# Risk-centric Macroeconomics and Safe Asset Shortages in the Global Economy: An Illustration of Mechanisms and Policies

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## 1. Introduction

In these notes I summarize my research on the topic of risk-centric global macroeconomics. This work is the outcome of collaboration with an outstanding group of coauthors. Collectively, this research makes the case that a risk-markets dislocations perspective of macroeconomics provides a unified framework to think about the mechanisms behind several of the main economic imbalances, crises, and structural fragilities observed in recent decades in the global economy. This perspective sheds light on the kind of policies, especially unconventional ones, that are likely to help the world economy navigate this tumultuous environment.

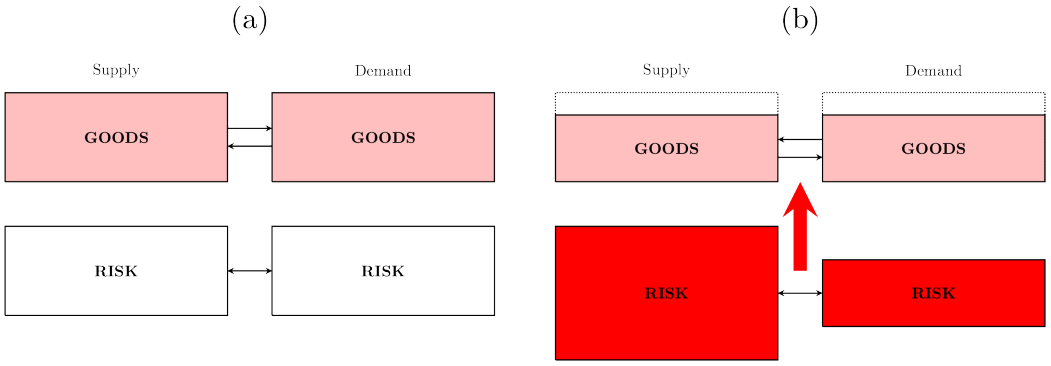


Figure 1: Output and risk supply vs. output and risk demand.

The starting point of this risk-centric perspective is the observation that economic activity generates output *and* risks. Economic agents must absorb both to ensure a smooth growth process.

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During normal expansions and contractions, macroeconomists (and our models) mainly focus on goods markets, studying whether the demand for output is well aligned with potential output, while risk markets considerations are relegated to a secondary role, mostly relevant to the field of finance (Figure 1a). In sharp contrast, this hierarchy flips during severe risk-off events. Risk markets become central, and their disruptions quickly permeate the real side of the economy through supply and demand mechanisms. That is, insufficient demand for the risks generated by economic activity contaminates – often in a chaotic (even Knightian uncertainty) fashion – equilibrium in goods markets (Figure 1b).

These risk events take place in a global economy with heterogenous and highly interconnected financial markets. These markets operate in different currencies and are exposed to large swings in capital flows. These flows provide many useful services to the global economy but can be fickle, perhaps because foreign crises cause faster transitions from speculation-mode to Knightian uncertainty-mode than crises take place in local markets. This difference is partly due to the fact that the policy infrastructure to support risk-markets during international crises is much less developed than the infrastructure to support local crises. Furthermore, the international dimension creates multiple substitutes for the distressed markets, which facilitates a speedy exodus, particularly from periphery markets.

There are important structural factors behind the buildups to these risk events, which stem from frictions in the production of financial assets (i.e., in the mapping from risk generation to asset production). These frictions are more acute in emerging markets (EMs), but fast growth in EMs relative to developed markets (DMs) combined with EMs increased prudence, has turned the global economy into a sort of "advanced EM," with corresponding recurrent risk events. A central ingredient in the instability of this global integration process is the large asymmetry in safe asset production across the world, with the U.S. as the core supplier of these assets (Figure 2). Several of the mechanisms I describe below underlie this asymmetry.

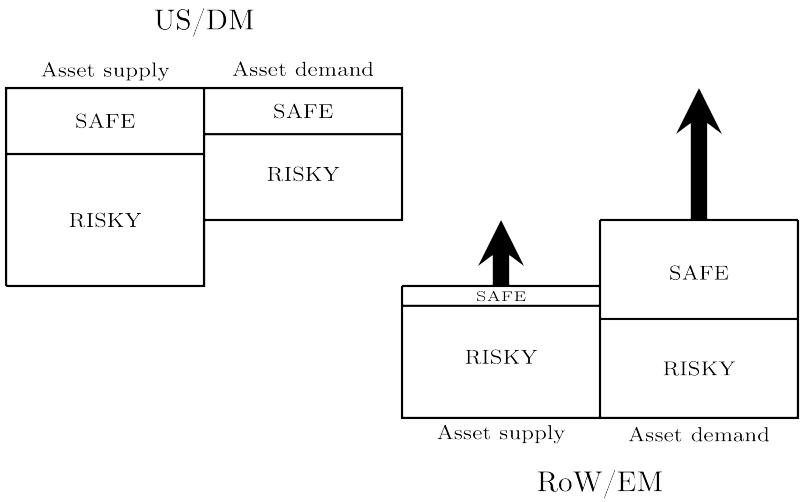



Figure 2

In order to keep the length of these notes under control while discussing many models, I only provide a pictorial illustration of the key mechanisms. All the topics I cover have an academic and a policy (even advocacy at times) dimension. Their organization is substantially aligned with the sequence of global macroeconomic events of the past two decades, starting with EM crises and concluding with the current environment of low interest rates and aggregate demand vulnerability. Section 2 focuses on EM crises. I will discuss sudden stops and financial underdevelopment, the reach for yield, and contingent reserves management and multilateral facilities. Section 3 focuses on global and DM crises. I will discuss global imbalances, Knightian uncertainty and flight to safety, and put-option style policies (policy puts). Section 4 focuses on structural risk-based demand recessions and global contagion. I will discuss safety traps and currency wars. Section 5 focuses on cyclical risk-based aggregate demand recessions, speculation, and macroprudential policy. Section 6 focuses on capital flows taxation in a low interest rates environment. Section 7 contains final remarks and references to ongoing research in the above areas.

## 2. Risk-centric Crises in Emerging Markets

EMs are the most exposed to international risk-market dislocations. The so called "sudden stops" refer to the rapid reversal of net capital inflows and their devastating consequences for the real economy. With the institutionalization of sound macroeconomic policy and the rapid growth in financial integration, the triggers for these sudden stops have gradually migrated (but not entirely) from conventional macroeconomic imbalances to risk-market dislocations — and the academic and policy debate has evolved accordingly.

There is a fundamental asymmetry at the root of the risk-based crises in EM: these economies are significantly better at producing output from physical capital than at producing tradable and pledgeable financial assets backed by that capital and future output stream (Figure 3). This asymmetry generates a chronic scenario of asset shortages with fast growth, which in turn provides fertile ground for asset bubbles. Speculative episodes are often fueled by reinforcing reach-for-yield but fickle capital flows, which sow the seeds for the next sudden stop. To limit the exposure to these large capital flow reversals, EMs often accumulate large international reserves and enact macroprudential policies. The lack of international coordination and limited availability of insurance arrangements, however, raises the costs of these policies for the local economies and, once aggregated, may hamper the stability of the entire global financial system.

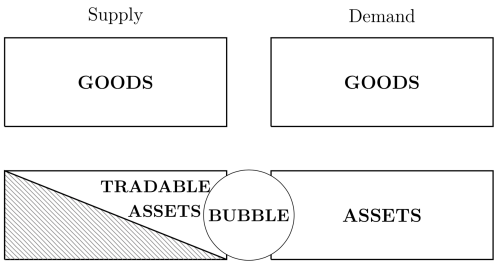


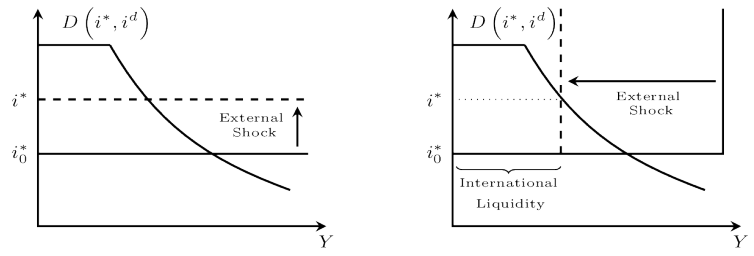

Figure 3: EM's financial underdevelopment: shortage of tradable assets creates room for bubbles to satisfy the demand for assets.

## 2.1. Sudden Stops and Domestic Financial Underdevelopment

The tension between fast growth and limited asset production in EMs can be resolved by looking for a store of value abroad. However, the large wedge between the returns on those foreign assets and domestic marginal product invites the emergence of domestic bubbly assets and collateral used to fund domestic investment.

In principle, both could be efficient outcomes: bubbles solve a sort of dynamic inefficiency due to financial underdevelopment, and real investment reduces chronic underinvestment due to financial frictions. However, they are also sources of financial fragility. Once the possibility of sudden stops arises, the very same financial underdevelopment behind those bubbly outcomes gives rise to a pecuniary externality in which the private sector overinvests in the domestic bubbles and capital and underinvests in international liquidity, exposing the economy to a sudden dry-up of international (and also domestic) funding.

This is the perspective we adopted in our work with Arvind Krishnamurthy, where we focused on both the ex-ante and ex-post (i.e., during the crisis) problems of sudden stops. Our analysis starts with a *dual liquidity* perspective, in which the distinction between domestic and international liquidity (or collateral) is unimportant during normal times but is critical during crises, where international liquidity binds. In fact, one way of thinking about bubbles in this context is as a temporary perception of domestic collateral as if it were international collateral, which becomes undone during sudden stops. This perspective motivates the view of sudden stops as price-insensitive international liquidity dry-ups. We argued that this is a better characterization of crises where everyone is trying to exit through the same narrow gate, rather than one in which crises amount to some exogenous jump in the country's risk premium. We referred to these as vertical (as opposed to horizontal) sudden stops.




Horizontal view Vertical view

Figure 4: Horizontal and vertical sudden stops. Dollar debt interest rate on y-axis, domestic output on x-axis. $D$ denotes constrained output demand.

The two panels in Figure 4 capture stylized versions of the horizontal (left) and vertical (right) perspectives. They both plot equilibrium dollar-debt interest rates (y-axis) and domestic output (x-axis). Output is constrained by liquidity, and the constrained demand for liquidity is a decreasing function of both international and domestic liquidity costs (the latter captured by the interest rate $i^d$). In the horizontal view, a sudden stop happens because the dollar-credit spread of the country spikes, shifting the effective supply of international liquidity up. In the vertical view, it is international liquidity that binds during a crisis, as the vertical supply shifts to the left. In both cases, the final result is a rise in credit spreads, a sharp drop in output, and the reversal of capital flows, but the similarities end there.

In terms of ex-post policy (i.e., during the sudden stop), expanding domestic liquidity is effective in stabilizing output in the horizontal view but it is ineffective in the vertical view since the binding constraint is a lack of international, not domestic, liquidity. That is, in the horizontal view domestic and international liquidity are good substitutes, which naturally facilitates the countercyclical response of the local central bank. In contrast, in the vertical view domestic and international liquidities are poor substitutes, thus there is little the local central bank can do ex-post, aside from supplying the international liquidity it has hoarded in advance.

Turning to the ex-ante questions, we ask whether the above outcome could be constrained efficient: is the private sector doing the best it can given the fickleness of capital flows? We argue that the very same financial underdevelopment behind the shortage of sound assets in EMs also leads the private sector to underinsure against international-liquidity dry-ups. The effective demand for international liquidity is constrained by limited domestic collateral, which introduces a gap between the social value of an extra unit of international liquidity and the private reward for a domestic lender of that unit of international liquidity, discouraging private provision of insurance. This gap is depicted in Figure 5 by the distance between the marginal product of capital (i.e., the dashed horizontal line) and the equilibrium expected return from a dollar-loan, $i^*$.

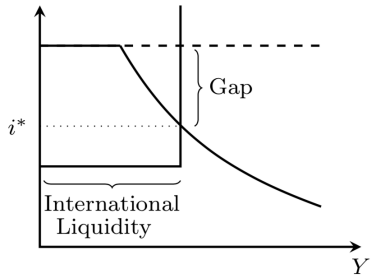



Figure 5: Gap between private and social marginal values of international liquidity in the vertical view.

This simple diagram captures a variety of phenomena around sudden stops. Underinsurance can take many forms: for instance, as a dollarization of liabilities or as a domestic real estate boom funded with capital inflows. Along the same lines, Figure 6 reproduces Figure 5 but replaces the dollar-rate for the current exchange rate on the y-axis via the uncovered interest parity condition (UIP). In this space, it illustrates the incentive of a central bank to defend the currency (via interest rate hikes) during a sudden stop (the so called "fear of floating"), since the domestic interest rate becomes largely disconnected from domestic activity, thus other goals, such as stabilizing the currency, gain priority.

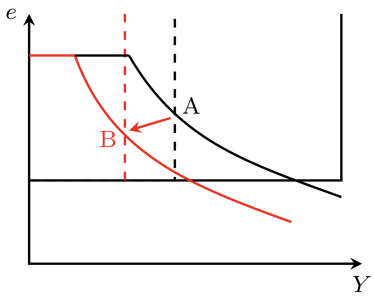



Figure 6: Exchange rate $e$ in units of domestic currency per unit of foreign currency on the y-axis. Anticipated defense of the exchange rate shifts the vertical curve inwards (less hedging).

For advanced EMs with credible macropolicy frameworks, these incentive problems, both of the private sector and policymakers, can be ameliorated by modifying the inflation targeting regime so that the explicit target is increased during sudden stops. A related mechanism that endogenizes such a rule is to overweight the basket of nontradable goods (equivalently, underweights tradables). These modifications reduce fear of floating and its anticipation mitigates the extent of the underinsurance problem. More abstractly, there is a variety of policies that implement the optimal mechanism more directly and have parallels in actual EMs' policies, such as sterilization and taxation of capital inflows. However we show that these policies typically need to be extremely large to work (sterilization) or are hard to implement, as they are often not coalition incentive compatible (i.e., there is a strong incentive to circumvent the regulation).

In work with Guido Lorenzoni, we explore the related theme of currency overvaluation during a boom. We show that, when the export sector faces borrowing constraints, it may well be the case that optimal policy includes a combination of currency weakening during the boom and during the early stages of the capital flow reversal phase. By doing so, the export sector's net worth rises during the sudden stop (a sort of shift to the right of the vertical constraint), which is when its pull is needed the most. These results are illustrated in Figure 7, which shows an example of the path of the equilibrium (dashed) and optimal (solid) exchange rate (top panel, measured as units of foreign currency per unit of domestic currency) and size of the export sector (bottom panel) for an economy that experiences an abrupt end of its overvaluation phase in period 5. Note that, somewhat paradoxically, because the export sector is better capitalized under the optimal policy (vertical constraint shifts to the right), the exchange rate depreciation at the sudden stop is less acute.

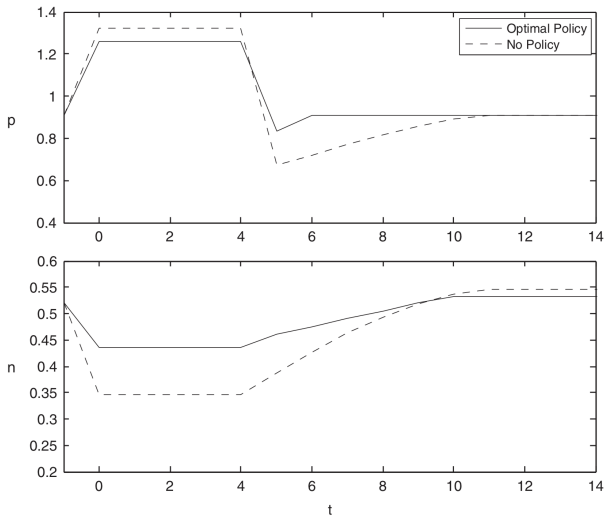



Figure 7: Laissez-faire vs. optimal path for exchange rate $p$ in units of foreign currency per unit of domestic currency (top panel) and number of export units $n$ (bottom panel). The appreciation lasts from $t = 0$ to $t = 4$.

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### 2.2. Reach for yield

A classic question in the capital flows literature is whether these flows are driven by pull (domestic) or push (foreign) factors. In my recent work with Alp Simsek we study the role of fickle reach-for-yield capital flows (a push factor) in exacerbating the severity of sudden stops. The fickleness stems from the fact that these flows are often from non-specialists prone to perceive Knightian uncertainty when crises strike in these foreign markets.

The basic idea of this work is that while fickleness exacerbates local liquidity crises, international diversification is a stabilizing force. In this context, we show that when countries have sufficiently symmetric expected returns, the capital flows are, on net, stabilizing despite their fickleness. The reach-for-yield phenomenon arises when expected returns significantly differ from this symmetric benchmark.

We start by modeling an isolated block of high return EMs. Then we expose these EM block to a lower-return but less crisis-prone DM block. The horizontal dashed line in the top panel of Figure 8 shows the equilibrium fire sale price in a country experiencing a local (vertical) crisis, when a block of homogeneous but not perfectly correlated EMs have cross holdings on each other. In this case, the gain from international diversification is substantial compared to the autarky equilibrium prices of zero (this is a normalization in the model). The horizontal dashed line in the bottom panel portrays the (ex-ante) outflows from a representative EM (which goes entirely to other EMs when not integrated to DMs).

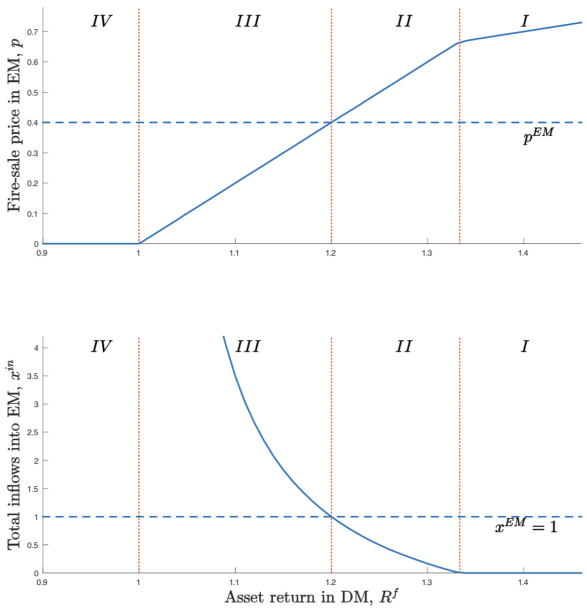


Figure 8: Reach for yield: The solid lines plot the equilibrium fire-sale price $p$ and inflows $x^{in}$ in the EM as a function of the return in the DM, $R^f$. The dashed lines illustrate the price and inflows that would obtain in the EM block in isolation (without any DM-EM flows).

Suppose now that we introduce a block of DMs that experience no liquidity crises but whose assets have a lower return than those from EMs. The solid lines in the figure illustrate this scenario. In region I, we see a situation where the return in DM is high (but possibly lower than the hold-to-maturity return on EM assets). In such a case, EMs do all their liquidity provision in DM assets and equilibrium fire-sale prices rise substantially, while EMs experience net capital outflows prior to a potential crisis (there are no inflows, and outflows remain at one). However, as the return in DM's assets starts to fall, at some point fickle capital inflows into EM start rising (region II), which depresses fire sale prices in the event of a crisis. These are reach-for-yield flows, which turn net-negative in region III, with fire-sale prices that are worse than without integration to DM and where EMs experience net capital inflows prior to crises.

On the policy front, we show that in regions III and IV, it may beneficial for the EM block to tax capital inflows, as long as they collectively face a sufficiently elastic supply of safe assets (a condition that may not hold in the current global environment of safe asset scarcity, see section 5.2 below).

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## 2.3. Contingent Reserves and Multilateral Financial Arrangements

The tendency for the private sector to underinsure against sudden stops is a (precautionary) reason for central banks in EMs to accumulate international reserves. Usually, these reserves take the form of ultra-safe sovereign bonds, primarily U.S. treasuries. This practice has important global systemic consequences, which I will discuss later, but it also has substantial costs for individual EMs. For this reason, I advocate for contingent instruments and special purpose vehicles (SPVs) involving the international financial institutions (IFIs) to help insure well behaved EMs against risk-based sudden stops.

My work with Stavros Panageas contains the models and quantitative analysis behind many of these recommendations, which often involved some contingency linked to commodity prices (for commodity producers) and VIX options structures.[1] The following table (Figure 9) illustrates the large expected gains from a VIX-based contingency for realistic calibrations. These gains are particularly large for countries whose sudden stops are mostly due to global risk factors. The first column shows an estimate of the likelihood of a VIX jump, conditional on the country experiencing a sudden stop, which is very high at around 70 percent for EMs in general and close to 90 percent for the relatively stable East Asian economies. The second column reports the average gain in reserves during a sudden stop from the hedging strategy, which exceeds 40 percent for the average economy in our sample and in many instances more than doubles international reserves.

| Country | $Pr(J = 1 \mid SS = 1)$ | Expected gain (options) |
|---|---|---|
| Argentina | 0.80 | 0.60 |
| Brazil | 0.60 | 0.14 |
| Chile | 1.00 | 1.40 |
| Indonesia | 1.00 | 1.40 |
| Korea | 1.00 | 1.40 |
| Malaysia | 0.67 | 0.26 |
| Mexico | 0.00 | 0.00 |
| Thailand | 1.00 | 1.40 |
| Turkey | 0.75 | 0.46 |
| Average | 0.72 | 0.39 |
| High-risk Countries | 0.71 | 0.36 |
| East Asia | 0.88 | 0.86 |

Figure 9: Expected gains in reserves on entering a sudden stop when following the hedging strategy in Caballero and Panageas (2006).

Some of the markets for these contingencies, especially those linked to global factors, already exist and are well developed (although probably not enough to absorb a massive EM reallocation toward them, which reinforces the next point). However, there is much scope for improving the liquidity of the EM asset class as a whole, which would not only reduce the severity of sudden stops but would also expand the effective supply of reliable assets. This larger effective supply of safe assets would attack the fundamental structural deficiency on which many of the risk dislocations build on. A few years ago I proposed that the IMF and other IFIs play the dual role of monitors

[1] VIX is a weighted average of the implied volatilility of (synthetic) 30 days options on the S&P 500 Index, and is often described as a "fear index."

and investors in a variety of SPVs and collateralized debt obligations (CDOs) whose assets are EM debt from countries that meet certain macroeconomic health criterion.[2]

In recent years the IMF has created useful contingent credit line facilities, and the Fed implemented large swap lines with foreign central banks during the worst days of the Global Financial Crisis (GFC).[3] These are all welcome steps from a risk-based perspective of crises. Still, we lack a larger, coordinated, and more dependable international liquidity arrangement that matches the existing domestic liquidity tools and their independence from the political process.

### 2.3.1. References


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[2] A similar proposal, the Sovereign bond-backed Securities (SBBS), is currently being considered by the European Systemic Risk Board to create a new regional safe asset.

[3] Australia, Brazil, Canada, Denmark, UK, ECB, Japan, South Korea, Mexico, New Zealand, Norway, Singapore, Sweden, Switzerland, from December 2007 to February 1, 2010.

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## 3. Risk-centric Crises in Developed Markets and the Global Economy

The acute scarcity of store-of-value assets in EMs has some parallels at the global level, particularly since the crash of the Japanese bubble in the late 1980s and the collective EM crisis of the late 1990s. The symptoms of asset scarcity have been recurrent and pervasive. For example, Figure 10 illustrates that the pre-GFC phase of the global economy exhibited a "conservation law" of speculative bubbles, that migrated through several asset classes.

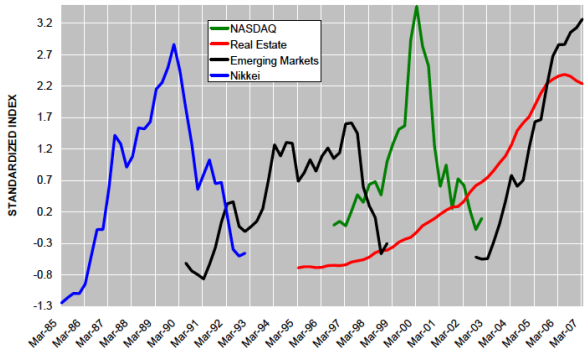


Figure 10: Conservation law of bubbles pre-GFC.

However, in recent decades, and partly because of the large participation of central banks and sovereign wealth funds, global asset demand has become biased toward safe assets. This phenomenon was a key factor behind the GFC and has deep implications for the functioning of the global economy going forward. I will discuss the mechanisms operating before and during the crisis in this section, and the recovery and structural implications in the next sections.

The so called global imbalances (primarily the large current account deficits in the U.S.) were one of the most talked about global phenomena before the subprime crisis. While I never shared the view that these imbalances would bring the U.S. financial system down through an EM style sudden stop, I believe that they did create a very significant risk-based fragility through the incentive for DMs' financial systems to increase leverage and to put their own production of "safe" assets into overdrive, using creative and complex financial engineering to extract safe tranches from subprime products. It is in this sense, and not via a sudden stop, that the U.S. crisis had an international origin. Then, capital flows quickly turned the U.S. subprime crisis into the GFC, which exposed many of the fragilities of the Euro area, triggering several rounds of crises in this region. Appropriately for a massive risk markets driven crisis, and having to deal with severe political obstacles, DM central banks implemented large unconventional asset-market put policies, which prevented a complete

meltdown of the global economy.[4]

### 3.1. Global Imbalances and Low Interest Rates

Much of the focus of the global imbalances literature pre-GFC was on the large current account deficit of the U.S. In work with Emmanuel Farhi and Pierre-Olivier Gourinchas, I modeled and argued that this was a capital account induced phenomenon reflecting the U.S. comparative advantage in producing store-of-value assets relative to the high-saving economies of Asia in particular. Moreover, Asia's faster growth implied a structural and increasing force to contend with. Figure 11 captures this tension.

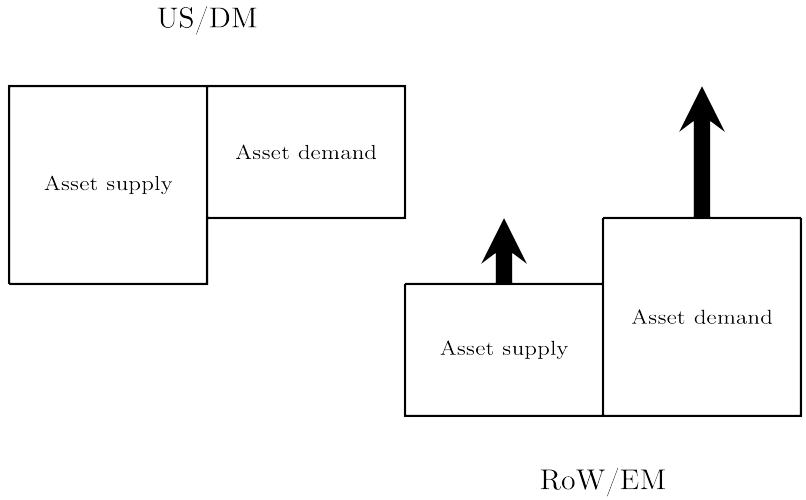


Figure 11: U.S./DM produces many assets, RoW/EM produces few assets but has high and growing demand for them.

Because the current account deficit was driven by asset demand, it also induced a steady decline in U.S. interest rates, immortalized in the so called "Greenspan conundrum" (the fact that despite hiking the federal funds rate, long rates kept dropping as a result of the global inflows toward U.S. treasury bonds). Ben Bernanke's famous "global savings glut speech" was based on similar observations. Figure 12 captures the mechanism in our model, through a Metzler diagram. The left panel reflects the asset demand and supply per unit of output ($W/X$ and $V/X$, respectively) in the U.S./DM, while the right panel does the same for the RoW/EM. The gaps between demand and supply in each panel reflect the net foreign asset positions per unit of output ($NA$). The arrow pointing downward for the equilibrium interest rate reflects that the weight of the right panel is rising over time as RoW/EM is growing at a faster pace than U.S./DM ($g^{DM} < g^{EM}$).

[4]Credit is also due to the massive Chinese fiscal expansion, which supported the entire EM world.

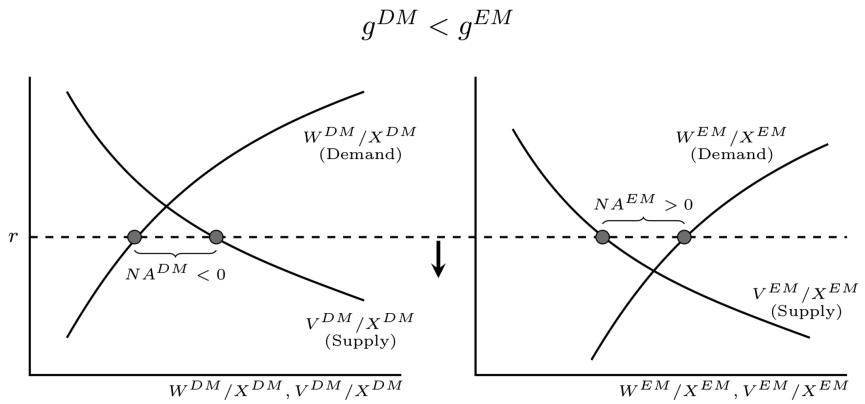


Figure 12: Metzler diagram.

Finally, in work with Pol Antras, we show that these patterns of reverse flows (from EM to DM) are exacerbated by trade-protectionism, as trade integration and capital inflows are complements in less financially developed economies. This complementarity arises because trade integration increases the return to capital in EM proportionally more than in DM (because trade allows the EM to reallocate capital toward less financially dependent sectors).[5]

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4. Antras, Pol, and Ricardo J. Caballero. 2009. "Trade and Capital Flows: A Financial Frictions Perspective." Journal of Political Economy, 117(4), 701-744.


### 3.2. Reach for Safety and Leverage

While our global imbalances models were motivated by a rising demand for safe assets, our original analysis did not have explicit risk in it. In a paper with Arvind Krishnamurthy we added risk and focused on the implications for the asset supplier economy (the U.S.). Our model shows

[5] In contrast, in the classical Heckscher-Ohlin-Mundell paradigm trade integration and capital inflows are *substitutes*.

that during the boom phase of this economy, a large external demand for safe assets not only puts downward pressure on the safe interest rate but also increases the leverage of its financial system and, somewhat paradoxically, initially compresses risk-premiums. These effects increase the vulnerability of the domestic financial system to a recessionary shock. That is, even without the risk of an EM style sudden stop, the nature of the inflows makes the U.S. more vulnerable to domestic shocks.

Figure 13 illustrates the mechanism. It shows the risk premium and interest rate (left panel) and asset value and external debt (right panel) graphed over time. Foreign inflows in search of safe assets start at $t = 0$. At $t = 6$ *domestic* shocks to output turn negative (while capital inflows continue). The figure shows that the risk premium and interest rate fall upon entry. After that, the risk premium rises gradually as leverage accumulates, and it accelerates after $t = 6$. The interest rate drops uniformly over time. It does so rapidly when the inflows start, gradually afterward since risk builds during the boom, and sharply again once domestic shocks turn negative. The right panel of the figure shows that domestic asset values rise upon entry and during the boom, before falling rapidly when output shocks turn negative. External (safe) debt accumulates throughout.[6]

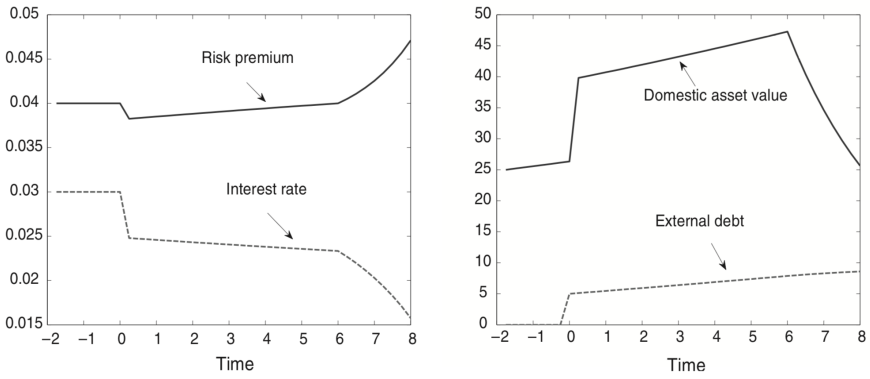


Figure 13: Risk premium and interest rate (left panel) and asset value and external debt (right panel) graphed over time. $t = 0$ is the date of foreign entry. $t = 6$ is when domestic output shocks turn negative.

In recent work with Alp Simsek, we dub this phenomenon of capital inflows into safe assets as reach-for-safety flows (to parallel the reach-for-yield flows), and show that while they stabilize the world economy, they can destabilize the recipient country. This is consistent with the persuasive empirical case made by Pierre-Olivier Gourinchas and Helene Rey that, in terms of gross capital flows, the U.S. behaves as a venture capitalist and insurer of last resort.

[6]Incidentally, from the perspective of the private sector, one can think of Quantitative Easing (QE) policies targeted toward safe assets as equivalent to these foreign inflows. In this case, as an attempt to contain an excessive deleveraging and boost asset prices.

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## 3.3. Complexity, Knightian Uncertainty and Flight to Safety

Up to this point, I have focused on the U.S. as a global supplier of assets and insurance. An natural question is whether the U.S. was selling too much insurance to the rest of the world. This may well have been the case but I believe there was a more central source of fragility. A key issue for understanding the severity of the subprime crisis and the GFC that followed is the form of that insurance (or, more accurately, of the assets created to replace the sales of U.S. treasuries to foreigners within the financial system), which came from the large private supply of complex, financially-engineered safe assets. This complexity gave rise to massive uncertainty once things began to unravel.

This perspective led Arvind Krishnamurthy and me to work on Knightian uncertainty for understanding crises. In a paper that was coincidentally published in October 2008, we argue that a central aspect of extreme crises is the unusual nature of the shock that surprises even sophisticated market participants, causing them to question their models. We show that a central feature of that environment is a sort of double-counting of risks. In terms of the risk-centric diagrams, we can capture this mechanism by splitting the risk-supply box into the perceived supply faced by two agents of equal size. Each of them thinks that it is absorbing more than its fair share of the risk, so collectively they perceive more risk than the underlying economy is generating, which creates an immediate imbalance in risk-markets that quickly contaminates goods markets (Figure 14).

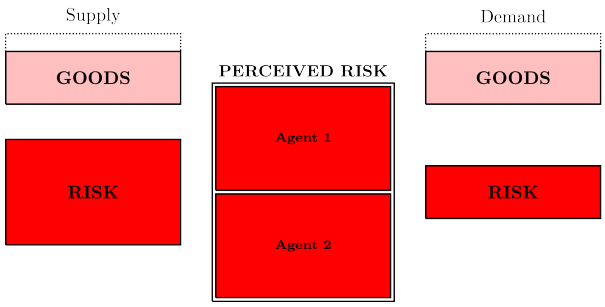


Figure 14

Where does the complexity come from? In work with Alp Simsek we modeled the financial system as a complex network, where banks understand the risks of their immediate neighbors, but not those of the neighbors of the neighbors, and so on. With a sufficiently large shock in the network, those distant linkages become relevant, triggering Knightian uncertainty responses, which

in our model consist of legacy asset (fire) sales ($A_0 = S$) to generate precautionary liquidity for a potential cascade.

In practice, the direct effect rarely turns risk into uncertainty – instead, uncertainty results from the second and higher rounds that do. For example, CDS prices of Lehman during the subprime crisis clearly anticipated that the investment bank could go under, but few anticipated that its collapse could drag down a large money market fund (Reserve Primary Fund) that was holding Lehman debt. Similarly, and even more indirectly, a few years earlier CDS prices anticipated that Russia could default on its debt during the EM crisis of the late 1990s, but few anticipated LTCM's exposure, not only to Russia itself, but to the reappraisal of risk that followed.

Figure 15 illustrates the mechanism. The top panel shows a small liquidity shock with a contained domino effect, where distant banks are not uncertain about the environment and hence turn into buyers ($A_0 = B$) of liquidated assets (the environment is simple). The bottom panel illustrates a larger liquidity shock and domino effect, which makes the environment uncertain for distant banks. In this case the equilibrium features a much larger flight to quality than in the certainty benchmark (the environment is endogenously complex) and all banks turn into sellers ($A_0 = S$).

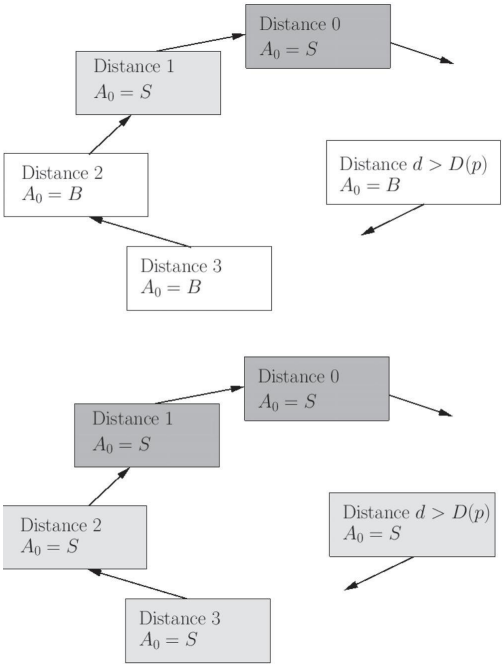


Figure 15: The partial domino effect and the precautionary actions with network uncertainty.

The international dimension adds yet another layer of complexity. As in the context of EMs, a well documented pattern is the fickle nature of capital flows, with large reversals of capital inflows and retrenchment of outflows during risk-off episodes (Figure 16). In other work with Alp Simsek we show that Knightian uncertainty provides one plausible explanation for such a pattern of fickleness and retrenchment.

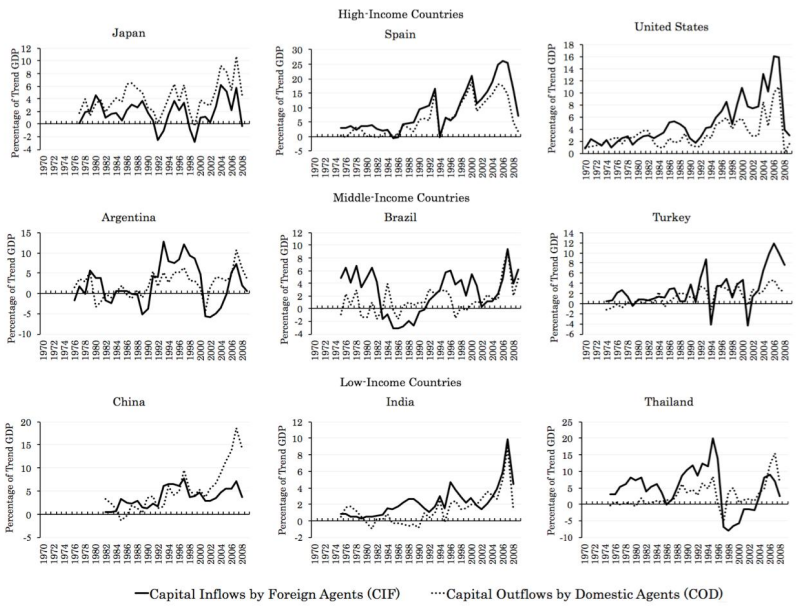


Figure 16: This figure from Broner et al. (2013a,b) shows the capital inflows and outflows for a sample of countries based on the IMF's Balance of Payments statistics. CIF is equal to the net purchases of domestic assets by non-residents, and COD is equal to the net purchases of foreign assets by domestic agents (including international reserves).

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## 3.4. Put Policies and Financial Defibrillators

Conventional monetary policy, the quintessential tool for plain-vanilla cycles, has an important role to play in risk-based contractions, mostly by improving the (ex-ante) Sharpe ratio of risky assets. Figure 17 illustrates this mechanism, in which lowering the interest rate expands the demand for risk.

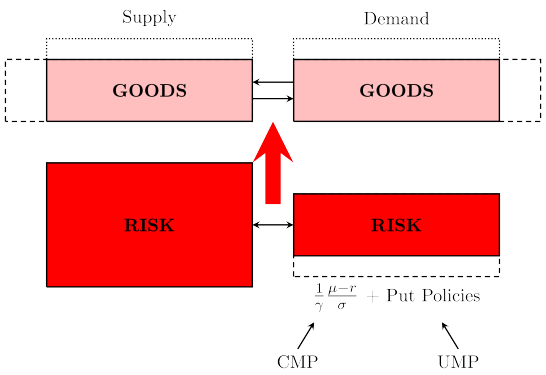


Figure 17

However, this channel is often insufficient, as interest rate adjustments are constrained by an effective lower bound, or by their impact on weak banks' profits, or by the need to defend a rapidly weakening exchange rate, and so on. In this context, unconventional "monetary" policies have a very significant role to play, and these are naturally, and mostly, risk-markets interventions. For EMs, unconventional policies are nearly conventional, since interest rate policy is often locked by equally urgent objectives, such as the exchange rate stabilization in a heavily dollarized economy, or the anchoring of potentially explosive inflation expectations. Still, given the current proximity of DMs' rates to their own effective lower bound, these policies now are also important for DMs.

As I mentioned earlier, acute risk market dislocations are messy and effective risk aversion can rise dramatically as financial complexity triggers Knightian uncertainty. In such an environment, unconventional policies that have a large anti-anxiety component are most powerful. Explicit and implicit insurance arrangements, put option type policies (such as private and sovereign credit market supports), are more powerful than call-option type policies (such as forward guidance), as financial markets shift their focus to the left tail of the distribution of risks during crises. Moreover, these policy actions have to be fast and anticipated by economic agents.

The lender of last resort facility is one such framework, but its scope is too narrow for full blown crises, especially those that destroy the asset side (and hence the collateral) of financial institutions, or that are concentrated outside of commercial banks. We need a broader *financial defibrillator* such that whenever a systemic crisis of uncertainty strikes, the government is able to provide access to reasonably priced balance-sheet insurance to financial institutions. Moreover, because it has to be fast, it should be managed by central banks, hopefully with a framework as close as possible to conventional monetary policy. We made one proposal of this kind with Pablo Kurlat at the Fed's Jackson Hole conference. Under our proposal, the central bank (CB) would issue *tradable insurance credits* (TICs):

- During a systemic crisis, each TIC entitles its holder to attach a CB guarantee to newly issued and legacy securities. The CB is the sole determiner of what constitutes a systemic crisis, partially based on observable indicators.

- All regulated financial institutions are allowed to hold and use TICs, and possibly hedge

funds, private equity funds, and corporations can use them as well.

- The basic mechanism attaches TICs to assets, but variants include attaching them to liabilities and even equity, depending on the particular needs of distressed institutions and markets. They could also operate as collateral-enhancers for discount window borrowing.

- During normal times, when TICs are *not* convertible, the CB can buy or sell TICs at a market price. Regulated financial institutions must hold a minimum amount of TICs as a proportion of risk-weighted assets and systemic importance.

It is important to notice that the TIC policy is not a conventional insurance policy, where, for a fee during normal times it ensures a cash injection during crises. Rather, the TIC policy is an "insurance-squared" policy: for a fee, it ensures that financial institutions will have *access* to insurance for their assets during a systemic crisis. This is a key feature that maximizes the perceived size of the policy. In my work on flights to safety with Arvind Krishnamurthy (discussed in the previous section) we show that when Knightian uncertainty is at play, it is possible to find situations where there could be nearly free-lunche-policies, as collectively agents envision and fear scenarios that are impossible (for example, everyone thinks that they will be hit harder than the average). A powerful put policy framework builds on these features.

### 3.4.1. References


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# 4. Structural Safe Asset Shortages, Aggregate Demand Constraints, and Global Spillovers

The acute scarcity of safe assets in EMs became an acute *global* scarcity with the collapse of the private production of safe assets and the downgrading of a share of European sovereign debt. All of a sudden, the mostly benign decline in safe interest rates that preceded the GFC turned into a negative force that put most DMs' interest rates against their effective lower bounds. Capital flows (now within DMs) spread the liquidity traps across the developed world and created the potential for currency wars. By then, not only the crisis, but also the ability to recover from it, heavily depended on risk-perceptions and policies at the global level.

## 4.1. Safety Traps

Figure 18 shows that while the decline in safe interest rates initially dragged down the expected return on risky assets, it eventually accommodated a rising equity-risk-premium (ERP) until the safe interest rate hit the zero lower bound (ZLB). Figure 19 is a particular representation of the risk-imbalance portrayed in Figure 1b, that captures the safe asset shortage view.

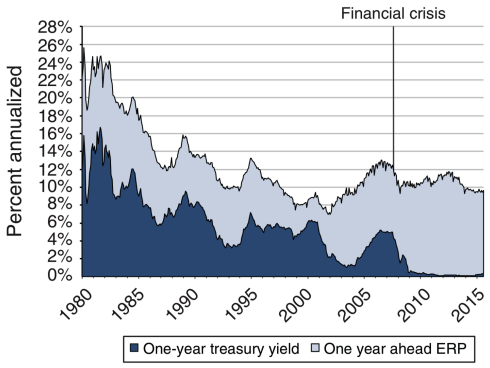


Figure 18: One-year Treasury yield from Federal Reserve H.15; equity risk premia (ERP) from Duarte and Rosa (2015).

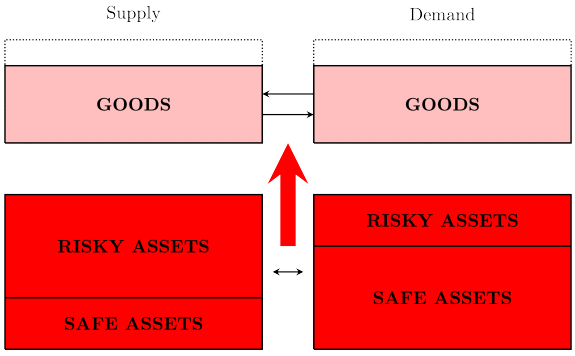


Figure 19

Emmanuel Farhi and I dubbed this situation a Safety Trap due to its origin in safe asset markets and because, unlike a conventional liquidity trap, it is responsive to put-policies but not to call-policies (such as forward guidance). To study this phenomenon we built a Keynesian model (sticky prices) with an endogenous risk premium. For this, we split economic agents between risk-neutral and Knightians – the latter are only willing to hold safe assets, while the former have a limited (by endowment and financial frictions) capacity to issue these assets. In this environment, when the safe interest rate drops, resources are transferred from the Knightian to the Neutral agents, which restores equilibrium by depressing the demand for safe assets. A safety trap takes place when the imbalance in the safe asset market is strong enough to bring the safe interest rate to its lower bound.

Figure 20 provides a Keynesian cross / AS-AD representation and illustrates this mechanism. The supply of safe assets, $V^S$, plays the role of an aggregate demand shifter. A drop in $V^S$ causes a recession if it is not compensated by a lower safe interest rate $r$, which is the case at the ZLB. Once interest rates reach the ZLB, equilibrium in the safe asset market is achieved by a costly recession (or slow recovery), which depresses everyone's income in order to drag down safe asset demand.

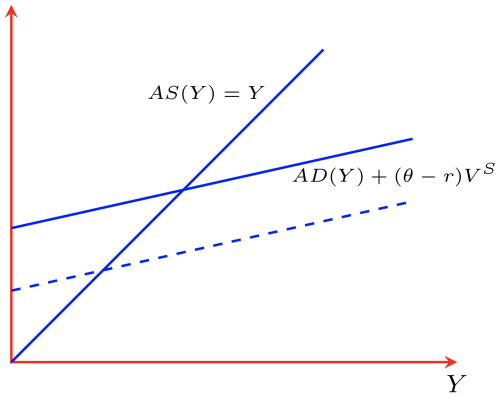


Figure 20: AS-AD representation and the Keynesian cross.

That is, when the imbalance in risk markets is severe, the economy is not only exposed to the standard (and important) supply side effects of balance sheet and collateral amplification mechanisms highlighted by the financial frictions literature, but also to the contractionary effects of a decline in aggregate demand.

In terms of policy interventions, safety traps are particularly responsive to QE-type policies that absorb risky assets from private balance sheets in exchange for safe assets. The expansion of public debt is also useful as long as it does not compromise the safety of such debt or the private sector's ability to issue safe debt. In contrast, forward-guidance-type policies are ineffective as they do not relax the safe asset constraint, and for the same reason asset price bubbles have limited traction in expanding aggregate demand.

#### 4.1.1. References


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2. Caballero, Ricardo J. 2011. "Asset Scarcity and Financial Crisis." In Interview with Federal Reserve Bank of Minneapolis, ed. Douglas Clement.

3. Caballero, Ricardo J., Emmanuel Farhi, and Pierre-Olivier Gourinchas. 2017. "Rents, technical change, and risk premia accounting for secular trends in interest rates, returns on capital, earning yields, and factor shares." American Economic Review, 107(5): 614–20.

4. Caballero, Ricardo J., Emmanuel Farhi, and Pierre-Olivier Gourinchas. 2017. "The safe asset shortage, the rise of mark-ups, and the decline in the labour share." VOXEU.org.


### 4.2. Global Spillovers and Policy Wars during the Recovery

In papers with Emmanuel Farhi and Pierre-Olivier Gourinchas, we show that in the international context, safety traps spread like wildfire across countries with structurally low interest rates and that, by the same token, put-policies anywhere are expansionary everywhere, which creates incentives for policy-free-riding, and, even worse, for currency wars.

Figure 21 illustrates the incentive to depreciate one own's currency by showing Home (y-axis) and Foreign (x-axis) output at the global ZLB, for different values of the exchange rate $E$ (measured as units of domestic currency per unit of foreign currency). The red curve is a constant global output condition consistent with an equilibrium in the safe assets market at the global ZLB. Point $A$ denotes the autarky equilibrium with both countries in a safety trap; full employment corresponds to output equal to one. When $E > E^a$, Home output increases and Foreign output decreases (point $B$). For a sufficiently high $E$, Home escapes the ZLB and Foreign absorbs all the global output loss required to balance the safe asset markets (point $C$).

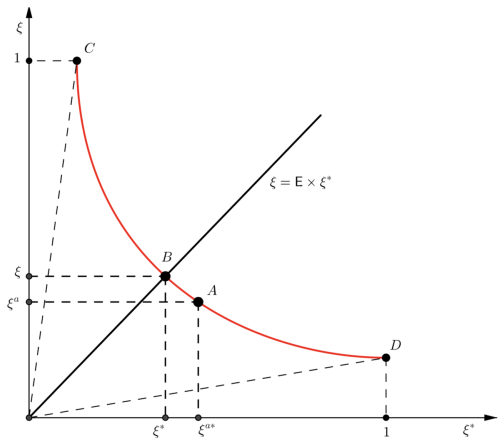


Figure 21: Home (y-axis) and Foreign (x-axis) output at the global ZLB, for different values of the exchange rate $E$.

#### 4.2.1. References


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## 5. Risk-centric Aggregate Demand Channels, Speculation, and Macroprudential Policy

The world economy has finally left the crisis behind, but the underlying structural asset market imbalances that took us there have not entirely disappeared, and we are in worse shape today in terms of our ability to respond to future risk-off shocks with conventional policies. In this context, risk-positions that may damage the capital of high-valuation levered financial institutions during a severe risk-off event acquire an extra layer of systemic risk and may justify macroprudential policies even in the absence of EM-style pecuniary externalities due to financial frictions.

In work with Alp Simsek we remove the market incompleteness behind the safe asset shortages mechanism but capture similar positive implications for aggregate demand recessions with a complete markets model with risk averse agents. In this model severe risk-off episodes generate aggregate demand recessions with powerful amplification mechanisms even if there are no financial frictions. It also generates low-interest rates during the risk-on phase due to economic agent's concern with the economy's vulnerability to risk shocks.

We also show that, when agents have heterogeneous valuations, financial transactions that increase the exposure of high valuation investors during the boom can be most damaging. The reason is that when interest rates are low, or are constrained by some other concern, there is the possibility of an aggregate demand externality. This will be the case if high valuation investors (such as levered global banks) suffer severe losses in the event of a risk-off scenario, which further drags down asset prices, and aggregate demand, and so on.

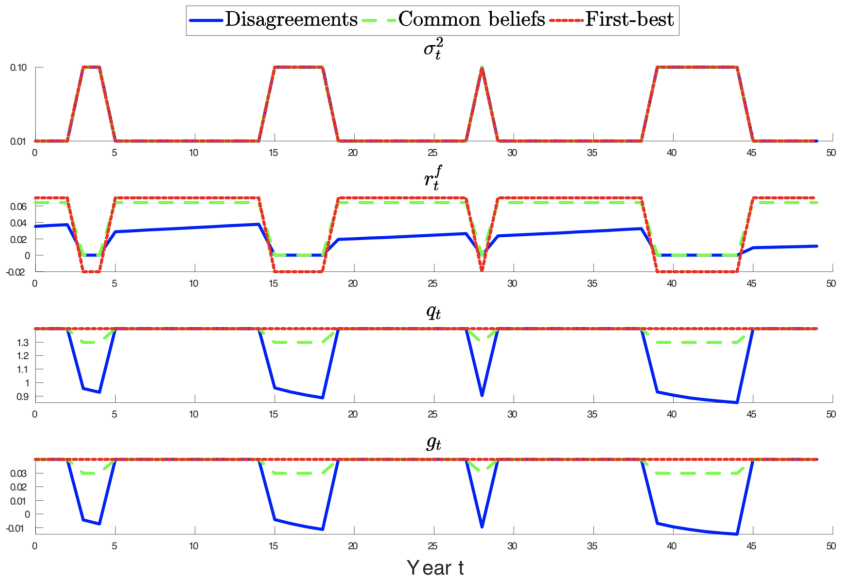


Figure 22: Evolution of the equilibrium variables (from top to bottom: risk, safe interest rate, asset prices, growth rate of output) with interest rate rigidities and belief disagreements (solid line), with rigidities and common beliefs (dashed line), and without rigidities (dotted line) over the medium run (50 years). The bottom two panels are in deviation from their diffusion component.

Figure 22 is a simulation from our model. The model has diffusion productivity shocks (removed from the figure) and risk-premium jumps. Heterogenous valuations are generated via heterogeneous beliefs with respect to the likelihood of risk-premia shocks (that is, we use speculation as a catchall for financial transactions between high and low valuation agents). The top panel illustrates a randomly chosen path of the risk-premium driver. The next panels show the path of interest rates, asset prices, and the rate of output growth, respectively. The red lines represent the path of the economy when there is no ZLB. The green dashed lines represent the path of the economy with homogeneous beliefs about the process driving the ERP shocks when the ZLB binds during ERP spikes. Finally, the blue lines represent the paths of the economy with the same average beliefs as the homogeneous economy but with disagreement (and hence speculation).

The figure is a proof of concept of how destabilizing shocks to high valuation investors' balance sheets can be for a low-interest rate economy. Note also that the anticipation of severe recessions significantly reduces the level of interest rates during the boom phase, which is due to a fear mechanism similar to that behind the safety traps described in the previous section.

The reason for this amplification in our framework is distinct from the standard and highly relevant balance sheet mechanism. In our model the feedback between aggregate demand and asset prices is a strongly destabilizing force that can only be contained by the expected capital gains from a recovery. That is, average optimism is a crucial state variable in this environment. However, average optimism is driven by the degree of speculation in financial markets. When speculation is high, the economy becomes effectively extrapolative, since the distribution of capital gains favors optimists during booms and pessimists during recessions. This extrapolative feature

raises the possibility of a disaster path during recessions where optimists' wealth is depleted. In turn, this possibility feeds into expectations and hence makes risk-off events much more severe.

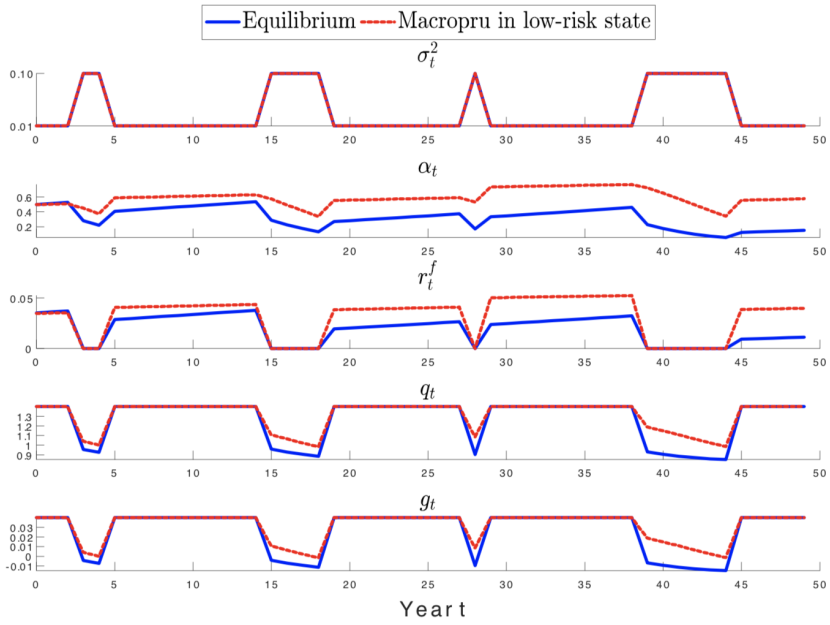


Figure 23: Evolution of the equilibrium variables without macroprudential policy (solid line) and with macroprudential policy in the boom state (dotted line) over the medium run (50 years). The bottom two panels are in deviation from their diffusion component.

In this context, we show that limiting the exposure of high valuation investors during the boom can significantly reduce the severity of crises (and safety traps). Highly levered investment banks holding AAA tranches of securitized subprime loans provides a particularly salient example of the type of bets that should be limited. The blue line in Figure 23 reproduces the path of the heterogeneous-beliefs economy in the previous figure, and the red line shows the path with macroprudential policy (risk limits during the boom). The policy reduces the severity of recessions and, by backward induction, raises equilibrium interest rates during the boom.

## 5.1. References


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2. Caballero, Ricardo J., and Alp Simsek. 2018. "Destabilizing Speculation and Policy Puts in a Low Interest Rate Environment." MIT mimeo (in progress)

## 6. Taxing Capital Flows in a Low Interest Rate Environment

If macroprudential policy may be justified, should we also tax capital flows? After all, they are inherently fickle and cause sudden stops and contagion.

In my work with Alp Simsek we show that local policymakers worried about the negative impact of fickle capital flows on domestic financial stability do indeed have an incentive to tax capital inflows. However, if everyone does the same, the policy backfires in equilibrium as global liquidity is reduced, which is detrimental for financial stability when there is a scarcity of safe assets.

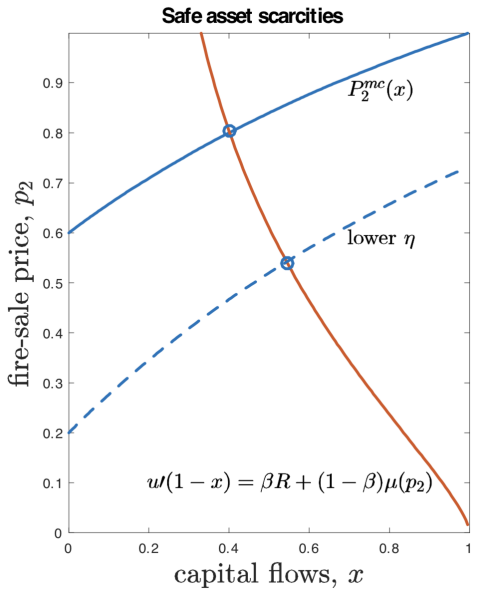


Figure 24: Comparative statics of equilibrium fire-sale price and capital flows with respect to changes in the supply of safe assets $\eta$.

Figure 24 illustrates this point. The blue lines represent the market clearing fire sale prices for an average economy experiencing a liquidity shock as a function of (symmetric) capital flows. It is an increasing function because the retrenchment of previous capital outflows dominates the fickleness of previous capital inflows, which are withdrawn at fire-sale prices. That is, other things equal, higher gross flows increase liquidity during crises. The downward sloping red line is the saving decision of a representative agent, which is decreasing because a worse fire sale price leads to more precautionary savings abroad. The important point is that a reduction in the availability of safe assets (the parameter $\eta$ in our model) shifts the equilibrium fire sale function downward, which leads agents to increase capital flows as a partial (and imperfect) substitute for the lost safe assets. In this environment, if all countries tax capital flows, it amounts to shifting the red line downward, which reinforces the negative effect of reduced safe assets on fire sale prices.

Of course there are exceptions to the argument against taxing capital flows, and I have already mentioned one: excessive reach-for-yield flows. However, the point is that there is a public-goods

aspect to capital flows that is typically ignored when only looking at one country's financial stability and this public-goods aspect is particularly valuable in a world with a scarcity of safe assets.

### 6.1. References


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## 7. Final Remarks

Somewhat paradoxically, as EMs have grown and become more prudent with respect to sudden stops, the world economy has become more EM-like, in that it has a chronic shortage of assets, especially safe ones. The downward pressure on safe interest rates resulting from this process has introduced new sources of fragility to the global economy, which has become exposed to risk-off shocks in particular. In this sense, too, the global economy has become more EM-like, as conventional monetary policy fight large risk-off events.

When thinking about preventive economic policies in this context, a useful metric for their effectiveness is their likely effect on equilibrium safe interest rates. From this perspective, and since fear and Knightian concerns are a central feature of the environment, policy-put frameworks are particularly useful, as is a macroprudential framework that limits speculation by high valuation agents during the risk-on phase.

In contrast, the benefit of taxing capital flows is more ambiguous, as it may exacerbate safe asset scarcity. What seems unambiguous, nonetheless, is that creating a global policy-put infrastructure akin to those existing for domestic risk-off shocks would reduce the undesirable fickleness of these flows (by reducing one of the sources of Knightian uncertainty) and expand the effective diversification benefits of capital flows. This would directly alleviate the sudden stops problem and reduce the structural asset shortage deficit that is behind much of the observed fragility of the global economy in recent decades.

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