Global Imbalances and Financial Fragility

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Abstract

The U.S. is currently engulfed in the most severe financial crisis since the Great Depression. A key structural factor behind this crisis is the large demand for *riskless* assets from the rest of the world. In this paper we present a model to show how such demand not only triggered a sharp rise in U.S. asset prices, but also exposed the U.S. financial sector to a downturn by concentrating risk onto its balance sheet. In addition to highlighting the role of capital flows in facilitating the securitization boom, our analysis speaks to the broader issue of global imbalances. While in emerging markets the concern with capital flows is in their speculative nature, in the U.S. the risk in capital inflows derives from the opposite concern: capital flows into the U.S. are mostly non-speculative and in search of safety. As a result, the U.S. sells riskless assets to foreigners, and in so doing, it raises the effective leverage of its financial institutions. In other words, as global imbalances rise, the U.S. increasingly specializes in holding its "toxic waste."

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The U.S. is currently engulfed in the most severe financial crisis since the Great Depression. The crisis was triggered by the crash in the real estate "bubble" and amplified by the extreme concentration of risk in a highly leveraged financial sector.

Conventional wisdom is that both the bubble and the risk concentration were the result of mistakes in regulatory policy: an expansionary monetary policy during the boom period of the bubble, and failure to reign in the practices of unscrupulous lenders. In this paper we argue that, while correct in some dimensions, this story misses two key structural factors behind the securitization process that supported the real estate boom and the corresponding leverage: First, over the last decade, the U.S. has experienced large and sustained capital inflows from foreigners seeking U.S. assets to store value (Caballero et al 2008). Second, especially after the NASDAQ/Tech bubble and bust, excess world savings have looked predominantly for safe debt investments. This should not be surprising because a large amount of the capital flow into the U.S. has been from foreign central banks and governments who are not expert investors and are merely looking for a store of value (Krishnamurthy and Vissing-Jorgenson 2008).

In this paper we develop a stylized model that captures the essence of this environment. The model accounts for three facts observed during the boom and bust phases of the current crisis: First, during a period of good shocks –which we interpret as the period up to the end of 2006– the growth in asset demand pushes up asset prices and lowers risk premia and interest rates. It is interesting to observe that the value of *risky* assets rises despite the fact that the increase in demand is for *riskless* assets. Second, foreign demand for debt instruments increases the equilibrium level of leverage of the domestic financial sector. In order to accommodate this demand, the U.S. financial sector manufactures debt claims out of all types of products, which is the reason for the wave of securitization. Third, if shocks turn negative –which we interpret as the period post-2006 – the foreign demand now turns toxic; bad shocks and high leverage lead to an amplified downturn and rising risk premia.

In addition to highlighting the role of capital flows in facilitating the securitization boom, our analysis also speaks to the broader issue of global imbalances. Many of the concerns regarding global imbalances derive from emerging markets' experiences, where capital flows are often speculative and a source of volatility, as emphasized in the literature on sudden stops. Our analysis shows that somewhat paradoxically, for a core economy such as the U.S., the risk in "excessive" capital inflows derives from the opposite concern: capital flows into the U.S. are mostly non-speculative and in search of safety. As a result, the U.S. sells riskless assets to foreigners and in so doing it raises the effective leverage of its financial institutions. In other words, as global imbalances rise, the U.S. increasingly specializes in holding its "toxic waste."

I Foreign Flows and Fragility

Time is continuous and indexed by t. There is a continuum of U.S. financial institutions, with mass one, that own assets which generate cash flows of X_t^d per unit time, where,

$$\frac{dX_t^d}{X_t^d} = gdt + \sigma dZ_t,$$

for constants g and σ. We can think of these cash-flows as arising from mortgage loans, credit card loans, auto loans, etc.[1] We assume the cash-flow process is exogenously given and not affected by other developments in the economy. This is certainly counterfactual, but simplifies the analysis of asset market equilibrium. We denote the present value of the cash-flows X_t^d held by the financial institutions as V_t.

The financial institutions have two liabilities, equity and short-term (instantaneous) debt. We assume there are no bankruptcy costs. This implies, since our model is set in continuous time, that the short-term debt is risk-free.

[1] In practice, some of these cash flows were brought onto banks' balance sheets as a response to the massive demand for assets. Our analysis starts from a moment where these cash-flows already exist, but it would be easy to model the entry process as a response of high asset demand.

Our key assumption concerns the demand for the safe debt. The external demand for U.S. assets, from foreign central banks for example, is in particular a demand for high-grade debt. We capture this demand in a reduced form fashion. We assume that there is a measure one of foreign investors who only invest in the debt of financial institutions. They allocate an exogenous stream of funds to investments in U.S. assets. This stream is perfectly correlated with U.S. income but it is *less* volatile than domestic income ($0 \leq \psi < 1$). That is, by themselves, capital flows are a source of income stability:

$$\frac{dX_t^f}{X_t^f} = gdt + \psi\sigma dZ_t$$

We may think of the case of $\psi > 1$ as that corresponding to emerging markets, where capital flows exacerbate the cycle.

Foreigners' bond holdings are denoted by B_t^f. We also assume that the foreign investors repatriate some of their U.S. invested wealth at the rate ρ. Denote,

$$c_t^f = \rho B_t^f$$

as the repatriated flow of resources.[2] Then the dynamics of foreign debt are

$$dB_t^f = (X_t^f - \rho B_t^f)dt + r_t B_t^f dt.$$

Throughout our analysis we will imagine that there is a date, t_0, on which the foreign investors' demand for U.S. debt first arises. We refer to this as the date of foreign entry. We analyze how this entry affects the equilibrium.

[2]Here is a micro-model that yields this behavior of foreigners. Suppose foreigners are modeled as overlapping generations. They live from t to $t + \delta$ ($\delta \to dt$). The previous generation bequests B_t^f of wealth. Then the current generation receives $X_t dt$ of income and consumes c_t to solve:

$$max \quad \rho\delta ln \; c_t + (1 - \rho\delta)E_t[ln \; B_{t+\delta}^f]$$

Note that the utility for bequest is over wealth. If we take $\delta \to dt$, this model yields the assumed consumption and savings behavior of foreign investors.

The financial institutions' owners/equity-holders are local investors who maximize preferences:

$$E_t \int_t^{\infty} e^{-\rho(s-t)} ln\ c^d_{t+s}\, ds.$$

The value of their ownership stake in the financial institutions, or the equity value of financial institutions, is

$$W_t = V_t - B^f_t.$$

A simple argument deriving from log preference allows us to derive the equity value. The local investor has wealth W_t and given log preference, he consumes ρW_t. The following accounting identity must hold for cash-flows:

$$X^d_t + X^f_t = c^d_t + c^f_t.$$

On the left-side is the amount of cash generated by the financial institution plus the amount of foreign savings invested in the U.S.. Thus it is the total amount of cash inflow into financial institutions. On the right-side is the amount consumed by local investors plus the amount of cash repatriated by foreign investors (i.e. cash outflows). This condition is basically a market clearing condition for the consumption goods. Rewriting,

$$X^d_t + X^f_t = \rho W_t + \rho B^f_t$$

or,

$$W_t = \frac{X^d_t}{\rho} + \frac{X^f_t - \rho B^f_t}{\rho}$$

which implies that the value of the assets held by the financial institutions is:

$$V_t = \frac{X^d_t + X^f_t}{\rho}.$$

These expressions lead to the first result of the analysis.

Proposition 1 *(Asset Demand Effect)*

An increase in foreign demand for ***riskless*** *assets,* X_t^f*, raises the value of* ***risky*** *domestic assets,* V_t*, and of domestic financial wealth,* W_t*. An increase in foreign riskless debt* B_t^f*, lowers the value of domestic financial wealth.*

Consider an initial condition when China begins to invest in U.S. debt so that X_t^f turns positive. Our proposition shows that this flow will push up the value of U.S. assets and domestic financial wealth in the short run. It explains how the value of U.S. assets rose in the early stages of external demand. This is the asset demand effect highlighted in the riskless environment of Caballero et al (2008). Over time, as foreign debt rises it puts downward pressure on domestic wealth, which is simply the residual of the value of domestic assets less foreign debt.

We next solve for the interest rate, r_t. Investors can purchase either equity or debt from financial institutions. Thus the interest rate must satisfy the local investor's marginal pricing condition (Euler equation). Going through the usual asset pricing steps based on an investor with consumption c_t, we have,

$$r_t = \rho + E_t[dc_t/c_t] - Var_t[dc_t/c_t].$$

The local investor has log preferences and wealth W_t. Thus,

$$c_t = \rho W_t.$$

We can then compute $E_t[dW_t/W_t]$ and $Var_t[dW_t/W_t]$ to find the equilibrium interest rate.

Proposition 2 *(Interest Rate)*

Define the foreign debt-to-asset ratio (leverage) of financial institutions as

$$b_t^f \equiv \frac{B_t^f}{V_t} = \rho \frac{B_t^f}{X_t^f + X_t^d}.$$

Also define the scaled foreign demand for domestic assets as

$$x_t^f \equiv \frac{X_t^f}{X_t^f + X_t^d}.$$

Then the interest rate is

$$r_t = \left(\rho + g - \sigma^2\right) - \rho x_t^f + \sigma^2 \left(1 - \frac{\left(1 - (1-\psi)x_t^f\right)^2}{1 - b_t^f}\right).$$

The first term in parenthesis corresponds to the interest rate in the absence of foreign capital flows. The next two terms capture opposing effects that foreign entry has on the interest rate. The first effect comes from expanding $E_t[dW_t/W_t]$. Upon entry, asset demand rises and lowers interest rates (mechanically, from the Euler equation, local wealth jumps on entry and thereafter grows more slowly, which requires a lower interest rate). The second effect is from the precautionary savings term $Var_t[dW_t/W_t]$. Since $\psi < 1$, external flows reduce domestic volatility because these flows are more stable than local cash-flows. This effect raises interest rates, as we can see by examining the precautionary savings term when $b_t^f = 0$,

$$\sigma^2 \left(1 - \left(1 - (1-\psi)x_t^f\right)^2\right) = \sigma^2 (1-\psi)x_t^f(2 - (1-\psi)x_t^f).$$

This expression is positive since $x_t^f < 1$ and $\psi < 1$.

Whether interest rates rise or fall upon foreign entry at t_0 depends upon parameters. However, as time passes, the precautionary savings effect starts putting downward pressure on interest rates. To see this, note that over time, as foreign debt accumulates, risk is brought back via an increase in leverage, b_t^f. Since foreign debt holders must be promised a fixed repayment, the domestic equity holders hold a residual claim that becomes riskier as leverage rises. The corresponding rise in precautionary savings reduces interest rates.

The interest rate expression also reveals a contrast between the emerging markets case and the U.S. case. As we have noted, we may think of the emerging markets case as one where foreign inflows are strongly procyclical, so that $\psi > 1$. In this case, foreign demand raises local volatility and risk, lowering interest rates through this precautionary savings effect.

Foreign entry, although creating some ambiguity in signing the change in interest rates, has a clear effect on risk premia. Let us consider a hypothetical asset-i, whose return depends on innovations in the risk factor dZ_t:

$$dR_t^i = E_t[dR_t^i]dt + \sigma^i dZ_t.$$

Thus, if we think of dZ_t as reflecting risk on mortgage loans held by financial institutions, this asset can be thought of as a mortgage-backed security. In general, the asset's return is correlated with the risks held by financial institutions.

Suppose that this asset is in zero net supply, then let us consider how $E_t[dR_t^i]$ will be determined. At the margin, if one of the financial institutions purchases this asset, it is taking on more risk, which then affects the risk held by the local investors. Thus, the expected return has to compensate the local investors for bearing additional risk. Since the local investors have wealth of W_t, we have,

$$\begin{aligned} E_t[dR_t^i] - r_t &= Cov_t[dR_t^i, dW_t/W_t] \\ &= \sigma^i \sigma \frac{1-(1-\psi)x_t^f}{1-b_t^f}. \end{aligned}$$

Proposition 3 *(Risk Premium)*

If $\psi < 1$, an increase in foreign demand for ***riskless*** *assets, x_t^f, lowers the* ***risk premium*** *on domestic assets. An increase in foreign leverage, b_t^f, always raises the risk premium.*

The intuition here is similar to that offered for the precautionary savings effects. Since $\psi < 1$, foreign inflows are more stable than domestic cash-flows, and hence the stabilization effect lowers risk premia.[3] This is the immediate effect of foreign flows on domestic risk

[3] There is another channel through which risk premia may fall. Since foreign inflows raise domestic wealth,

premia. This effect helps explain why the U.S. experienced a sustained period of low risk premia beginning in 2000.

Over time, external leverage grows and transfers more residual risk onto the domestic equity holders. This effect increases risk premia and as time passes becomes the dominant driver of the risk premium. Moreover, leverage also leads to a dynamic amplification mechanism. If U.S. shocks turn negative so that X_t^d and V_t fall, the effective leverage, $b_t^f = B_t/V_t$, rises. Thus the negative shock, through leverage, leads risk premia to rise further. We interpret the magnified downturn beginning in mid-2007 as corresponding to this leverage multiplier effect.

Finally, note that if $\psi > 1$, foreign inflows raises local risk premia. In this sense, the case of emerging markets experience with capital inflows is one of unambiguously rising risk.

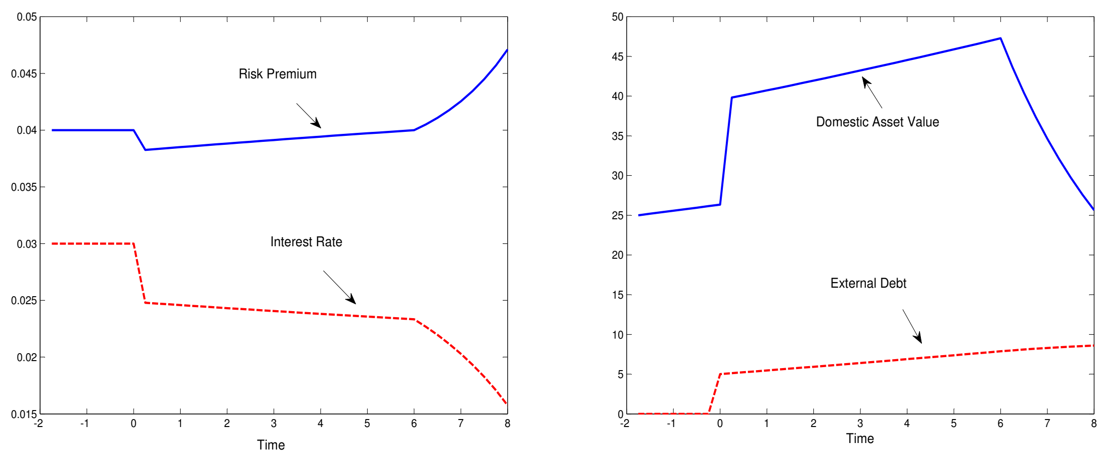

Figure 1: Risk premium and interest rate (left panel) and asset value and external debt (right panel) are graphed over time. Parameters are $g = 0.03, \sigma = 0.20, \rho = 0.04$ and $\psi = 0.5$. We set $X^f(t_0) = 0.5X^d(t_0)$. We also use an initial condition for debt upon entry at t_0 such that $B(t_0) = V(t_0)/5$, which helps to pictorially see the results. Time 0 is the date of foreign entry. Time 6 is the date when shocks turn negative. Prior to Time 6, X^f and X^d grow at rate g, while after Time 6 they grow at rate $g - 2\sigma$.

Figure 1 illustrates these results. We set $g = 0.03, \sigma = 0.20, \rho = 0.04, \psi = 0.5$, and set $X^f(t_0) = 0.5X^d(t_0)$. We also use an initial condition for debt upon entry at t_0 such that $B(t_0) = V(t_0)/5$, which helps to pictorially see the results. Time 0 is the date of foreign

through decreasing absolute risk aversion there is a wealth effect that will lower risk premia.

entry. We plot a particular realization of shocks such that prior to Time 6, X^f and X^d grow at rate g, while after Time 6 they grow at rate $g - 2\sigma$. Thus we interpret Time 6 as the date when shocks turn negative.

The left panel of the figure shows that the risk premium and interest rate fall upon entry. The risk premium rises thereafter as leverage accumulates, rising faster after Time 6. The interest rate uniformly falls as risk accumulates over time. The right panel of the figure shows that the asset value rises upon entry before falling when shocks turn negative.

II Securitization and Misperceived Safety

How is safe debt created and sold to satisfy debt demand? The model represents safe-debt as a short-term claim on the financial institutions. Thus the model directly can account for the increase in financial sector leverage ratios in the period preceding the crisis. In practice, debt is also created through the process of securitization: pooling and tranching of mortgage and related assets to form "*Aaa*" senior tranches; the financial sector writing credit default insurance on risky loans, which is then packaged with the risky loans to form safe debt. The process of safe-debt creation is evident in much of the financial innovation during the last 7 years.

The events of the summer of 2007 revealed that the safe debt created by financial innovations was not truly safe. The assumptions on cash-flow correlations underlying the insurance benefits to the pooling aspect of securitization proved wrong. As a result, senior tranches had higher default exposure than had been perceived by many investors. The institutions that sold credit default insurance ran into trouble, calling into question the value of the credit default insurance they had sold to support the safe status of some debts. In short, safe-debt has proven to be unsafe.

The realization of misperceived safety can create a further leverage amplifier. Prior to the investors' realization, some investors were holding claims which they thought were safe-debt but were in fact closer to equity. When investors realized this fact they shifted their portfolios to sell the "equity" and demand safe-debt.

It is straightforward to see the effect of such a portfolio shift: interest rates will fall, the risk premium will rise, and leverage will rise further exposing the financial sector to negative shocks. This realization of misperceptions effect is consistent with a "flight to quality."

III Conclusion

We have presented a model to show how global imbalances has driven the U.S. securitization boom and bust. Since flows into the U.S. have been predominantly seeking safe debt, U.S. financial institutions, in producing the safe debt have been left holding a levered claim on local mortgage risks. Thus our analysis ties together the behavior of leverage and the demand for U.S. assets. An important aspect of the story that our analysis only touches upon is that in creating safe assets, the U.S. financial sector not only took on more leverage but also sourced assets (i.e. subprime loans) that carried higher cash-flow risks. That is, part of the response to the increase in asset demand was an increase in asset supply, which at the margin may have led to more toxic assets being created. It is likely that this phenomenon, also driven by external demand for U.S. assets, has played a part in the build-up to the current financial crisis.

IV References

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