^\nu = \mu^A\) otherwise. The planner chooses the consumption of traded goods for active households to maximize the sum of the utility of a representative active household of measure \(a\) and of a continuum of inactive households which differ according to their draws of the idiosyncratic state \(\nu_i\). Households’ labour supply and consumption of non-traded goods and is pinned down by \(c_T^A\) and rationed uniformly. Since utility is time-separable and markets are complete, the planning problem is summarised by the following Lagrangean,
\[
\mathcal{L} = W(s') \, f(s') - \lambda \left\{ \rho(c_T^A(s')) \left[ c_T^A(s') - y_T^A(s')\right]\right\}, \tag{24}
\]
where \(\sum_{t=0}^{\infty} \int_{s' \in S^t} W(s') \, f(s') \, ds'\) is given by (23). The first order condition is given by,
\[
\frac{dW(s')}{dc_T^A(s')} = \lambda \left\{ \rho(c_T^A(s')) + \frac{d\rho(c_T^A(s'))}{dc_T^A(s')} \left[ c_T^A(s') - y_T^A(s')\right]\right\}. \tag{25}
\]

The LHS of (25) captures the marginal social benefit of increasing consumption of the traded good by active households by one unit. This object captures the intratemporal trade-offs arising due to inefficient inflows, nominal rigidities and limited financial market participation and is the initial object I focus on. The RHS of (25) characterises the marginal revenue that could be earned by selling one unit of traded consumption abroad and captures the dynamic dimensions of the policy trade-off. The first term is the price of one unit of traded consumption and the second term reflects how this price changes with hegemon households’ consumption. For a small open economy, the second term would be zero. The marginal social benefit of a unit of active

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21This follows by rewriting (21) as,
\[
\sum_{t=0}^{\infty} \int_{s' \in S^t} \int_{\nu' \in V^t} \beta^t \left[ \mathbb{1}_{\{\nu' \leq \bar{\nu}\}} u\left(c_T(s', \nu'), c_{NT}(s')\right) + \mathbb{1}_{\{\nu' > \bar{\nu}\}} u\left(c_T(s', \nu'), c_{NT}(s')\right) + \mathbb{1}_{\{\nu \leq \nu' \leq \bar{\nu}\}} u\left(c_T(s', \nu'), c_{NT}(s')\right) - \psi\left(\frac{1}{A(s')}c_{NT}(s')\right)\right] f(s') \, g(\nu') \, ds' \, d\nu' \tag{22}
\]
The marginal social benefit of active households’ consumption of traded goods differs from the marginal private benefit to active households, attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin). The gains from an increase in financial market participation (extensive margin), attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin). The gains from an increase in financial market participation (extensive margin), attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin). The gains from an increase in financial market participation (extensive margin), attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin).

\[
\frac{dW(s^t)}{dc_T^A(s^t)} = \mu^A a(s^t) \left[ \frac{\partial u(c^A_T(s^t), c_{NT}(s^t))}{\partial c^A_T(s^t)} \frac{\partial u(c^A_T(s^t), c_{NT}(s^t))}{\partial c_T^A(s^t)} \frac{\partial c_T^A(s^t)}{\partial c_T^A(s^t)} - \frac{\partial u(c^A_T(s^t), c_{NT}(s^t))}{\partial c_{NT}(s^t)} \frac{\partial c_T^A(s^t)}{\partial c_{NT}(s^t)} \right] + \mu^A \frac{d c_T^A(s^t)}{d c_T^A(s^t)} \int \frac{\partial u(c^A_T(s^t), \nu^t)}{\partial \nu^t} \tau(s^t, \nu^t) g(\nu^t) d \nu^t + \mu^A \Omega(s^t)
\]

(26)

I define the direct gains to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin). The gains from an increase in financial market participation (extensive margin), attributable to an improvement in the financial terms of trade are captured by,

\[
- \frac{d \bar{\pi}(s^t)}{d c_T^A(s^t)} g(\pi(s^t)) \left( u(c^A_T(s^t), c_{NT}(s^t)) - u(c^A_T(s^t), c_{NT}(s^t)) \right) + \frac{d \bar{\nu}(s^t)}{d c_T^A(s^t)} g(\bar{\nu}(s^t)) \left( u(c^A_T(s^t), c_{NT}(s^t)) - u(c^A_T(s^t), c_{NT}(s^t)) \right)
\]

(27)

The marginal social benefit of active households’ consumption of traded goods differs from the marginal private benefit to active households, attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin). The gains from an increase in financial market participation (extensive margin), attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin). The gains from an increase in financial market participation (extensive margin), attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin). The gains from an increase in financial market participation (extensive margin), attributable to an improvement in the financial terms of trade as the consumption gains from tilting the wealth distribution, abstracting from demand externalities and for a given level of financial market participation (intensive margin).

**Proposition 6** (Negative marginal benefit for inactive households)

In any state $s^t$, the direct gains to the hegemon from tilting the wealth distribution accrue only to financially active households of measure $a(s^t) < 1$. If $\theta > 1 - (ac_T^A)/c_T$, the marginal benefit of tilting the wealth distribution is negative for every inactive household.

Following the wealth transfer from active households in the foreign country to active households in the hegemon, the latter overconsume relative to the social optimum (for the hegemon) and there is a negative aggregate demand externality. In the presence of nominal rigidities, domestic equilibrium outcomes can be inefficient and if domestic financial markets are incomplete, welfare may fall because financially inactive households are worse off. However, this will be partly offset by the extensive margin, an increase in financial market participation.

**Lemma 7** (Overborrowing by financially active households)

If $\theta > 1 - (ac_T^A)/c_T$, financially active households overborrow relative to the social optimum.

The sequence of consumption $\{c_T^A(s^t)\}$ is sufficient to pin down consumption allocations for all
households, under the maintained assumptions I maintain. The optimal level of consumption for a benevolent planner is pinned down where the marginal social benefit of a unit of consumption is equal to the revenue that could be raised from selling it abroad. The marginal social benefit of consumption is lower than a flexible price equilibrium, see Lemma 7, while the marginal revenue that could be earned abroad from selling a unit of consumption is unchanged for a given level of consumption, since assets are priced by foreign active households’ stochastic discount factor. As a result, the planner chooses a lower \( c^A_t(s^t) \) than the allocation in the decentralized equilibrium.

**Proposition 8 (Optimal capital inflow tax)**

The hegemon has an incentive to tax capital inflows \( \tau_x(s^t) > 0 \), if welfare falls in response to an improvement in the financial terms of trade, \( dW(s^t)/dc^A_t(s^t) < 0 \), subsidize capital inflows \( \tau_x(s^t) < 0 \) if \( dW(s^t)/dc^A_t(s^t) > 0 \) and sets capital inflow tax to zero if \( dW(s^t)/dc^A_t(s^t) = 0 \).

The relative importance of the forces at play depends on a variety of factors such as the goods’ and labour market structures, the idiosyncratic distribution and the Pareto weights. The aggregate welfare gains \( W(s^t) \) from an improvement in the financial terms of trade (\( \Delta \Gamma > 0 \)) associated with hegemony are lower, and possibly negative, as: i) wages become more rigid (\( \gamma^w \uparrow 1 \)) and goods become more substitutable \( \theta \) high, ii) participation of households in financial markets is low (\( a_{low} \)) and \( d^2c_{NT}/(dc^A_t da) \) is relatively small, iii) there exists limited scope to incentivize higher participation (\( \gamma \) high), iv) the Pareto weight attached to inactive households is high (\( \mu^{NA \ high} \)). Active households increase their consumption in response to (\( \Gamma \uparrow \)), resulting in capital inflows and an exchange rate appreciation. Foreign goods appear less expensive and relative goods’ prices are distorted because wages in the domestic sector cannot adjust downwards. Allowing for imperfect downward nominal wage rigidity, the negative aggregate demand externality is higher as the share of wage contracts that can be renegotiated down falls, but also as domestic and foreign goods become more easily substitutable. As the measure of households participating in financial markets \( a \) rises, so does the aggregate benefit accruing to hegemon households in international financial markets. However, while a higher level of financial participation will imply larger direct gains, it will also imply a larger in magnitude aggregate demand externality \( d^2c_{NT}/(dc^A_t da) > 0 \). Additionally, since the planner’s preferences are concave, there is a preference for more equal allocations across households which is realised when financial market participation rises. Finally, political economy considerations must be accounted for since elected governments facing domestic heterogeneity may disproportionately appeal to the interests of their voter base. As the Pareto weight attached to households not participating in financial markets rises, the welfare gains from hegemony fall drastically.

Following the financial crisis, both the percentage of households holding stocks, bonds or mutual funds and the percentage of households with mortgages plummeted by around 15%. The aggregate welfare gains associated with the cheaper credit enjoyed by hegemon households may have fallen significantly. In addition, regional variation in financial market participation

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23This intuition was formulated in a representative agent endowment economy in Costinot, Lorenzoni, and Werning (2014).
and political economy considerations may incentivize the hegemon government to overweight the welfare of inactive households. As a result, the balance of incentives for the hegemon government is likely to have tilted towards a more prudential and protectionist stance, which can be implemented by capital inflow taxes, amongst other instruments.

**Implementation.** Capital flow taxes distort active households’ intertemporal consumption allocation, who take lump-sum taxation as given. A capital inflow tax increases the cost of borrowing to households and disincentivizes them from increasing current consumption in response to an improvement in the financial terms of trade. Allowing for capital flow taxes, the risk-sharing equation (13), becomes,

\[
\frac{u'(c^A(s_t+1))}{u'(c^{A*}(s_t+1))} \frac{P^*(s_t+1)e(s_t+1)}{P(s_t+1)} \xi^{-1}(s_t) = \frac{\Gamma(s_t)}{1 + \tau^x(s_t)} \forall s_t \in S_t.
\]

If \( \eta = \tilde{\eta} \) and \( \frac{dW(s')}{dc^A}(s') < 0 \) it is optimal for capital inflow taxes to offset improvements in the financial terms of trade one for one, since the lump-sum rebates to domestic households exactly offset the rebate of losses from ownership of financial intermediaries. If \( \eta < \tilde{\eta} \), the optimal capital controls still have the opposite sign of \( \Gamma - 1 \), but do not fully offset the shock since the losses from ownership of financial intermediaries are disproportionately borne by foreign households, as in Farhi and Werning (2012).

**Discussion.** The model economy features heterogeneity in income, but no heterogeneity in wealth. To the extent that the participation costs reflect collateral costs, allowing for a distribution of \( \gamma(\nu') \), as in Alvarez, Atkeson, and Kehoe (2009), can capture the implications of wealth on financial market participation. Wealthy households would face a lower \( \gamma(\nu') \) for a given level of income, generating a positive relationship between financial market participation and wealth. An improvement in the financial terms of trade (\( \Gamma \uparrow \)) would have additional distributional effects, and the trade-offs facing the hegemon are likely to worsen.

Additionally, while I focus on limited financial market participation of households as a key friction, limited financial market participation by firms will deliver a similar trade-off. In particular, not all firms have access to capital markets and especially not international markets. The issue is exacerbated when taking into account that excess demand for U.S. assets does not necessarily extend beyond treasuries and AAA bonds. A model where firms face an investment choice, are subject to idiosyncratic income shocks and must pay a fixed cost to access international capital markets will once again deliver the economic trade-off discussed above.\(^24\)

Although the focus of this paper is the domestic policy dilemma faced by the hegemon, I briefly discuss the international macroeconomic outcomes resulting from asymmetries in international financial markets. First, I have assumed that financial intermediation of hegemon debt is less costly than intermediation of foreign debt. U.S debt flows may be easier to intermediate because they are subject to higher enforcement standards or are less prone to sudden exchange rate depreciations, see Mendoza, Quadri, and Ríos-Rull (2009), Farhi and Maggiori

\(^{24}\)This would be similar in spirit to Maggiori, Neiman, and Schreger (2018) who sketch a simple model where firms must pay a fixed cost to borrow in foreign currency, generating size dependent selection as in Melitz (2003) and argue that this is consistent with data on bond issuances and currency denomination.
Notice that the total cost of international intermediation, in equilibrium, is decreasing in the share of U.S. inflows, $d\omega(f, f^*)/df < 0$. Should the U.S. tax capital inflows such that the international capital allocation tilts away from the United States, total costs of financial intermediation will rise and global welfare could fall as international financial markets become less efficient.

Second, over-borrowing by financially active households in the hegemon inflicts a positive aggregate demand externality abroad since a foreign exchange rate depreciation stimulates demand for foreign goods and results in higher foreign employment. However, the magnitude of the employment gains depends on the upward rigidity of wages, which in the data is found to be significantly lower than downwards rigidities, see Barattieri, Basu, and Gottschalk (2014) and Jo (2019) amongst others. Employment losses in the hegemon are therefore likely to outweigh the gains abroad.

As a result, the response of global welfare to fluctuations in the financial terms of trade, and therefore U.S. macroprudential policy is ambiguous. Should the U.S. employ capital inflow taxes to offset financial asymmetries, even though the unemployment avoided domestically is likely to outweigh the foregone employment abroad, international financial markets become less efficient as foreign debt flows are costlier to intermediate.

### 4.1 Dynamic Efficiency

An increase in current consumption comes at the expense of a fall in consumption in some future states which may or may not be dynamically inefficient. Costinot, Lorenzoni, and Werning (2014) show that a large economy has an incentive to manipulate its monopsony power over the terms of trade over time, and this is independent on whether the country is a borrower or a lender.\(^{25}\) Consider two periods $t, t + 1$ (or states) and suppose that the hegemon runs a deficit in both. The hegemon is purchasing units of current consumption by selling units of future consumption and has an incentive to drive down (up) current (future) prices by consuming relatively less today. The incentive to do so is higher in periods of higher deficits, for example in period $t$ relative to $t + 1$ if $y_{T,t+1} > y_{T,t}$. In contrast, in a small open economy, any distortion to intertemporal allocations is inefficient. An improvement in the financial terms of trade in period $t$, $\Gamma_t \uparrow$, associated with inefficient capital inflows, increases the relative price of future consumption incentivizing households in the hegemon country to consume more in period $t$.

**Proposition 9** (Dynamic efficiency)

As long as the marginal social value of $c_A^1(s^t)$ is positive, an improvement in the financial terms of trade worsens dynamic efficiency if the associated capital inflows are countercyclical and improves dynamic efficiency if capital inflows are procyclical.

Asymmetries in financial markets which encourage households in the hegemon country to borrow improve the dynamic efficiency of the domestic economy during periods of high tradable output, $y_{T,t} > y_{T,t+1}$, by driving up the relative price of current consumption when the trade output
deficit is lowest. During periods of low tradable output, increased borrowing by financially active households drives up the price of imports when the trade deficit is largest and the intertemporal consumption allocation is inefficient. As a result, even financially active agents who increase consumption in response to an improvement in the financial terms of trade, assign their consumption inefficiently across time if the financial terms of trade are countercyclical. Gourinchas, Rey, and Govillot (2018) argue that the 'exorbitant privilege' carries an 'exorbitant duty' as the U.S. is called upon to provide insurance to the rest of the world in periods of global stress. I suggest that one channel for this is through favourable to the rest of the world movements in the terms of trade vis-a-vis the US. 26

However, the presence of negative aggregate demand externalities works against the incentives of the hegemon to exercise its monopsony power in goods markets. Consider once again the case where the hegemon is a debtor. In periods of higher tradable endowment the hegemon has a lower incentive to drive down consumption prices therefore a capital inflow subsidy is prescribed. However, in periods of high tradable consumption the discrepancy between the private and social marginal welfare of $c^A_t(s^t)$ is highest and there is an incentive for macroprudential intervention restricting capital inflows, lowering the incentives for dynamic manipulation of the terms of trade. On the other hand, during periods of low tradable endowment, the hegemon wants to exercise its monopsony power to lower the price of consumption. However, in these periods, it is least concerned about aggregate demand externalities which are likely to be small.

**Proposition 10** (Optimal capital taxation and demand externalities)

Negative aggregate demand externalities mitigate the incentives of the hegemon to engage in dynamic manipulation of the terms of trade.

5 Quantitative Study

5.1 Extended Model

I now explore the results above in a calibrated model with a richer production structure and occasionally binding wage constraints. The model is a variation on the workhorse two-country New-Keynesian model prevalent in international macroeconomics, as in Farhi and Werning (2017) and Corsetti, Dedola, and Leduc (2018) amongst others. I introduce endogenous limited financial market participation and international financial market segmentation to the model. Wages are downward rigid, as only a fraction of wage contracts can be renegotiated each period. I specialize the period utility of households to be non separable in consumption and leisure, following Greenwood, Hercowitz, and Huffman (1988) henceforth GHH, such that

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26Rey (2015) argues that the global financial cycle can lead to excessive credit growth during upturns and excessive retrenchment during downturns. However, the model I consider does have credit market frictions per se, and the relevant distortion is monopsony power in goods markets.
in each period households maximize,

$$u(c, l) = \frac{1}{1-\sigma} \left( c - \kappa \frac{l^{1+\eta}}{1+\eta} \right)^{1-\sigma} - 1, \quad \kappa, \sigma, \eta > 0. \quad (28)$$

GHH preferences imply that labour supply is not subject to wealth effects, in line with evidence in Schmitt-Grohe and Uribe (2012). This is particularly well suited for the analysis in this paper since when the economy is demand constrained, employment must be rationed. In a model with rich inequality across agents in the presence of wealth effects on labour supply it is unclear how to correctly ration employment. GHH utility implies the labour wedge (18), as defined on the aggregate consumption good, is independent of $\nu^t$. The first order conditions for the households are given by,

$$\left( c(s^t, \nu)^t - \kappa \frac{l^{1+\eta}(s^t, \nu)^t}{1+\eta} \right)^{-\sigma} = \lambda(s^t, \nu)^t p(s^t),$$

$$\kappa l^n(s^t, \nu)^t \left( c(s^t, \nu)^t - \kappa \frac{l^{1+\eta}(s^t, \nu)^t}{1+\eta} \right)^{-\sigma} = \lambda(s^t, \nu)^t w(s^t),$$

which imply that labour supply is given by,

$$l^s(s^t, \nu)^t = \left( \frac{1}{\kappa \frac{w(s^t)}{p(s^t)}} \right)^{\frac{1}{\eta}}, \quad (29)$$

and does not depend on $\nu^t$, therefore is common for all households.

The composite consumption good is described by the following nested CES aggregator,

$$C = \left[ \chi^{1-\theta} C^\theta_{NT} + (1-\chi)^{1-\theta} C^\theta_{T} \right]^{1/\theta}, \quad (30)$$

where $\frac{1}{1-\theta}$ is the elasticity of substitution between traded and non-traded goods and $C_T$ is described by,

$$C_T = \left[ a_H^{1-\phi} C^\phi_H + (1-a_H)^{1-\phi} C^\phi_F \right]^{1/\phi}, \quad (31)$$

where $\frac{1}{1-\phi}$ is the Armington elasticity. Foreign households’ preferences are symmetric.

I consider production in a continuum of varieties of traded goods which differ across countries. A competitive firm aggregates these varieties according to,

$$Y_H = \int_0^1 \left( Y_H^{i+1/\epsilon} \right)^{1-1/\epsilon} \frac{1}{1-1/\epsilon} \, dt, \quad \epsilon > 1$$

Each variety is produced by a monopolist with linear technology $Y_H^{i} = A(s^t) L^i$. In the hegemon, monopolists hire labour in a competitive market at a wage $w$ and sets prices $p_H^{i}, p_H^{i*}$ to maximize
profits, taking aggregate demand for home goods, $C_H^i$ domestically and $C_H^{i*}$ abroad, as given,

$$\max_{\{p_H,p_H^{i*}\}} \left( p_H - \frac{w}{A} \right) C_H^i + \left( e_p H^i - \frac{w}{A} \right) C_H^{i*},$$

and the optimal price is a constant markup over wage costs. In a symmetric equilibrium,

$$p_H = \frac{\epsilon w}{\epsilon - 1} A.$$  

The price of goods produced abroad $p_F$ is derived analogously. In the first instance, I assume firms price their goods in their domestic currency (PCP), such that $p_H^* = p_H/e$ and $p_F = p_F^e$, which results in perfect exchange rate pass-through. I revisit the case of dominant currency pricing (DCP) in section 5.4 where I study the implications of international trade pricing practices on the welfare costs of inefficient capital flows. Since producers now compete over both domestic and foreign consumers, aggregate demand externalities are larger that in the reduced model.

Wages paid in the traded sector are downwards rigid, and the economy is subject to the complementary slackness condition (16). Prices inherit the rigidity of wages. In states of the world where the economy is demand constrained economy, production is determined by demand and by market clearing, total demand is given by,

$$Y_H = c_H + c_H^* + a_H \gamma_H + a_H^* \gamma_H^*, \quad Y_F = c_F + c_F^* + a_F \gamma_F + a_F^* \gamma_F^*,$$

where $\gamma_H, \gamma_H^*, \gamma_F, \gamma_F^*$ are shares of the participation cost paid in each good variety. The demand for individual traded varieties is given by,

$$c_H = \frac{a_H}{1 - a_H} \left[ p_H^{i*} \right]^{-1} \frac{1}{1 - \phi} c_F, \quad c_F^* = \frac{a_H}{1 - a_H} \left[ p_F^{i*} \right]^{-1} \frac{1}{1 - \phi} c_H^*.$$  

5.2 Calibration

The calibration for the model is reported in Table 1. A key parameter governing existence, sign and magnitude of aggregate demand externalities in the model is the aggregate Armington elasticity, recently estimated in Feenstra et al. (2014). The reported range for the disaggregated sector specific elasticities, with metals being lowest and electronics being highest is $[0.88, 3.48]$. Simply weighting sectoral elasticities by their import contribution would result in an aggregate elasticity of 2.32 and I calibrate to an Armington elasticity of 2, which is used in their paper. The shares of traded and non-traded goods, and the elasticity of substitution between traded and non-traded goods are calibrated according to estimates in Corsetti, Dedola, and Leduc (2008) and Mendoza (1991) respectively. These estimates are also close to those of Stockman and Tesar (1995). I calibrate downward nominal wage rigidities in line with Jo (2019) who estimates $\gamma^w = 0.67$, i.e. 67% of contracts are renegotiated downwards annually using the Current Population Survey (1979-2017). This is consistent with Barattieri, Basu, and Gottschalk (2014)
who find that although 21% of wages are adjusted quarterly, of which, only a total of 2.6% of wage adjustments were downwards, using survey data from the Survey of Income and Program Participation for the period 1996-1999. The idiosyncratic shock distribution is calibrated in line with Cociuba and Ramanarayanan (2017) who use CEX data from Heathcote, Perri, and Violante (2009) to estimate residual variances of quarterly income and consumption unexplained by household characteristics. Finally, I calibrate the financial participation cost to match a financial participation margin of 50%, consistent with estimates in Vissing-Jorgensen (2002) who uses household level data from the Panel Study of Income Dynamics and other datasets.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rate</td>
<td>$\beta = 0.992$</td>
</tr>
<tr>
<td>Coefficient of risk aversion</td>
<td>$\sigma = 2$</td>
</tr>
<tr>
<td>Share of non traded</td>
<td>$\chi = 0.45$</td>
</tr>
<tr>
<td>Elasticity parameter (T,NT)</td>
<td>$\frac{1}{1-\phi} = 0.74$</td>
</tr>
<tr>
<td>Share of home traded</td>
<td>$a_H = 0.72$</td>
</tr>
<tr>
<td>Elasticity parameter (H,F)</td>
<td>$\frac{1}{1-\theta} = 2$</td>
</tr>
<tr>
<td>Elasticity traded varieties</td>
<td>$\epsilon = 11$</td>
</tr>
<tr>
<td>Wage rigidity (quarterly)</td>
<td>$\gamma_w = 0.905 (67% \text{ annual})$</td>
</tr>
<tr>
<td>Frisch elasticity</td>
<td>$1/\eta = 2$</td>
</tr>
<tr>
<td>Idiosyncratic shock distribution</td>
<td>$lognormal$</td>
</tr>
<tr>
<td>Financial participation cost</td>
<td>$\gamma_c = 0.045 (a = 50% \text{ annual})$</td>
</tr>
</tbody>
</table>

Table 1: Calibration for benchmark model. The discount factor $\beta$ is set such the annual interest rate is 3% and $\kappa$ is set so that hours worked are 1/3 in the steady state.

The stochastic shock process is given by a trend stationary AR(1) process,

$$\tilde{s}_t = \rho \tilde{s}_{t-1} + u_t,$$

where $s_t = [\hat{Y}_{NT,t}, \hat{Y}_{NT,t}^*, \hat{A}_{T,t}, \hat{A}_{T,t}^*, \hat{\Phi}_{t,t}]$, are disturbances, in percentage terms, to non-traded output, traded productivity and $\Phi_{t,t}$ are panel CIP deviations, $\rho$ is a 5x5 matrix capturing the autocorrelation properties of the shocks and $V(u)$ is the variance covariance matrix. Output and productivity data is estimated from the OECD STAN database. Foreign estimates are constructed as a trade weighted average of G10 currency countries. The series are constructed from 1999 to 2017. The shock process for $\Gamma$ is estimated using CIP deviations vis-a-vis the U.S. from the panel of G10 currencies, and is detailed in Appendix D. At an annual frequency, the

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26In particular, they regress regress income and consumption on sex, race, education, age, interaction terms between experience and education, and dummies for region of residence, following Krueger and Perri (2006), from 1980Q1 to 2003Q4.
autocorrelation matrix is given by,

\[
\rho = \begin{bmatrix}
0.26 & 0.18 & -1.01 & 0.37 & -17.63 \\
-0.13 & 0.76 & -0.60 & -0.02 & -19.94 \\
0.27 & -0.24 & 0.81 & -0.26 & -5.84 \\
-0.01 & -0.10 & 0.05 & 0.95 & -5.72 \\
-0.02 & 0.07 & -0.10 & 0.01 & -0.17
\end{bmatrix},
\]

and the covariance matrix, is given by,

\[
V(u) = \begin{bmatrix}
1.68e^{-3} & -6.55e^{-4} & -1.36e^{-3} & 2.49e^{-4} & 9.63e^{-6} \\
-6.55e^{-4} & 1.98e^{-3} & 1.59e^{-3} & 6.36e^{-5} & 5.18e^{-5} \\
-1.36e^{-3} & 1.59e^{-3} & 2.21e^{-3} & -1.03e^{-4} & 2.19e^{-5} \\
2.49e^{-4} & 6.36e^{-5} & -1.03e^{-4} & 8.68e^{-5} & 2.32e^{-6} \\
9.63e^{-6} & 5.18e^{-5} & 2.19e^{-5} & 2.32e^{-6} & 3.55e^{-6}
\end{bmatrix}.
\]

Importantly for the analysis, the sample mean of panel CIP deviations is 51.98 basis points, or 0.5198%, implying that on average, the return on U.S. treasuries, hedged for currency risk, is about half a percent lower than a trade-weighted portfolio of foreign government bonds. I normalize steady state output and productivity levels to 1, and impose symmetry across countries.

I solve the model on a \([16384 \times 7]\) grid for the state variables \(\{Y_{NT}, Y_{NT}^*, A_T, A_T^*, \Gamma, w_{t-1}, w_{t-1}^*\}\) and I use Chebyshev interpolation to evaluate the variables of interest, as in Cociuba and Ramarayan (2017). I consider grids up to 4 standard deviations from the mean of each variable, 8 for wages, and I use 4th order Chebyshev polynomials. I solve for households’ financial market participation choice using the Matlab Symbolic Toolbox to handle equation (8). For each point on the state space, I evaluate the households’ participation choice and derive the measure of participating agents and, additionally, I check if the downward wage rigidity (16) is binding.

5.3 Results

Figure 3 shows the impulse response of prices and allocations to an improvement in the financial terms of trade associated with a 1% drop in U.S interest rates. Active households increase their current consumption of traded goods, \(c_A^t \uparrow\), with their consumption of imports \(c_A^t \uparrow\) rising more than their consumption of home goods \(c_H^t \downarrow\). In equilibrium, the dollar appreciates and the relative price of imports falls for US households. Inactive households do not reallocate consumption intertemporally. Faced with relatively cheaper imports they substitute consumption away from domestically produced goods resulting in a fall in domestic aggregate demand for home goods \(c_H\). Abroad, the price of U.S exports rises and foreign households substitute

\[28\] I adjust these estimates to a quarterly calibration, as in Edmond and Veldkamp (2009).

\[29\] Changing the order or the grid, or using splines rather than Chebyshev polynomials does not significantly affect the results.
their consumption towards domestically produced alternatives ($c^*_H \downarrow$). Overall production in the U.S. falls ($Y_H \downarrow$) as there is expenditure switching away from home goods by both domestic and foreign households. As a result, there is a rise in involuntary unemployment in the U.S., leading to a negative income effect on all domestic households. The downward nominal wage rigidity which prevents price adjustments in equilibrium is binding for 10 quarters. While for active households, this is offset by increased borrowing, inactive households consumption falls. As a result, there is a significant increase in financial market participation of around 1.4%.

![Figures showing impulse responses](image)

**Figure 3**: Impulse response, in % percentage deviations from the steady state, to an improvement in financial terms of trade ($\Gamma \uparrow$), under producer currency pricing.

In contrast, a shock to non-tradable output of the same magnitude, i.e a productivity shock or labour earning shock, would lead to a larger increase in both active and inactive households’ consumption, driven by a rise in consumption of non-traded goods. As a result, financial market participation actually falls slightly. The exchange rate depreciates but wages rise, and the wage rigidity is then binding throughout, resulting in a slight fall in home production.

A necessary condition for the emergence of aggregate demand externalities is the presence of nominal rigidities. Downward nominal wage rigidities pose an occasionally binding constraint to firm’s pricing. Figure 7 in Appendix C shows the comparative statics of the impulse responses to consumption, production and wages under different parametrizations of $\gamma^w$. While the impact response of these variables is unchanged as I assume there is no renegotiation in the period of the shock, the adjustment process is much faster when $\gamma^w$ is lower.

### 5.4 Inefficient capital flows, aggregate demand externalities and dominant currency pricing

In this section I contrast the macroeconomic outcomes of inefficient capital flows under PCP, as reported in the previous section, with the case of dominant currency pricing (DCP) where firms in both the U.S and the foreign country invoice their goods in dollars. The U.S is then special
along at least two dimensions in international markets, it issues assets which command a large convenience yield and it issues the currency in which most of international trade in goods is invoiced. In particular, the short-run exchange rate pass-through to import prices is given by,

\[ p_F = p_F^* e^{\hat{\xi}}. \]
\[ p_H = p_H e^{-\hat{\xi}^*}. \]

Under PCP, as studied in previous sections, \( \hat{\xi} = \hat{\xi}^* = 1 \). In contrast, under local currency pricing (LCP) \( \hat{\xi} = \hat{\xi}^* = 0 \). The case of interest (DCP) requires \( \hat{\xi} = 1, \hat{\xi}^* = 0 \).

Figure 4 shows the analogous impulse response to an improvement in the financial terms of trade \((\Gamma \uparrow)\) under DCP. Overall, consumption rises by less since the U.S. terms of trade fails to improve since the price of imports is fixed. However, aggregate demand externalities are lower since domestic households do not substitute away from home goods. The analysis suggests that dominant currency pricing exacerbates the welfare costs of financial hegemony if the hegemon issues the currency of trade invoicing, and I study this further in section 5.5.

![Figure 4: Impulse response](image)

Figure 4: Impulse response, in % percentage deviations from the steady state, to an improvement in financial terms of trade \((\Gamma \uparrow)\), under dominant currency pricing.

## 5.5 Welfare

Finally, I analyse the response of welfare to inefficient capital inflows. I evaluate the welfare implications of PCP vs DCP and analyse the contribution of active and inactive household welfare. I define aggregate welfare as,

\[ W = \sum_{t=0}^\infty \int_s \int_{\nu t} [\beta^t u(c(s^t, \nu^t), l(s^t))] f(s^t)g(\nu^t) ds^t d\nu^t, \]

where \( u(\cdot) \) is given by (28) and is of GHH form.
I construct the Hicksian equivalent variation for welfare, measured in percentage consumption terms, as used in Lucas (2003) to evaluate the welfare costs of business cycles. In particular, I construct a set of time-invariant proportional consumption transfers \( \{ \mu(\nu) \}_{\nu \in V} \) such that each agent is equally well off across two regimes,

\[
\sum_{t=0}^{\infty} \int_{s^{t}} \left[ \beta^{t} u \left( c^{n}(s^{t}, \nu^{t}) (1 + \mu(\nu)), l^{n}(s^{t}) \right) \right] f(s^{t}) ds^{t} = \int_{\nu^{t} \in V} \mu(\nu^{t}) g(\nu^{t}) d\nu^{t}
\]  

where \((c^{n}(s^{t}, \nu^{t}), l^{n}(s^{t}, \nu^{t}))\) are equilibrium consumption and leisure allocations under the new regime and \((c^{o}(s^{t}, \nu^{t}), l^{o}(s^{t}, \nu^{t}))\) are the corresponding allocations under the old regime. As a result of the aggregate demand externality and limited financial market participation, there is large heterogeneity in welfare outcomes with some households left worse off \((\mu(\nu^{t}) > 0)\) and some households enjoying higher welfare \((\mu(\nu^{t}) < 0)\). The aggregate transfer is derived as \(\int_{\nu^{t} \in V} \mu(\nu^{t}) g(\nu^{t}) d\nu^{t}\) and will in general differ from \(\mu^{RA}\), the compensation required by a notional representative household who consumes aggregate consumption and leisure.

Key to the existence of a policy dilemma is domestic market incompleteness, due to endogenously limited financial market participation. Since aggregate consumption rises, if lump-sum redistributive transfers were possible, the government could ensure that aggregate welfare rises by overcoming market incompleteness. In this case, the relevant metric for welfare would be \(\mu^{RA}\). In contrast, if markets are incomplete and redistributative lump sum transfers across agents are not desirable or feasible, then \(\int_{\nu^{t} \in V} \mu(\nu^{t}) g(\nu^{t}) d\nu^{t}\) is the relevant metric for aggregate welfare and welfare may fall even if aggregate consumption rises, due to heterogeneity in the fortunes of domestic households. This political disagreement lies at the heart of the hegemon’s dilemma.

Additionally, to correctly capture the welfare implications of involuntary unemployment in an economy with elastic labour supply, I assume that each agent supplies total labour hours \(l^{s}(s^{t}, \nu^{t})\), according to the FOC (30), but only \(Y_{H}(s^{t})/A(s^{t})\) hours to the productive traded sector. The remaining hours are dedicated to home production and are unproductive, as in Ragot and Le Grand (2017).

Figure 5 illustrates the divergence in fortunes of households along the idiosyncratic wealth distribution as a result of lower borrowing costs for households in the hegemon, reflected by covered interest rate parity (CIP) deviations.30 First, the Hicksian transfers for households which were always active are uniformly negative, indicating that their lifetime utility is higher in a regime with CIP deviations. Second, households which never participated in financial markets require positive transfers, with poorer households requiring the highest. Third, the transfers required by households occasionally active in financial markets are somewhere in between. Figure 8 in Appendix C shows how the distribution of transfers changes under DCP.

30I discretize the idiosyncratic shock distribution into 100 equally sized bins from 0.05 to 4. I average over 200 simulations of 400 periods. Changing these computational parameters does not significantly alter the results.
Figure 5: Distribution of Hicksian consumption equivalent welfare transfers, leaving each households indifferent between a regime with covered interest rate parity deviations (panel) and a regime where CIP deviations are set to 0.

Table 2 shows the sum of transfers, weighted by the distribution of idiosyncratic shocks under PCP, DCP, and under PCP in an economy with a representative agent who consumes aggregate consumption and works aggregate hours and if only active or inactive households’ welfare was valued.

<table>
<thead>
<tr>
<th>PCP</th>
<th>DCP</th>
<th>$\mu^{RA}$</th>
<th>$\mu^{NA} = 0$</th>
<th>$\mu^{A} = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.136e^{-4}$</td>
<td>$6.788e^{-4}$</td>
<td>$-6.518e^{-4}$</td>
<td>$-1e^{-3}$</td>
<td>$1.43e^{-3}$</td>
</tr>
</tbody>
</table>

Table 2: Hicksian welfare transfers under different regimes.

6 CIP deviations and the international allocation of credit

In this section I provide supporting evidence, in the form of conditional correlations that whilst negative deviations from the covered interest rate parity (consistent with excess demand for U.S Treasuries) are associated with a fall in total credit to the non-financial sector in a panel of advanced economies (G10 currencies), credit to the non-financial sector in the U.S is relatively stable and may even rise. The panel consists of Australia, Canada, Germany, Japan, New Zealand, Norway, Sweden, Switzerland, the United Kingdom and the United States. There is an emerging literature on the relationship between deviations from the covered interest parity and exchange rate movements, and more recently credit flows. In particular Avdjiev et al. (2016) show that CIP deviations are associated with both bilateral and trade-weighted exchange rate movements in the dollar. Additionally, they show that an appreciation in the dollar exchange
rate leads to a decrease of cross-border dollar lending. Niepmann and Schmidt-Eisenlohr (2018) show that an appreciation of the dollar is associated with a reduction in the supply of commercial and industrial loans by U.S. banks.

In the model above, international financial markets are segmented and international intermediation is subject to costs. In particular, hegemon liabilities are less costly to intermediate and this generates excess demand for these assets in equilibrium. Assuming that these intermediation pose constraints on the financiers’ balance sheets, rather than act as risk bearing constraints, this is reflected in deviations from the covered, as opposed to uncovered, interest rate parity. As a result, financially active households in the hegemon enjoy lower borrowing costs, and total borrowing rises. As detailed in Appendix D, I construct CIP deviations based on hedged portfolios of U.S and foreign government bonds following Du, Im, and Schreger (2018) and collapse them at the end of every quarter, for the regressions below.

The BIS total credit statistics capture the borrowing capacity and propensity of the private non-financial sector in a country and the government. The statistics include lending to households, non-financial corporations and the government, from all lenders both domestic and international via both loans and debt securities. I consider a balanced panel of the G10 currency countries from 1999Q1 to 2017Q2.

My preferred regression specification is given by,

$$\Delta \log(TC_{i,t}) = a + \beta_1 \overline{CIP}_{1,t} + \beta_2 \Delta \log(\varepsilon_t) + \delta_1 (\mathbb{1}_{i=\$} \times \overline{CIP}_{1,t}) + \epsilon_{i,t}$$

I focus on the panel mean of CIP deviations for two reasons. First, the question of interest considers heterogeneity only between the U.S. as hegemon and the rest of the world. Second, a large literature focuses on the role of a global financial cycle as a driving force for both CIP deviations and differences in international capital flows, therefore the implications of bilateral CIP deviations are diminished, although these remain significant in regressions. The key variables in the regression specification are $\beta_1$ which captures the implications of mean CIP deviations on total credit to the non-financial sector and $\delta_1$ which captures how this relationship differs for the U.S. The change in the nominal exchange rate is added as a control because it is a known driver of cross-border lending. The results are summarised in Table 2.

Notably, the interaction term is significant across specifications and robust to the introduction of changes in $\Delta \log(\varepsilon_t)$. Additionally, after controlling for changes in nominal exchange rates, regressions suggest that credit in the U.S overall, as well as private credit from banks (column 3), is associated with negative CIP deviations. Interestingly, Kalemli-Ozcan, Sorensen, and Yesiltas (2012), showed that bank leverage ratios in the U.S. did not rise during the crisis, when CIP deviations peaked, which suggests the possibility of credit inflows to the U.S. Bilateral CIP deviations are significant and of the correct sign, but become insignificant once nominal exchange rates are added.
\[ \Delta \log(TC_{i,j}) \]

\[ \Delta \log(TC_{i,j}) \]

\[ \Delta \log(TC_{priv-banks}) \]

\[ \Delta \log(TC_{i,j}) \]

\[ CIP_t \]

\[ 12.15 \]

\[ 1.506 \]

\[ 3.156 \]

\[ 10.66 \]

\[ 1.61 \]

\[ 2.54 \]

\[ -11.77 \]

\[ -11.78 \]

\[ -9.93 \]

\[ 3.27 \]

\[ -4.48 \]

\[ 2.84 \]

\[ -0.903 \]

\[ -0.703 \]

\[ -25.08 \]

\[ 14.72 \]

\[ 5.352 \]

\[ 6.25 \]

\[ 0.040 \]

\[ 0.0246 \]

\[ 0.030 \]

\[ 0.0199 \]

\[ 6.92 \]

\[ 5.75 \]

\[ 5.2 \]

\[ 3.24 \]

\[ 0.1337 \]

\[ 0.5382 \]

\[ 0.3221 \]

\[ 0.0550 \]

Table 3: Regression table for total credit, t-statistics reported in brackets.

### 7 Conclusion

I have analysed the policy trade-offs faced by a large open economy that issues assets in high international demand and, as a result, experiences inefficient capital inflows. I highlight that macroprudential policies restricting capital inflows can be unilaterally optimal for this economy. The economic trade-off I study arises in economies with limited financial participation by households and production subject to price rigidities, since the lower borrowing costs faced by hegemon households lead to over-borrowing by financially active households which distorts relative prices and results in involuntary unemployment via an aggregate demand externality. Due to an exchange rate appreciation, contemporaneously associated with an increase in consumption by financially active households, the relative price of imports falls and there is expenditure switching away from domestically produced goods. I calibrate a two-country model to the U.S and a trade-weighted average of G10 currency countries and jointly estimate output and CIP deviations to quantify the policy dilemma.

Several features of domestic and international markets exacerbate the costs to inefficient capital inflows for a large open economy. First, welfare gains from lower borrowing costs are proportional to financial market participation. The large fall in U.S financial market participation observed since the financial crisis may have tilted the balance of incentives for the U.S towards a more prudential stance. Second, welfare costs are higher if the hegemon faces imports invoiced in domestic currency. I show that under dominant currency pricing, the welfare costs to the hegemon are higher because exchange rate pass through to imports is zero. Third, the premium attached to U.S assets tends to be countercyclical. As a result, the consumption reallocation by active households is dynamically inefficient domestically since over-borrowing during recessions contributes to terms of trade deteriorations in periods where import demand is high in the hegemon.

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References


8 Appendix A

Proof to Proposition 1.
Consider the households’ asset market constraint. Setting \( r^G(s^t, \nu) = r^*(s^t, \nu)p(s^t) \cdot x(s^t) \), yields,
\[
\tau(s^t, \nu^t) \leq -x(s^t, \nu^t) + \int_{s^t}^{s^t+1} q(s^t+1, \nu^t+1)x(s^t+1, \nu^t+1)ds^t+1d\nu^t+1 + \pi(s^t, \nu^t),
\]
Financiers profits are given by, \( \Pi(s^t+1) = \int_{s^t}^{s^t+1}[\omega_x(s^t+1) - \omega_x(s^t)]x(s^t+1)ds^t+1 < 0 \), and rebates to the home country are \( \eta \Pi(s^t) = \int_{s^t}^{s^t+1} \omega_x(s^t) x(s^t) ds^t+1 \). As a result the home budget constraint becomes,
\[
\tau(s^t, \nu^t) \leq -x(s^t, \nu^t) + \int_{s^t}^{s^t+1} \tilde{q}(s^t+1, \nu^t+1)x(s^t+1, \nu^t+1)ds^t+1d\nu^t+1,
\]
where \( \tilde{q}(s^t+1) \) refers to the frictionless price of an internationally traded AD security. Solving the budget constraint forward, using the risk sharing condition (absent frictions) \( q^*(s^t)e(s_0)/e(s^t) = q(s^t) \), substituting autarkic consumption allocations for inactive agents and substituting for the foreign Euler condition yields (14).

Proof to Proposition 2.
Consider the international risk sharing condition (13). Since \( P = p_t/g_t \) and \( P^* = p_t^*/g_t^* \), this can be rewritten in terms of tradable goods as,
\[
\frac{u^t(c_t^A(c_t^A(s^t))))}{u_t(c_t^A(s^t))} \frac{p_t(c_t^A(s^t))/g_t(c_t^A(s^t))}{p_t^*(c_t^A(s^t))/g_t^*(c_t^A(s^t))} e(s^t)/g_t^*(c_t^A(s^t)) \xi^{-1}(s^t+1) = \Gamma(s^t)
\]
Rearranging, suppressing state notation unless required, and imposing the law of one price on tradable goods, \( (p_T = p_T^*) \),
\[
\Gamma = u^t(c_t^A)g_T(c_t^A) = u^t(c_t^A)g_T^*(c_t^A) \xi^{-1}
\]
I normalise \( \xi = 1 \forall \Gamma \), which implies that all functions \( u_t, u^t, p_T, p_T^*, g_T, g_T^* \), evaluated at \( c_t^A(s^t) \), are normalised by the analogues evaluated at \( c_t^A(s^t+1) \). Implicit differentiation yields,
\[
\frac{d\Gamma}{dt} = \frac{d\Gamma}{dt} + \frac{d\Gamma}{dt} \frac{u_t(c_t^A)g_T(c_t^A)}{u^t(c_t^A)g_T^*(c_t^A)} + \frac{d\Gamma}{dt} \frac{u_t(c_t^A)g_T^*(c_t^A)}{u^t(c_t^A)g_T^*(c_t^A)}
\]
Finally, rearranging yields,
\[
\frac{dc_t^A}{dt} = \frac{d\Gamma}{dt} = \frac{u_t(c_t^A)g_T(c_t^A)}{u^t(c_t^A)g_T^*(c_t^A)} > 0,
\]
\[
\Gamma = \frac{u_t(c_t^A)g_T(c_t^A)^2}{u^t(c_t^A)g_T^*(c_t^A)^2 + u^t(c_t^A)g_T^*(c_t^A)} - \frac{d\Gamma}{dt} \frac{u_t(c_t^A)g_T^*(c_t^A)}{u^t(c_t^A)g_T^*(c_t^A)}
\]

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where the sign of \( \frac{dc^A_T}{d\Gamma} \) is determined by the concavity of \( u \) and \( g \), and the fact that \( c^A_T \) is decreasing with \( c^A_T \) on the Pareto frontier. This establishes that \( d(c^A_T(s^t)/c^A_T(s^{t+1}))/d\Gamma(s^t) > 0 \). It follows that \( d(c^A_T(s^t))/d\Gamma(s^t) > 0 \).

**Proof to Lemma 3.**
Taking an implicit derivative of \( h(.) \), where \( \hat{c}^{NA} \) and \( \bar{c}^{NA} \) are the break even levels of inactive consumption,

\[
\frac{d\hat{c}^{NA}}{dc^A} = \frac{-u''(c^A)(c^A - \bar{c}^{NA} + \gamma)}{u'(\bar{c}^{NA}) - u'(c^A)}
\]

I follow Alvarez, Atkeson, and Kehoe (2002) and Cociuba and Ramanarayanan (2017), in setting period 0 endowment for households in each country such that they face the same period 0 Lagrange multiplier. Using the fact that \( \hat{c}^{NA} < c^A \), \( \bar{c}^{NA} > c^A \), \( dc^A_T/d\Gamma > 0 \) (follows from Proposition 1), consumption of non-traded goods is unaffected by \( \Gamma \), and \( dc^{NA}_T/d\Gamma = 0 \),

\[
\frac{dc^{NA}}{d\Gamma} > 0, \frac{dc^{NA}}{d\Gamma} > 0,
\]

where I have also assumed \( \bar{c}^{NA} - c^A > \gamma \). Finally, if the marginal investor is a borrower,

\[
\int_{\nu(\Gamma_1)}^{\nu(\Gamma_2)} \nu t g(\nu t) d\nu t > \int_{\nu(\Gamma_1)}^{\nu(\Gamma_2)} \nu t g(\nu t) d\nu t
\]

and since \( c^{NA} \) is monotonically increasing in \( \nu \) and,

\[
a = 1 - F(\pi) + F(\psi)
\]

this implies \( a(\Gamma) > 0 \).

**Proof to Lemma 5**
Consider the following maximization,

\[
L = [\chi c^\theta_{NT} + (1 - \chi)c^\theta_T] \bar{\theta} - \lambda[PC - p_T c_T - p_N T c_{NT}]
\]

The first order conditions with respect to \( c_{NT} \) and \( c_T \) are given by,

\[
\frac{1 - \theta}{\chi C - \rho} \frac{c^\theta_{NT}}{c^\theta_{NT} - \lambda p_{NT} = 0},
\]  
\[
\frac{1 - \theta}{(1 - \chi)C - \rho} \frac{c^\theta_{T}}{c^\theta_{T} - \lambda p_{T} = 0},
\]

Rearranging and imposing market clearing, \( c_{NT} = Y_{NT} \), yields the aggregate demand function for non-traded goods. Under the assumptions of the reduced model, the aggregate demand is
given by (24). Taking a derivative and setting it to zero yields,
\[
\frac{dY_{NT}}{dc_T} = \chi \left\{ \frac{c^A_T}{1 - \chi} \frac{dp_T}{c_T} + 1 \right\} = 0.
\] (37)

By the definition of the tradable price index,
\[p_T \equiv \min\{p_T c_T : c_T \geq 1\}\]
we can derive that,
\[c_T + p_T \frac{dc_T}{dp_T} = 0.
\]
Since \(\frac{dp_T}{c_T} = \frac{dp_T}{c_T} \frac{dc_T}{c_T} = \frac{dp_T}{c_T} a\), a negative aggregate demand externality \(\frac{dY_{NT}}{dc_T^A} < 0\) arises for,
\[\theta > 1 - \frac{ac_T^A}{c_T},\]
proving the result.

For completeness, I also prove the existence of negative aggregate demand externalities for \(\theta > 0\) when inactive agents satisfy their intratemporal Euler equation, \(\tau^e(s^t, \nu^t) = 0\). I begin by deriving the demand for non-traded goods in terms of traded consumption by active households \(c^A_T\) yields,
\[
\frac{dY_{NT}(c^A_T)}{dc_T} = \frac{1}{1 - \theta} \left[ \frac{p_T}{p_{NT}} \right]^T \frac{\theta}{1 - \theta} c_T \frac{dp_T}{p_{NT} dc_T^A} + \left[ \frac{p_T}{p_{NT}} \right]^T \frac{\theta}{1 - \theta} \frac{dc_T}{dc_T^A} < 0
\]
which requires that,
\[
\frac{1}{1 - \theta} \frac{c_T}{p_T} \frac{dp_T}{dc_T} \frac{dc_T}{dc_T^A} < -\frac{dc_T}{dc_T^A}
\]
where I have used \(\frac{dp_T}{dc_T^A} = \frac{dp_T}{dc_T} \frac{dc_T}{dc_T^A}\) and \(\frac{dp_T}{dc_T} = -\frac{p_T}{c_T}\). Combining, I derive that \(\frac{dc_{NT}}{c_T} < 0\) iff \(\theta > 0\) proving the result.

**Proof to Proposition 6.**

Consider equation (26). The gains to a household in the hegemon country from the government tilting the wealth distribution \((\Gamma(s^t) \uparrow)\) are captured by \(\int_{\nu^t \in V^t} \mu^t \frac{\partial u(s^t, \nu^t)}{\partial c_T(s^t, \nu^t)} \frac{dc_T(s^t, \nu^t)}{dc_T(s^t)} g(\nu^t) d\nu^t\).

Since inactive households consume autarkic allocation, \(\frac{dc_T(s^t, \nu^t)}{dc_T(s^t)} = 0 \ \forall \nu_t \in [\underline{\nu}, \overline{\nu}]\) proving the first statement of the proposition. The second statement of the proposition follows because \((1 - \tau_G(s^t, \nu^t)) > 0, \ \tau_l(s^t, \nu^t) > 0\) by the assumption that wages are rigid above the market clearing level, \(\forall \nu^t \in V^t, s^t \in S^t\). As a result, if \(\frac{dc_{NT}(s^t)}{dc_T(s^t)} < 0\), abstracting from \(\Omega(s^t)\), (26) is
negative when evaluated for idiosyncratic $\nu^t \in [\nu, \bar{\nu}]$.

**Proof to Proposition 9.**

Differentiating equation (25) with respect to $y_T(s^t)$ yields,

$$
\frac{dc_T^A(s^t)}{dy_T(s^t)} = \frac{d}{dc_T} \left[ \int_{\nu^t} \partial u(c_T(s^t, \nu^t), c_{NT}(s^t, \nu^t)} {\partial c_T^A(s^t)} \left( 1 + \frac{dc_{NT}}{dc_T^A(s^t)} \frac{p_{NT}(s^t)}{p_T(s^t)} \tau_T(s^t, \nu^t) \right) g(\nu^t) \ d\nu^t \right] - \lambda \rho(c_A^A(s^t)) + \frac{d\rho(c_A^A(s^t))}{dc_T^A(s^t)} [c_A^A(s^t) - y_T(s^t)] > 0.
$$

Optimal consumption of active households is procyclical, $dc_T^A(s^T)/dy_T(s^t) > 0$, as long as the social marginal value of active consumption is positive. The proposition follows by noticing that lower borrowing costs implement procyclicality of $c_T^A$ only if $y_{T,t+1} < y_{T,t}$. Since $\frac{dc_T^A(s^t)}{d\Gamma(s^t)} > 0$, the dynamically efficient $\Gamma(s^t)$ is procyclical with respect to $y_T(s^t)$.

**Proof to Proposition 10.**

Follows from the proof to Proposition 9 and that fact that as $\tau_T(s^t, \nu^t) \downarrow 0$, $\forall s^t, \nu^t$, optimal consumption becomes more pro cyclic as monopsonistic concerns of the hegemon in goods’ markets are traded off with concerns overs aggregate demand externalities.

9 Appendix B

**Domestic financial intermediation.** Under complete markets, there exist separate markets for insurance of aggregate and idiosyncratic shocks. Domestically, a financial intermediary sells idiosyncratic insurance to households and buys government bonds contingent on the aggregate state. The financiers’ problem is to maximize,

$$
\int_{s^t+1} \int_{\nu^t+1} \int_{\nu^t} q(s^t+1, \nu^t+1, \nu^t+1) x(s^t+1, \nu^t+1) g(\nu^t) ds^t+1 + ds^t+1 dv^t - q(s^t+1) B(s^t+1)
$$

subject to,

$$
\int_{\nu^t+1} \int_{\nu^t} x(s^t+1, \nu^t+1, \nu^t) g(\nu^t) dv^t+1 + dv^t = B(s^t+1)
$$

The first order condition yields,

$$
q(s^t+1) = \int_{\nu^t+1} q(s^t+1, \nu^t+1) g(\nu^t+1)
$$

Further details on derivation of the marginal social benefit of active households’ consumption.

It is useful to first define the wedge in the intratemporal goods market,

$$
\tau_G(s^t, \nu^t) = 1 - \left( \frac{\partial u(s^t, \nu^t)}{\partial c_{NT}(s^t, \nu^t)} \frac{\partial u(s^t, \nu^t)}{\partial c_T(s^t, \nu^t)} \right) \frac{p_T(s^t)}{p_{NT}(s^t)}
$$

(41)

and, in turn, the labour wedge can be expressed as,

$$
\tau_l(s^t, \nu^t) = 1 - \left( \frac{dv(s^t, \nu^t)}{dl(s^t, \nu^t)} / (1 - \tau_G(s^t, \nu^t)) \frac{p_{NT}(s^t)}{p_T(s^t)} \frac{\partial u(s^t, \nu^t)}{\partial c_T(s^t, \nu^t)} \right) \frac{1}{A(s^t)}
$$

(42)

The derivative of (27) with respect to $c_{T}^A(s^t)$ is given by,

$$
\int_{\nu^t \in \nu_T} \mu_{\nu^t} \partial u(s^t, \nu^t) \left( \frac{dc_{T}(s^t, \nu^t)}{dc_{T}^A(s^t)} + (1 - \tau_G(s^t, \nu^t)) \frac{p_{NT}(s^t)}{p_T(s^t)} \frac{dc_{NT}(s^t)}{dc_{T}^A(s^t)} \tau_l(s^t, \nu^t) \right) g(\nu^t) \, dv^t
$$

(43)

where the final term is reported in (27) and follows from Leibniz rule. Equation (26) follows by breaking the integral over idiosyncratic states in the activity and inactivity zones, noticing that,

$$
\frac{dc_{T}(s^t, \nu^t)}{dc_{T}^A(s^t)} = 0 \ \forall \ \nu^t \in \nu_T,
$$

(44)

and 1 otherwise, setting $\tau_G(s^t, \nu^t) = 0$ for active households, and rearranging,

$$
\frac{\partial u(s^t, \nu^t)}{\partial c_T(s^t, \nu^t)} (1 - \tau_G(s^t, \nu^t)) \frac{p_{NT}(s^t)}{p_T(s^t)} \tau_l(s^t, \nu^t) = \frac{\partial u(s^t, \nu^t)}{\partial c_{NT}(s^t, \nu^t)}.
$$

(45)

for inactive households.

10 Appendix C
Figure 6: Returns to financial market participation for households, given levels of consumption when active and inactive. See Table 1 for calibration.

Figure 7: Impulse response, in % percentage deviations from the steady state, to an improvement in financial terms of trade ($\Gamma$ ↑), under producer currency pricing subject to different levels of downward nominal wage rigidities.

11 Appendix D

Using notation standard in the empirical finance literature, I define the yield on a one period government bond in country $i$ as $y_{t,i} = -\log(P_{n,i,t})$. In addition, define the market-implied forward premium $\rho_t^i = \log(F_{t,i}^q) - \log(e_{t+1}^i)$, where $F_{t,t+1}^q$ is the outright forward and $e_{t,t+1}^i$ is the spot nominal exchange rate from period $t$ to $t+1$, expressed in dollar units. In frictionless international markets, the covered interest rate parity condition implies, $\rho_{t,i} = y_{t,i}^{r,f} - y_{t,i}^{d,r,f}$. However, in general, the yield on government bonds may differ from the risk-free rate by a convenience-yield, $y_{t,i}^{r,f} - y_{t,i}^i = \lambda_i^i$. (46)
The $n$–maturity deviation from covered interest rate parity between government bond yields in the United States and country $i$ is given by,

$$\Phi_{i,t} = y_{n,t}^i - y_{n,t}^S - \rho_{n,t}^i,$$

where $y_{n,t}^i, y_{n,t}^S$ are the yields on $n$–maturity bonds in country $i$ and the U.S respectively, and $\rho_{n,t}^i$ is the $n$–year market implied forward premium. If markets are otherwise frictionless, $\Phi_{i,t} = \lambda_{n,t}^S - \lambda_{n,t}^i$, see Du, Im, and Schreger (2018). For the quarterly regressions in section 6, I use one year maturity bonds and CIP deviations are collapsed at the end of quarter as in Jiang, Krishnamurthy, and Lustig (2018). Further details on the data are included in the Data Appendix.