Cheap but Flighty: A Theory of Safety-seeking Capital Flows*

Toni Ahnert† and Enrico Perotti‡

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Abstract

We offer a model of financial intermediaries as safe-asset providers in an international context. Investors from countries exposed to expropriation risk seek to invest in safe-haven countries in order to satisfy a demand for safety. Intermediaries compete for such cheap funding by carving out safe claims, which requires demandable debt. While these safety-seeking inflows allow developed countries to lower their funding cost and expand investment, risk-intolerant investors achieve safety by withdrawing even under minimal residual risk. As a result, safety-seeking inflows into developed countries not only reallocate but also create risk. Early liquidation inefficiently diverts scarce resources from productive uses, so a domestic planner wishes to contain the scale of safety-seeking inflows. A macroprudential regulator imposes a Pigouvian tax on safety-seeking inflows.

Keywords: Capital flows, safe assets, demandable debt, unstable funding, safe haven, macroprudential regulation, Pigouvian tax.

JEL classifications: F3, G01, G2.

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†Bank of Canada and CEPR, 234 Wellington Street, Ottawa ON K1A 0G9, Canada. Email: `toni.ahnert@gmail.com`.

‡University of Amsterdam, CEPR, and Tinbergen Institute. Amsterdam Business School, Roetersstraat 18, Amsterdam 1018 WB, Netherlands. Email: `E.C.Perotti@uva.nl`

1 Introduction

The scale of the credit boom in the run-up of the 2007-09 financial crisis has led to a search for global explanations. An influential view is that excess credit was driven by low interest rates, associated with the recycling of large global imbalances into the US financial system (Bernanke, 2005; Caballero et al., 2008; Merrouche and Nier, 2014), which compensated for low US saving rates. Historically, capital moved from developed to emerging countries to pursue higher returns. However the scale of such flows fell short of the amount implied by neoclassical theory (Lucas, 1990), and often was not correlated with productivity growth (Gourinchas and Jeanne, 2013). A common explanation is that expropriation risk discourages foreign capital inflows in emerging countries.

In the last decades net capital flows have reversed direction (Prasad et al., 2007), as emerging countries invested much of their trade surpluses in safe assets in developed countries (Gourinchas and Rey, 2007; Mendoza et al., 2009). Foreign inflows largely targeted safer assets, so demand for safety grew faster than US public debt, leading US commercial and shadow banks to expand the supply of safe private claims. This global portfolio reallocation boosted US credit volume and the concentration in risky holdings by US residents and intermediaries, boosting their leverage (Caballero and Krishnamurthy, 2009). The literature has so far treated safety-seeking capital inflows into advanced economies as inherently stable.

This paper offers a model of safe-asset provision by financial intermediaries in an international context. We study safety-seeking capital flows from countries subject to expropriation or political risk to safe-haven countries as well as the implications for funding structure, domestic investment, and endogenous fragility of intermediaries in developed countries.[1] While safety-seeking inflows support higher domestic investment, they also increase the scale of runs on intermediaries. Due to a pecuniary externality associated with asset sales, safety-seeking inflows inefficiently reduce future investment, resulting in a role for macroprudential regulation. A cap on cheap-but-flighty foreign funding is socially desirable

[1] Badarinza and Ramadorai (2018) link capital flight into safe havens to political risk in some countries.

and can be decentralized via a Pigouvian tax on safety-seeking capital inflows.

In our model, all investors have some demand for safety to ensure a subsistence level of consumption. We distinguish between domestic investors in a stable institutional environment that can easily achieve safety via local government bonds, and foreign investors in (emerging) countries exposed to expropriation risk. We focus entirely on safety-seeking private capital flows.[2] Emerging market investors seek safe assets issued by intermediaries from countries with good protection of property rights in order to improve upon the low safe return offered by local storage (the only option not subject to expropriation risk).

A first insight is that for a private claim to be safe, it needs to be demandable (Proposition 1). Demandable debt overcomes an agency conflict between safety-seeking investors and return-seeking intermediaries. While long-term funding would be desirable to prevent costly liquidation, foreign investors would not accept such a claim because it is not perfectly safe, even when senior to all other claims. Intermediaries that cannot commit ex ante to a liquidation policy prefer to continue investment in case of interim uncertainty. Hence, safety-seeking foreigners offer cheap funding only if they have the right to withdraw in uncertain states, provided enough loss-absorption capacity is available to back withdrawals.

Foreign investors accept the lower return of demandable debt in exchange for safety, while domestic investors not exposed to expropriation risk are willing to offer insurance by investing in a long-term debt claim.[3] Since foreign investors withdraw even under minimal interim uncertainty, capital inflows not only concentrate risk on domestic investors (Caballero and Krishnamurthy, 2009), but it also increases domestic fragility. In short, foreign funding is cheap but flighty, and domestic intermediaries accept this instability in exchange for a lower average funding cost.

The nature of safety-seeking foreign investors implies that capital inflows increase the

[2] While our paper emphasizes private flows in the period since the reversal of capital flows, Gourinchas and Jeanne (2013) document the importance of public flows in the period up to 2000.

[3] Gourinchas et al. (2010) show that the United States provides insurance to the rest of the world in the form of a lower yield during normal times and a transfer of wealth to foreign investors in crisis.

fragility of domestic intermediaries, with more withdrawals and asset sales. When choosing their funding profile, intermediaries trade off the lower funding cost of foreign funding with privately costly asset sales, attracting foreign capital only if it is cheap enough (Proposition 2). In the unique equilibrium, capital flows arise when safety-seeking foreign capital is abundant enough such that safety-seeking funding is cheap enough (Proposition 3). As safety-seeking foreign capital grows (e.g. because of trade surpluses), foreign funding becomes cheaper, supporting more initial domestic investment but also increasing the volume of asset sales and thus reducing its equilibrium value (Proposition 4).

Intermediaries do not internalize all the risk created by their funding choice, resulting in socially excessive asset sales and productive losses. Since intermediaries take the interim liquidation value of investment—the price of assets sold—as given, they fail to internalize how their choice to attract flighty funding affects the aggregate volume of asset sales and, thus, its price. The social cost of liquidation is given by the foregone return on late-arriving investment projects not undertaken with scarce funds that purchase assets from intermediaries instead (Stein, 2012). As a result, a domestic planner relies less on foreign funding and chooses a lower initial investment than in the unregulated economy (Proposition 5), reducing the scale of runs and preserving resources for future opportunities.

Having established a microfounded welfare benchmark, we show that foreign investors always benefit from capital flows as another safe option becomes available. The domestic economy loses for intermediate level of capital inflows, however, as the social costs associated with asset sales more than compensate the benefits of cheaper funding and more initial investment (Proposition 6). Finally, we show that a well-designed Pigouvian tax on safety-seeking capital inflows achieves the efficient outcome (Proposition 7).[4] This result provides a rationale for macroprudential policies that target short-term foreign inflows, such as a systemic risk tax on non-core funding (Shin, 2011; Hahm et al., 2013). Another implications is that Basel III liquidity regulation, such as the Liquidity Coverage Ratio, should require higher liquidity risk weights for intermediaries reliant on safety-seeking funding (e.g., foreign

[4]See Jeanne and Korinek (2010) for a Pigouvian tax approach to overborrowing by emerging economies.

deposits and funding from offshore centers and countries in which expropriation risk is high).

We explore two extensions. Even if investment risk is scale-invariant, more credit may involve more opaque assets, defined as those with a slower resolution of uncertainty. Greater interim uncertainty induce more frequent runs on domestic intermediaries (on top of the higher scale of runs on intermediaries established in the main model). A recent example is securitized mortgages pools that are relatively safe but hard to evaluate, and have played a key role in large credit booms followed by crises (Jorda et al., 2015). Second, we consider whether "safe intermediaries" could overcome runs by investing only in safe assets backed by long-term debt. However leveraged intermediaries have an incentive to invest in risky assets, so they cannot credibly commit to safety under even minimal uncertainty about asset choice. Kacperczyk and Schnabl (2013) document such a risk-taking behaviour of "safe" money market mutual funds during the financial crisis.

Literature. We seek to contribute to a literature on capital flows from developing countries. Caballero et al. (2008) interprets such flows as seeking improved intertemporal smoothing in countries with better financial development. Mendoza et al. (2009) show how countries with better private contractual enforcement can offer better insurance to foreign investors. We share the focus on different institutional circumstances across countries: in their work residents may divert resources because of limited enforcement of contracts, while in our context some government may expropriate investors. We complement their quantitative macro approach that emphasizes optimal risk bearing with our focus on safety rather than insurance needs. Crucially, we show how safety provision by private intermediaries may add risk in addition to reallocating it across investors.

We model demand for safety as a large disutility when consumption falls short of some essential needs, a form of Stone-Geary preferences. Such a subsistence or habit level of consumption is commonly studied in development and macro-economics. A dynamic version of such preferences is used in habit formation models of asset pricing (Campbell and Cochrane, 1999). These preferences are consistent with the shown strength and stability of demand for safe assets (Krishnamurthy and Vissing-Jorgensen, 2012; Gorton et al., 2012).[5]

In the model foreign investors need an intermediary to invest in domestic assets (Caballero and Krishnamurthy, 2009). Intermediation may be indispensable for access, safekeeping (for investors subject to expropriation risk, even direct holdings need to be protected), or for anonymity when needed to avoid taxation or expropriation risk. We show how private intermediaries can provide safety only via demandable debt. This is in contrast with the usual motivation due to liquidity insurance (Diamond and Dybvig, 1983). Demandable debt has been seen as an optimal contract to resolve agency conflicts (Calomiris and Kahn, 1991; Diamond and Rajan, 2001). A similar yet distinct conflict arises in our model: under residual risk return-seeking intermediaries prefer to continue investment, while safety-seeking foreign investors prefer to liquidate. The right to withdraw resolves this conflict.

There are few doubts on the key role of massive inflows in the rapid growth of privately-produced safe assets by US banks and shadow banks up to 2007. The experience showed how short term funding proved very risk intolerant during the 2007–2008 run. Yet it is hard to assess empirically the relative risk tolerance of foreigners, as it is hard to ascertain the national origin of investors. Most capital inflows are routed through major financial centers such as London or Hong Kong or offshore centers keen on anonymity. Figure 1 shows large net OFC inflows into the United States, targeted to privately intermediated safe assets. Consistently with our story, even though distressed US intermediaries suffered major outflows in 2007–08, the dollar actually appreciated (Maggiori, 2013). While most countries suffering a banking crisis suffer massive outflows, the US proved to be a safe haven since running investors redirected their funds towards safer dollar options.

Structure. The remainder of the paper proceeds as follows. Section 2 presents the model and studies the benchmark of autarky. Section 3 studies the contractual forms offered by domestic intermediaries and describes the equilibrium in this economy. Section 4 derives

[5] Recent work has explained the demand for safety as arising from a subset of investors who are always infinitely risk-averse (Caballero and Farhi, 2017). In the presence of neglected risk, these preferences can create large-scale instability (Gennaioli et al., 2013).

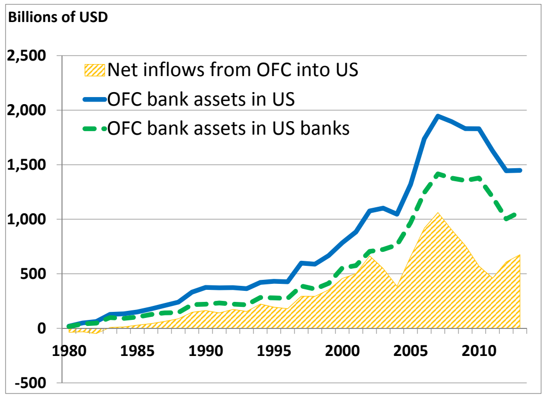

Figure 1: Flows between offshore financial centres (OFC) and the United States (US). Source: BIS locational intermediary statistics. All values in billions of US dollars (USD).

the planner's allocation and derives normative implications, based on a pecuniary externality of interim asset sales. Section 5 considers extensions and Section 6 concludes.

2 Model

There are three dates $t = 0, 1, 2$, a domestic D and a foreign F region, and a single good for consumption and investment. Domestic investors have mass 1 while foreign investors have mass W. There is a unit continuum of domestic intermediaries $i \in [0, 1]$. All investors have identical preferences, information, and endowment e at $t = 0$ and consume c_t at date t.

Investor preferences specify a demand for safety over a minimum total consumption level $S \in (0, 1)$ below which investors suffer a huge disutility. Once this subsistence or reference level is secured, investors are risk-neutral with no time preference:

$$U(c_1, c_2) = \begin{cases} c_1 + c_2 & \text{if } c_1 + c_2 \geq S \\ -\infty & \text{if } c_1 + c_2 < S. \end{cases} \tag{1}$$

At $t = 0$ all investors can invest in local physical storage and financial assets, namely government bonds and claims on intermediaries. Storage at $t = 0$ yields a unit safe return at $t = 2$. The proceeds from storage cannot be expropriated. A government bond offers a (two-period) return of $r^B > 1$ at $t = 2$ in both regions. We normalize the endowment to $e \equiv 1 + S/r^B$. Foreign investors require an intermediary to access domestic assets. Intermediaries invest in domestic investment only. This assumption is relaxed in section 5.2.

The only source of heterogeneity are differences in political risk across regions. A domestic government never expropriates, while a foreign government may seize all assets in its region (except storage). Thus, foreign investors can satisfy their need for safety only via local storage or by investing in safe claims issued by domestic intermediaries. Let the chance of expropriation be $\theta_L > 0$ for foreign investors. We assume that domestic agents investing in foreign assets are more often exposed to expropriation risk, $\theta_H > \theta_L$. This difference is large enough to discourage any speculative capital flows across regions:

$$(1 - \theta_H)R_F < r^B < (1 - \theta_L)R_F, \tag{2}$$

where R_F is the expected return on foreign investment. This condition states that the domestic government bond dominates risky foreign investment in terms of expected returns for domestic agents. For foreign agents, foreign investment subject to expropriation risk dominates domestic government bonds in terms of expected return. This assumption allows us to focus entirely on safety-seeking capital flows.

Intermediaries maximize expected equity value at $t = 2$ subject to limited liability. At $t = 0$ intermediary i raises domestic funding d_i and foreign funding f_i to invest $I_i = d_i + f_i$ in a common domestic investment technology subject to aggregate risk. Following Stein (2012), there is a public signal at $t = 1$ about the return at $t = 2$. With probability $\delta \in (0, 1)$, a high state H obtains and investment will surely yield $R_i = R(I_i) > 1$ at $t = 2$, with decreasing returns to scale, $R'(\cdot) < 0$ and $R''(\cdot) \leq 0$.[6] With probability $1 - \delta$, a residual risk state RR

[6] The condition $R''(\cdot) \leq 0$ is sufficient for the concavity of the objective function and thus a maximum. It ensures that the marginal revenue in the high state, $MR = R_i + I_i R'(I_i)$, decreases in investment I_i.

obtains and the initial investment can be recovered in expectation. Investment fails (zero output) with positive probability $1-\gamma$, where $\gamma \in (0,1)$. Figure 2 summarizes.

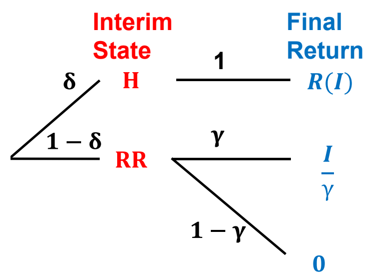

Figure 2: Information structure of risky domestic investment.

Each intermediary chooses whether to sell assets at $t = 1$. Early liquidation is costly as it is worth a fraction $\alpha \in (0,1)$ of the initial investment. It is never efficient to sell in the high state because $R > \alpha$. In contrast, continuation in the residual risk state risks a complete loss but has a higher expected return than asset sales because $\alpha < 1$. In sum, intermediaries always wish to continue investment. The interim signal and the decision of intermediaries to sell assets at $t = 1$ are not contractible.

While each intermediary takes α as given, this liquidation value is determined endogenously. Following Stein (2012), at $t = 1$ investment can be sold to patient investors (PIs), who are distinct from both domestic and foreign investors. PIs receive an endowment V at $t = 1$ and can either absorb asset sales by intermediaries or invest in new, late-arriving real investment projects whose concave return at $t = 2$ is $g(\cdot)$. In the high state, intermediaries never sell assets, so PIs invest in the late opportunity to receive $g(V)$. In the residual risk state, PIs absorb any aggregate sales $\ell \equiv \int_0^1 \ell_i \, di$ from intermediaries and invest $V - \ell$ to receive $g(V - \ell)$. Their willingness to acquire these assets requires that their marginal return equals the marginal return on new projects. This condition pins down the equilibrium liquidation value $\alpha(\ell)$:[7]

$$\frac{1}{\alpha} = g'(V - \ell). \tag{3}$$

[7]For PIs to fully invest in new projects in the high state it is required that $g'(V) > 1$, which we maintain henceforth. This assumption implies that asset sales are costly in the residual risk state, $\alpha^* < 1$.

Fire sales occur when intermediaries jointly liquidate, depressing its value α. It will soon be clear that the volume of foreign funding attracted by intermediaries affects the volume of asset sales in the residual risk state, causing a negative liquidation externality.

Each intermediary offers a menu of debt contracts defined by the amount, timing, and seniority of repayment, and may be conditional on the composition of funding. Debt is repaid pro rata when assets are insufficient to repay equally senior claims.[8] To focus on debt contracts, we assume a non-contractible final return (Hart and Moore, 1998).[9] Each intermediary has local access to one unit of domestic funding, $d_i \leq 1$, and competes freely for foreign funding.

Autarky. In the benchmark without capital flows, foreign investors use storage to satisfy their safety needs as it is the only asset not subject to expropriation risk. They invest all residual wealth in risky foreign investment as it dominates the local government bond in expected return (as implied by Condition 2). Domestic investors satisfy their safety needs by investing S/r^B in the government bond as it dominates storage, $r^B > 1$. Endowment is normalized so that domestic investors have an unit of residual wealth after achieving safety. It funds intermediaries as long as it returns at least r^B to domestic investors.

As intermediaries cannot attract foreign funding, they raise domestic funding, $I_i^{Aut} = d_i^{Aut}$. Intermediaries offer risky long-term debt with face value L_2 at $t = 2$ since domestic investors are willing to hold such claims once they achieved safety. Intermediaries maximize expected equity value, so the expected funding cost equals r^B as the participation constraint of domestic investors binds. Since $\alpha < 1$, investment is always continued in the residual risk state. In autarky there is no benefit to issue demandable debt. Let $MR(I_i) = MR_i \equiv I_i R_i' + R_i$ be the marginal revenue of investment in the high state, so intermediary i's expected equity is

$$\pi_i^{Aut} \equiv I_i \left[\delta R_i + (1 - \delta)\right] - d_i r^B. \tag{4}$$

[8] For demandable debt, the continuation of investment at $t = 1$ depends on the withdrawals of investors. We abstract from non-essential runs in the high state due to pure coordination failure (Allen and Gale, 2007).

[9] This assumption is merely for expositional simplicity. Our results do not depend on whether long-term funding takes the form of long-term debt or equity.

We assume that domestic investment return dominates the government bond yield for low investment levels and that the available domestic funding suffices for the efficient investment level in autarky, $\delta MR(0)+1-\delta > r^B > \delta MR(1)+1-\delta$. Autarky investment $I_i^{Aut} = I^{Aut} \in (0,1)$ is the same for all intermediaries and equalizes the expected marginal revenue with its funding cost:

$$\delta MR(I^{Aut}) + 1 - \delta \equiv r^B. \tag{5}$$

It immediately follows that investment has a positive NPV and intermediaries make positive expected profits:

$$\delta R(I^{Aut}) + (1-\delta) > r^B. \tag{6}$$

Finally, consider the pricing of long-term debt. Domestic investors receive L_2 in the high state and a unit expected return in the residual risk state (upon partial or full default on their claim at the final date). Taken together, $L_2^{Aut} \equiv \frac{r^B-(1-\delta)}{\delta} > 1$. Note that Condition (6) implies the feasibility of paying the debt claim in the high state, $R(I^{Aut}) > L_2^{Aut}$.

3 Capital inflows and endogenous risk

This section introduces safety-seeking foreign funding. It first defines the contractual requirements to attract foreign funding (subsection 3.1 and then characterize the equilibrium with capital inflows as well as the effect of rising safety-seeking capital (subsection 3.2).

3.1 Funding contracts

Consider the claim (X_1, X_2) targeted at foreign (safety-seeking) investors and the claim (L_1, L_2) targeted at domestic (return-seeking) investors.

Proposition 1 ***Funding contracts.*** *Foreign funding can be attracted by demandable debt* $(1, X_2)$ *provided the intermediary has a sufficient amount of loss-absorbing funding,* $\alpha\, I_i \geq f_i$.

Domestic funding is attracted with risky long-term debt $(0, L_2)$ *at an expected cost of* r^B.

The portfolio choice of domestic investors is exactly as in autarky. Suppose that the safe claim offered by an intermediary has a return below r^B (verified below). Then domestic investors invest $\frac{S}{r^B}$ in the domestic bond to satisfy their safety needs. The domestic bond yields more than storage, while investment in foreign assets is not safe because of expropriation risk. The residual domestic wealth can provide risk-absorbing capital for intermediaries ($L_1 = 0$), provided the long term debt yields in expectation the return on the outside option r^B. Domestic investors do not choose any foreign speculative component because the expropriation-risk-adjusted return is too low, $(1 - \theta_H)R_F < r^B$.

The demand for safety by foreign investors shapes the funding contracts offered. Foreign investors can satisfy their need for safety by either storing or holding a safe claim on an intermediary. Thus, this claim has to yield at least a unit return ($X_2 \geq X_1 \geq 1$) to match the return on the outside option (storage) and it must be completely safe. The residual wealth of foreign investors is channeled to foreign risky investment, as in autarky.[10]

Since intermediaries prefer to continue investment in the residual risk state, there is a chance of complete loss. For a claim to be safe under this conflict of interest between safety-seeking investors and return-seeking intermediaries, it must be demandable. Demandable debt allows foreign investors to withdraw in the residual risk state. When foreign funding is attracted, there is always some liquidation of investment in the residual risk state, $\ell > 0$. Early withdrawals are costly in expected return terms. Thus intermediaries set the lowest interim face value, $X_1^* = 1$, and compete for foreign funding via the final face value X_2. To be safe, demandable debt must be backed by enough loss-absorbing long-term debt, ensured by the requirement $\alpha I_i \geq f_i$. Note that foreign investors would refuse any long-term debt—even if senior to debt offered to domestic investors.

Intermediaries never offer claims with an expected return above r^B as domestic fund-

[10] Recall that foreign investors cannot directly invest in domestic investment without an intermediary.

ing can be attracted locally at expected cost r^B to fund the autarky level of investment. Intermediaries also do not make any foreign investments due to lower expropriation-adjusted expected returns. Thus the return on the risky claim exceeds the return on the safe claim.

3.2 Equilibrium

We turn to describing the equilibrium in which all intermediaries and investors take the face value of demandable debt X_2 as given. We derive the demand for foreign funding by intermediaries, the supply of foreign funding by safety-seeking foreign investors, and the Walrasian equilibrium as well as its comparative statics with respect to foreign capital W.

Intermediaries choose the volume of domestic and foreign funding to maximize expected equity value π_i, subject to a safety constraint, $f_i \leq \alpha I_i$. We show in Appendix A that an intermediary's problem reduces to

$$\begin{aligned} \max_{f_i \geq 0,\, d_i \in [0,1]} \pi_i \quad &= \quad I_i \left[\delta R_i + 1 - \delta\right] - d_i\, r^B - f_i \left[\delta X_2 + \frac{1-\delta}{\alpha}\right] \\ \text{s.t.} \qquad & \qquad f_i \leq \alpha I_i \quad \text{and} \quad I_i = d_i + f_i, \end{aligned} \tag{7}$$

because each intermediary can attract any amount of domestic funding $d_i \in [0,1]$ at expected cost r^B and holds domestic investors down to their participation constraint. The demand for funding by intermediaries is stated in the following proposition.

Proposition 2 ***Demand for funding.*** *For $r^B > \underline{r}^B$, there exists a unique threshold $\overline{X} \equiv \frac{1}{\delta}\left[r^B - \frac{1-\delta}{\alpha}\right] > 1$. If foreign funding is expensive, $X_2 > \overline{X}$, then autarky is optimal, $f_i^* = 0$ and $d_i^* = I^{Aut}$. For $X_2 \leq \overline{X}$, both types of funding are attracted and the safety constraint binds, so $f_i^* = \alpha I_i^*$ and $d_i^* = (1-\alpha)I_i^*$. As a result, all investment is liquidated in the residual risk state, $\ell_i^* = I_i^*$, and the face value of long-term debt is $L_2^* = \frac{r^B}{\delta}$. The investment level $I_i^*(X_2)$—and thus the demand for foreign funding $f_i^*(X_2)$—is uniquely pinned down by*

$$MR\left(I_i^*\right) = (1-\alpha)L_2^* + \alpha X_2. \tag{8}$$

Proof See Appendix A.

When foreign funding is attracted, Equation (8) has an intuitive interpretation. Bank shareholders receive a payoff in the high state only, so they equalize the marginal benefit of investment to the marginal cost of funding. Funding costs are a weighted average of a share $1-\alpha$ of domestic funding at face value L_2^*, and a share α of foreign funding at face value X_2.

Each intermediary trades off a lower cost of foreign funding with its associated (private) cost of liquidation under residual risk. When domestic funding is expensive, $r^B > \underline{r}^B \equiv \delta + \frac{1-\delta}{\alpha} > 1$, intermediaries demand foreign funding only when sufficiently cheap, $X_2 \leq \overline{X}$. In this case the threshold face value of demandable debt $\overline{X}$ exceeds 1, the lower bound on demandable debt return. We maintain this lower bound on r_B henceforth. Otherwise, $r^B \leq \underline{r}^B$ implies no capital flows in equilibrium. At the threshold $\overline{X}$, foreign funding is as expensive as domestic funding, once we account for its (private) cost of liquidation: $r^B \equiv \delta\overline{X} + \frac{1-\delta}{\alpha}$. Hence, the intermediary is indifferent between autarky and attracting foreign capital at $\overline{X}$.

When foreign funding is cheap ($X_2 \leq \overline{X}$) the bank seeks to attract as much as possible, and the safety constraint is binding. Hence, the withdrawals of foreign investors under residual risk imply full liquidation of investment, $\ell_i^* = I_i^*$. Thus domestic investors are only repaid in the high state, providing insurance to foreign investors in the residual risk state. As a result, the face value on long-term debt is higher than in autarky, $L_2^* > L_2^{Aut}$. The condition in Equation (8) again implies feasibility whereby all investors are fully repaid in the high state, $R_i^* I_i^* > d_i^* L_2^* + f_i^* X_2$.

In the market for foreign funding, total intermediary demand is $f(X_2) \equiv \int_0^1 f_i(X_2)\, di$. We next consider the supply of safety-seeking funding by foreign investors. The outside option of foreign investors (of mass W) is to store S at a unit return to achieve safety. When an intermediary offers as safe claim, foreign investors prefer it as long as it offers a weakly better return, $X_2 \geq 1$. Note that even for $X_2 > 1$, foreign investors need to invest S in the demandable debt claim because the loss-absorption capacity ensures a unit safe return in the residual risk state. Taken together, the aggregate supply of foreign funding is

$$f(X_2) = \begin{cases} [0, WS] & \text{if } X_2 = 1 \\ WS & \text{if } X_2 > 1. \end{cases} \tag{9}$$

We turn to the equilibrium in the market for foreign funding. The stock of foreign wealth W determines the amount and cost of foreign funding. Specifically, wealth accumulation in less safe economies reaches a critical threshold for stability in safe-haven countries.

Proposition 3 ***Equilibrium.*** *There exists a unique equilibrium. If foreign wealth is below a certain threshold, $W \leq \underline{W}$, autarky is optimal. In the range $W \in \left(\underline{W}, \overline{W}\right)$, foreign capital is relatively scarce, $f^* = WS$, and relatively expensive, $X_2^* > 1$. For $W \geq \overline{W}$, foreign capital is abundant, $f^* < WS$, and cheap, $X_2^* = 1$.*

The proposition states the equilibrium for different levels of foreign wealth. Intermediaries recognize that foreign funding may impose (private) liquidation costs due to its risk intolerance, and do not seek to attract run-prone ('flighty') funding unless it is cheap enough. At $\overline{X}$, their demand shifts discontinuously from zero to $f(\overline{X}) = \alpha I^{Aut} > 0$ and rises monotonically as X_2 decreases below $\overline{X}$. Once safety-seeking foreign wealth suffices to fully absorb this demand at $X_2 = \overline{X}$, an equilibrium with positive capital inflows arises. We henceforth focus on this case, defined by $W \geq \underline{W}$. The second threshold $\overline{W} > \underline{W}$ is the amount of foreign wealth such that its cost drops to $X_2 = 1$, the return on foreign investors' outside option.[11] For $W > \overline{W}$, safety-seeking foreign wealth is so large that intermediaries

[11] The value $\underline{W}$ solves $\delta MR\left(\frac{S}{\alpha}\underline{W}\right) \equiv r^B - (1-\delta)$ while the value $\overline{W}$ solves $\delta MR\left(\frac{S}{\alpha}\overline{W}\right) \equiv (1-\alpha)r^B + \alpha\delta$.

cannot fully absorb it, forcing some foreign investors into storage to achieve safety.

The equilibrium liquidation value in the residual risk state matches the marginal investment return of PIs:

$$\alpha^* = \frac{1}{g'(V - I^*)}. \tag{10}$$

The next proposition analyses the effect of an increase in foreign wealth (a higher values of W) that shift outward the supply of safety-seeking foreign funding.

Proposition 4 ***Comparative statics.*** *For $W \in \left(\underline{W}, \overline{W}\right)$, higher foreign wealth W lowers the cost of foreign funding X_2^*. Both foreign funding f^* and domestic investment I^* rise. The associated higher scale of liquidation in the residual risk state ℓ^* reduces its value α^*.*

Intuitively, more foreign capital increases safety demand and more safety-seeking funding is intermediated. Thus, foreign capital inflows can boost initial domestic investment. Its cost is higher early liquidation of investment and thus lower liquidation values (fire sales), which reduces late domestic investment.

4 Normative implications

To study the normative implications of our setup, we consider a constrained planner (P) who chooses the volumes of domestic and foreign funding for all intermediaries to maximize utilitarian welfare. In analogy to the problem in (7), the domestic planner solves

$$\begin{aligned} \max_{\{f_i, d_i\}} \quad &= \int_0^1 \left(I_i \left[\delta R_i + 1 - \delta\right] - d_i\, r^B - f_i \delta X_2\right) di - V + \delta g(V) + (1-\delta) g(V - \ell) \\ \text{s.t.} \quad & f_i \leq \alpha I_i, \quad \ell_i \equiv \frac{f_i}{\alpha}, \quad \alpha = g'(V-\ell)^{-1}. \end{aligned} \tag{11}$$

The critical feature is that the planner internalizes how funding affects the aggregate volume of liquidation, $\ell = \int_0^1 \ell_i di$ and thus the liquidation value α. Since liquidation losses in the residual risk state is merely a transfer to late investors, it does not enter the planner's objective function. However, now the planner also evaluates the net return of late-arriving projects at the interim date. Since all intermediaries are ex ante equal, the efficient allocation is symmetric across intermediaries and can be characterized as follows.

Proposition 5 ***Planner.*** *There exists a unique threshold $\overline{X}^P < \overline{X}$ such that autarky is efficient as long as the cost of foreign funding is high, $X_2 > \overline{X}^P$. For $X_2 \leq \overline{X}^P$, the safety constraint binds, $f^P = \alpha I^P$ and the planner attracts less foreign capital, $f^P(X_2) < f_i^*(X_2)$, and funds less domestic investment, $I^P(X_2) < I_i^*(X_2)$, than in the unregulated economy.*

Proof See Appendix B, which also defines I^P.

This solution internalizes how foreign capital inflows $\{f_i\}$ increases liquidation volume ℓ in the residual risk state, reducing the liquidation value α. The efficient solution reduces reliance on foreign capital along two dimensions. First, avoiding safety-seeking inflows is efficient for an intermediate cost range $X_2 \in [\overline{X}^P, \overline{X}]$ for which foreign capital is intermediated in the unregulated economy (Proposition 2). Second, when it is efficient to attract foreign inflows, $X_2 \leq \overline{X}^P$, its volume is lower than in the unregulated economy for any given face value X_2. The net result is lower domestic investment at $t = 0$ and higher liquidation values at $t = 1$.

The aggregate liquidation volume is $\ell^P \equiv I^P$ because of symmetry, while the liquidation value is $\alpha^P \equiv g'(V - \ell^P)^{-1}$. The Lagrange multiplier on the safety constraint is $\lambda^P \equiv \frac{r^B - \delta MR(I^P) - (1-\delta)}{\alpha^P}$. Let $\epsilon \equiv \frac{d\alpha}{d\ell}\frac{\ell}{\alpha} = I^P \frac{g''(V-I^P)}{g'(V-I^P)}$ be the elasticity of the liquidation value with respect to its volume. To ensure a unique solution, we restrict attention to parameter values and functional forms $g(\cdot)$ such that $\epsilon \in (-1, 0)$.[12]

This welfare benchmark enables us to characterize the distribution of gains and losses arising from capital inflows in the unregulated economy. Let $\underset{\sim}{W} \in (\underline{W}, \overline{W})$ be the inter-

[12]This condition guarantees that more foreign funding decreases the liquidation value, $\frac{d\alpha}{df_i} < 0$.

mediate level of foreign wealth at which the equilibrium cost of foreign funding equals the planner's threshold, $X_2^* = \overline{X}^P$, which is defined analogously to $\underline{W}$ and $\overline{W}$.

Proposition 6 ***Distribution of gains and losses.*** *The foreign region is strictly better off for any $W \in [\underline{W}, \overline{W})$, while it has no welfare gain for $W \geq \overline{W}$. The domestic region loses from capital inflows for $W \in [\underline{W}, \underset{\sim}{W})$ but gains for all $W > \underset{\sim}{W}$.*

Intuitively, the foreign region gains from capital flows whenever the safe claim returns more than local storage, $X_2^* > 1$. Interestingly, the domestic region can be worse off when foreign capital is scarce. Foreign funding is still cheap enough to be attracted by price-taking intermediaries, but its real cost is higher due to the negative externality. Once foreign capital is abundant such that safety demand high ($W > \underset{\sim}{W}$), its cost becomes low enough to (more than) compensate for this social loss to the domestic region.

Finally, we examine whether the efficient level of foreign funding and domestic investment can be attained in a regulated economy. In particular, we consider a Pigouvian tax τ on foreign capital inflows, designed for intermediaries to internalize the social costs created by risk-intolerant funding on the liquidation value and thus the profitability of later investment. Hence, the expected profit of intermediary i in the regulated economy is $\pi_i^R \equiv \pi_i - \tau f_i$.

Proposition 7 ***Macroprudential regulation.*** *The Pigouvian tax on safety-seeking capital inflows $\tau^* = -\frac{\epsilon}{1-\epsilon} I^P \lambda^P + \frac{1-\delta}{(\alpha^P)^2(1+\epsilon)} > 0$ achieves the efficient allocation.*

Proof See Appendix B.

Proposition 7 characterizes the optimal tax on foreign capital inflows. Its first term captures how higher foreign funding tightens the safety constraint via its indirect effect on equilibrium liquidation values. The second term captures how a greater reliance on foreign funding forces more liquidation in the residual risk state due to a lower liquidation value.

5 Extensions

5.1 Endogenous opacity

So far, withdrawals by foreign investors are triggered by residual risk at $t = 1$. This section studies how more lending may imply investing in more opaque assets. In our setting, this may expand the frequency of the residual risk state. Specifically, let $\delta_i = \delta(I_i)$ be a function of the volume of investment with $\frac{d\delta}{dI} < 0$. It is easy to show that higher investment leads to a greater frequency of withdrawals and liquidation. The demand for funding in Proposition 2 generalizes. If foreign funding is cheap, the intermediary still attracts as much foreign funding as possible, constrained only by the safety requirement, $f_i^* = \alpha I_i^*$. Investment $I_i^*(X_2)$ then solves

$$MR(I_i^*) + \eta_i(R_i - \alpha X_2) = (1 - \alpha)L_2^* + \alpha X_2, \tag{12}$$

where $\eta_i \equiv \frac{d\delta_i}{dI_i}\frac{I_i}{\delta_i} < 0$ is the elasticity of the probability of the high state with respect to the level of investment. The new second term on the left-hand side captures the greater opacity of investment as its scale increases. Since this term is negative, intermediaries chooses a lower scale of foreign funding compared to the main model. Since the intermediary bears all costs of making investment more opaque, its impact is fully internalized by intermediaries.

5.2 Safe intermediaries?

So far, intermediaries are assumed to invest in risky projects. We now consider whether "safe intermediaries" may emerge to invest only in safe domestic bonds so as to avoid costly runs. This would allow the capture of the safety premium without costly interim liquidation due to early withdrawals of risk-intolerant investors.

In the absence of certainty about a safe choice, such an arrangement is fragile in a context of safety demand. We retain the assumption that the composition of funding is verifiable and contractible. However, even a slight uncertainty over asset choice by such intermediaries (an infinitesimal governance risk) undermines the credibility of safe intermediaries.

It is easy to see that shareholders of safe intermediaries may have an incentive to make risky investment. Suppose that an intermediary were to raise long-term funding at face value $F \geq 1$ from safety seeking investors. If invested in public debt the intermediary's riskless profit is $r^B - F$ per unit of foreign funding f, so $\pi^{safe} = f\,[r^B - F]$. If the intermediary shifts (any amount) into the risky investment, it will repay fully in the high state but (partially) default in the residual risk state, leading to an expected profit $\pi^{risky} = f\,\delta[R(f) - F]$. Risk-taking incentives are lowest for low funding costs, $F = 1$, and for low investment returns due to decreasing returns, $f = W$. Hence, leveraged intermediaries prefer risky investment if

$$\delta[R(W) - 1] > r^B - 1. \tag{13}$$

In this case no safe intermediary can commit to offering the safety required to attract foreign funding. This is consistent with evidence on how even prime money market mutual funds proved to be risk-taking ahead of the 2008 Lehman default, even in a context of rising distress since the summer of 2007 (Kacperczyk and Schnabl, 2013).[13]

5.3 Correlated runs

So far we have considered aggregate risk, whereby all investment returns are perfectly correlated. As a result, the residual risk state creates a systemic crisis by assumption. However, safety-seeking demand may also create correlated runs even when returns are uncorrelated. If investors receive precise information on each lending pool, runs would occur for all intermediaries with uncertain asset values, as in the baseline case. However, in reality investors are more likely to receive information about aggregate profitability. Due to uncertainty about each intermediary's risk, all banks may be run in the residual risk state.

[13] The panic created by their "breaking the buck" forced the US government to offer a temporary blanket guarantee to the entire sector. The extreme response to a minimal deviation from capital protection attests to extreme risk intolerance.

6 Conclusion

This paper has sought a foundation for the widespread view that global imbalances shaped the credit boom and, ultimately, the financial crisis (Caballero and Krishnamurthy, 2009). We show how the accumulation of wealth in countries with a weak protection of property rights creates a demand for safety provided by intermediaries in developed countries. The optimal contractual arrangement shapes the funding structure of domestic intermediaries, creating a clear link between inexpensive funding, credit expansion, and instability.

Studying inflows into developed countries is specular to the literature on sudden capital outflows from emerging economies. Our contribution is to derive the funding arrangement shaped by a demand for safety and to show how it may create endogenous fragility. In our model, domestic and foreign investors have identical preferences and endowments, but regions differ in their exposure to expropriation risk. The funding arrangement comprises loss-absorbing and long-term claims issues to domestic investors and demandable debt claims issued to foreign investors. Demandable debt offers safety at the expense of greater fragility, making foreign funding cheap but flighty.

While global imbalances reflect major shifts in wealth away from developed countries, a large fraction has flown back in the form of inexpensive claims on intermediaries, allowing developed countries to expand credit at times of declining savings. We show that the safety-seeking nature of foreign flows creates risk. The demand for safety not only redistributes risk among investors, but it also increases risk through larger and more frequent runs. The funding shift leads to greater vulnerability even in solvent states and may induce further runs by risk-tolerant investors who seek to avoid dilution. This result has clear implications and supports a mandate for implementing macroprudential policy to oversee the nature of foreign inflows, since the socially preferred funding structure would involve less credit volume and lower instability than the private choice.

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Appendix A Proof of Proposition 2

We suppose here (and verify later) that paying the face value L_2 in the high state is feasible for an intermediary. Hence, we can combine the payoffs of an intermediary i and its local domestic investors as long as the latter group receives an expected return of r^B each. Table 1 states the realized payoffs. In the residual risk state, all foreign investors withdraw, so the intermediary must pay $f_i X_1 = f_i$, which requires a liquidation volume $\ell_i \equiv \frac{f_i}{\alpha}$. The remaining investment, $I_i - \ell_i = I_i - \frac{f_i}{\alpha}$ is continued and earns a return of $\frac{1}{\gamma}$ and 0, respectively.

State	Investment return	Probability	Liquidation?	π_F	$\pi_i + d_i r^B$
H	R_i	δ	No	$X_2 \geq 1$	$I_i R_i - f_i X_2$
RR	$1/\gamma$	$(1-\delta)\gamma$	Yes	$X_1 = 1$	$\left(I_i - \frac{f_i}{\alpha}\right)\frac{1}{\gamma}$
RR	0	$(1-\delta)(1-\gamma)$	Yes	$X_1 = 1$	0

Table 1: Payoffs to foreign investors and the intermediary plus local domestic investors.

Accounting for the expected cost of domestic funding, $d_i r^B$, intermediary i's expected equity value π_i arises as the objective function stated in the main text in Equation (7).

We next solve this constrained optimization problem. Let $\mathcal{L}_i$ be the Lagrangian and λ_i the multiplier associated with the safety constraint. The first-order conditions are

$$\frac{d\mathcal{L}_i}{dd_i} = \delta MR(I_i) + (1-\delta) - r^B + \alpha\lambda_i \quad (14)$$

$$\frac{d\mathcal{L}_i}{df_i} = \delta MR(I_i) + (1-\delta) - \left[\delta X_2 + \frac{1-\delta}{\alpha}\right] - (1-\alpha)\lambda_i \quad (15)$$

and $\lambda_i \geq 0$ and $f_i \leq \alpha I_i$ with complementary slackness. We consider two cases in turn.

Slack safety constraint. Suppose the safety constraint is slack, $\lambda_i^* = 0$. If foreign funding were cheap, then only foreign funding but no domestic funding would be attracted, violating the supposed slack safety constraint. Thus, foreign funding must be expensive, $X_2 \geq \overline{X}$ (for some $\overline{X}$ to be determined), so only domestic funding is attracted, $f_i^* = 0$ and $d_i^* = I^{Aut}$. This choice verifies a slack safety constraint. Evaluating $\frac{d\mathcal{L}_i}{df_i} = 0$ at the autarky portfolio choice and using $\frac{d\mathcal{L}_i}{dd_i} = 0$ defines $\overline{X}$ stated in the main text in Proposition 2.

Binding safety constraint. Suppose $\lambda_i^* > 0$. Then, the safety constraint binds, $f_i^* = \alpha I_i^*$. Optimality requires $f_i^* > 0$, so $\frac{d\mathcal{L}_i}{df_i} = 0$ yields the multiplier $\lambda_i^* = \frac{\delta}{1-\alpha} MR\left(I_i^*\right) - \frac{1-\delta}{\alpha} - \frac{\delta}{1-\alpha} X_2$. Inserting this multiplier in $\frac{d\mathcal{L}_i}{dd_i} = 0$ yields $\delta MR(I_i^*) = (1-\alpha) r^B + \alpha\delta X_2$. Since the safety constraint binds, all investment is liquidated in the residual risk state and domestic investors are fully defaulted upon. They are only repaid in the high state, so their binding participation constraint is $r^B = \delta L_2^*$. Using this relation, we can simplify the first-order condition as stated in the main text in Equation 8. It follows that the Lagrange multiplier is indeed positive for all $X_2 \leq \overline{X}$, confirming the initial supposition:

$$\lambda_i^* = \lambda^* = r^B - \frac{1-\delta}{\alpha} - \delta X_2 > 0. \tag{16}$$

Equation 8 defines a positive and decreasing demand for foreign funding, $f_i^*(X_2) > 0$ for any $1 \leq X_2 \leq \overline{X}$. To ensure $\overline{X} > 1$, we impose the lower bound on the cost of domestic funding stated in the main text. Moreover, we must ensure sufficient safety capacity in the economy, $d_i^* \leq 1$, so the following sufficient condition is imposed throughout: $\delta MR\left(\frac{1}{1-\alpha}\right) \leq (1-\alpha) r^B + \alpha\delta$, which can be interpreted as another lower bound on the cost of domestic funding or as a lower bound on the degree of concavity of the investment technology.

It is easy to show that, at $X_2 = \overline{X}$, both the investment level and the expected profits of the intermediary are equal, $I_i^*(\overline{X}) = I^{Aut}$ and $\pi_i^*(\overline{X}) = \pi^{Aut}$. By the envelope theorem, the expected equity value decreases in the face value, $\frac{d\pi_i^*}{dX_2} < 0$, so the intermediary chooses to attract foreign funding whenever $X_2 < \overline{X}$. Moreover, f_i^* and I_i^* decrease in X_2.

Finally, we verify the feasibility for an intermediary to repay all investors in the high state, $R(I_i^*) I_i^* \geq d_i^* L_2^* + f_i^* X_2$. Using $d_i^* = (1-\alpha) I_i^*$, $f_i^* = \alpha I_i^*$, and noting that it suffices for this inequality to hold at $X_2 = \overline{X}$, we obtain $\delta R_i^* + 1 - \delta \geq r^B$ (i.e. investment has positive NPV at the optimum). This requirement is always satisfied because it is implied by the first-order condition evaluated at $X_2 = \overline{X}$.

Appendix B Proof of Propositions 5 and 7

Let λ_i^P be the Lagrange multiplier with respect to the safety constraint of intermediary i and $\mathcal{L}^P$ be the Lagrangian of the planner based on problem (11). The planner takes into account how f_i affects ℓ_i and thus α. Total differentiation yields

$$\begin{aligned} \frac{d\alpha}{df_i} &= \frac{g''(V-I^P)}{g'(V-I^P)(1+\epsilon)}, && (17) \\ \frac{d\ell_i}{df_i} &= \frac{g'(V-I^P)}{1+\epsilon}, && (18) \end{aligned}$$

because $\ell^P = I^P$ by symmetry and where $\epsilon = \frac{d\alpha}{d\ell}\frac{\ell}{\alpha} = I^P \frac{g''(V-I^P)}{g'(V-I^P)}$ is the elasticity of the liquidation value with respect to its volume. To ensure $\frac{d\alpha}{df_i} < 0$ and equilibrium uniqueness, we focus on parameters and functional forms of $g(\cdot)$ such that $\epsilon \in (-1, 0)$. Since domestic funding has no impact on the liquidation value, the first-order condition with respect to domestic funding, $\frac{d\mathcal{L}^P}{dd_i} = 0$, has the same functional form as in the unregulated economy:

$$\lambda_i^P = \lambda^P = \frac{r^B - \delta MR(I^P) - (1-\delta)}{\alpha^P}, \tag{19}$$

where $\alpha^P = g'(V-I^P)^{-1}$ and $I_i^P = I^P$ by symmetry.

Since foreign funding affects the liquidation value, the first-order condition with respect to foreign funding, $\frac{d\mathcal{L}^P}{df_i} = 0$, differs from the unregulated economy and can be expressed as

$$\delta MR(I^P) + (1-\delta) - \delta X_2 = \lambda^P \left[1 - \alpha^P - I^P \frac{d\alpha}{df_i}\right] + \frac{1-\delta}{\alpha^P}\left(1 - \frac{d\ell_i}{df_i}\right). \tag{20}$$

Comparing this first-order condition to condition (15) reveals that there are two additional positive terms on the right-hand side of (20). As a result, $I^P < I^*$ and $f^P < f_i^*$ for any given X_2 such that foreign capital is intermediated. Solving this system of equations, the efficient investment level I^P is implicitly defined by

$$\delta MR(I^P) = \frac{1-\alpha^P}{\alpha^P}(1-\delta) + \delta(1+\epsilon)\alpha^P X_2 + \left(1 - (1+\epsilon)\alpha^P\right) r^B. \tag{21}$$

The threshold $\overline{X}^P$ below which foreign capital is attracted is again obtained by evaluating equation (20) at the autarky allocation, $f^{Aut} = 0 = \ell^{Aut}$. Thus, $\alpha^{Aut} = g'(V)$ and $\overline{X}^P \equiv \frac{r^B-(1-\delta)g'(V)^2}{\delta} < \frac{r^B-(1-\delta)g'(V)}{\delta} = \overline{X}$.

Finally, we consider the regulated economy. Let $\mathcal{L}_i^R$ be the Lagrangian of intermediary i subject to regulation in the form of a Pigouvian tax on capital inflows. It follows that $\frac{d\mathcal{L}_i^R}{dd_i} = \frac{d\mathcal{L}_i}{dd_i}$ and $\frac{d\mathcal{L}_i^R}{df_i} = \frac{d\mathcal{L}_i}{df_i} - \tau$. Comparing the latter condition to equation (20), both conditions are identical for $\tau^* = -I^P\lambda^P\frac{d\alpha}{df_i} + \frac{1-\delta}{\alpha^P}\left(1 - \frac{d\ell_i}{df_i}\right) > 0$. Using the total differentials stated above, the optimal tax can be rewritten to the expression stated in the main text.