Flight to Quality and Bailouts:
Policy Remarks and a Literature Review

Ricardo J. Caballero and Pablo Kurlat[1]
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Introduction

The term "flight to quality" is used to describe an environment where investors seek to sell assets perceived as risky and purchase safe assets instead, leading to widening risk premia and severe disruptions in credit and other financial markets. By all accounts, the U.S. is currently experiencing an extremely severe episode of this kind.

Financial Markets in the U.S. are struggling with a chronic flight to quality problem since mid 2007 that has oscillated in intensity but with ever increasing peaks. By September 15th of this year, even money market funds were perceived as "unsafe;" the ensuing flight to quality brought treasury rates down to zero and triggered record setting spikes in gold and oil. Policymakers, realizing that time was running out, reacted by announcing the largest financial "bailout" package in world history.

Relative to the rest of the world, the U.S. is significantly more resilient to flight to quality episodes for at least three reasons: First, the U.S. as a whole is perceived as a "safe haven," and hence while investors run from risk, the U.S. typically sees sustained and stabilizing net capital inflows toward its safest assets. Second, the highly leveraged financial sector, and banks in particular, are net recipients of funds in search of "quality." This good correlation between leverage and the direction of funds is a key ingredient for financial stability, which is absent in many other financial systems around the world where the banking sector is the first victim of financial panics. Third, and partly due to the first reason, the US has a flexible economic policy framework.

However, one of the main reasons the current episode has become so severe is that this second stabilizing mechanism has vanished. While deposits have followed the standard pattern, almost all other forms of funding are leaving the financial system in herds. This process has dried up liquidity in key financial markets and has strained banks' balance sheets from plummeting asset values and hard to-roll-over liabilities. The system was simply not ready for such a dramatic turnaround in correlations, triggering all manner of amplification mechanisms, ranging from endogenous tightening in margin

requirements to a sudden rise in Knightian uncertainty. The first purpose of this article is to survey the empirical and theoretical literature describing these mechanisms.

The second purpose of this article is to discuss the policy implications of flight to quality mechanisms. In brief terms, the general policy message that emerges from the existing literature is rather obvious: When flight to quality is severe, predictable and reliable systemic bailouts and lender of last resort facilities are highly desirable. This is particularly the case when government instruments are sound and the first stabilizing mechanism mentioned above – the rise in foreign capital inflows toward treasuries remains active, as the cost of capital to finance the intervention is brought down by the flight to quality itself (i.e., there is sharp rise in demand for Treasury Bills and Bonds). The goal of policy at these times is to transfer some of the government's liquidity, collateral and trust, to the distressed domestic financial sector. The last section of the paper summarizes some of these policy implications and adds a few conjectures.

There is, however, a less "linear" way to present the policy results and conjectures that flow from the existing theories, and from what these miss. This is by providing a critical description of some of the common features of current bailout proposals. Given the nature of the meeting for which this article is being prepared, we do this directly here. Most readers may wish to read only up to the end of this introduction, while others may wish to continue and find in the rest of the paper a brief description of some of the articles that provide the backbone (but not the entire skeleton) for much of what is said here.

Most proposals, including the one just approved by Congress, have in common a few general principles: First, they recognize the need to recapitalize the financial system and to improve the liquidity of several key asset and insurance markets. Second, there is an agreement on the need to protect taxpayers by giving the government a share of the upside as well. In fact, many of us think that almost any reasonable intervention at this time is likely to yield a large excess return to the government. Third, most see moral hazard as a reason to limit the extent of the intervention and, in particular, to punish shareholders. Not doing so, the argument goes, would make future crises more likely as it would encourage the financial sector to repeat the excesses that caused the crisis in the first place.

We share the first two "principles" but are less persuaded by the third one. The main problem of the standard moral hazard view is its disregard for the incentive problems it generates *within* crises. In real life, unlike in many of our models, crises are not an instant but a time period. This time dimension creates ample opportunity for all types of of strategic decisions within a crisis. Distressed agents have to decide when and if to let go of their assets, knowing that a miscalculation on the right timing can be very costly. Speculators and strategic players have to decide when to reinforce a downward spiral, and when to stabilize it. Governments have to decide how long to wait before intervening, fully aware that delaying can be counterproductive, but that the political tempo may require that a full blown crisis

becomes observable for bickering to be put aside. Each of these agents is in the game of predicting what others are likely to do. In particular, the likelihood of a bailout and the form it is expected to take change the incentives for both distressed firms and speculators within the crisis. These incentives are central, both to the resolution of the current crisis as well as for the severity of the *next* crises.

A standard advice stemming from the moral hazard camp is to subject shareholders to *exemplary punishment* (the words used by Treasury Secretary Paulson during the Bear Stearns intervention). This is sound advice in the absence of a time dimension within crises. With no time dimension, all shareholders were part of the boom that preceded the crisis and as soon as the bailout takes place the crisis is over; the next concern is not to repeat the excesses that led to the crisis. Punishing shareholders means punishing those that led to the current crisis, and it is better that they learn the lesson sooner rather than later.

However, this advice can backfire when we add back the time dimension. Now, the expectation that shareholders will be exemplarily punished if the crisis worsens delays in the decision to inject much needed capital by stabilizing investors. As a concrete example, sovereign wealth funds are now much less eager to inject equity into the U.S. financial system than they once were. Conversely, destabilizing speculators and shortsellers see the value of their strategy reinforced by the policy of exemplary punishment. For both reasons, crises become more acute, as the equity market becomes extremely one-sided when uncertainty and risk rise during bouts of panic and confusion. The anti-moral hazard strategy turns into a crisis enzyme.

This theme also highlights an aspect that is being minimized in current proposals: the strategic component. One of the puzzling behaviors during the current crisis is why so much informed capital has remained on the side, despite obvious fire sales. For relatively small investors, or those constrained by regulation on the size of their position, the fear of *exemplary* punishment should another bout of panic take place may be the answer. However, for large investors,, who have the potential to gain control, the most likely answer is predatory and strategic behavior. When uncertainty rises, markets become illiquid and market power develops. In this context, the optimal strategy of the predators is to wait or pull out resources from the target, waiting for a deeper crisis. In such a context, a potential bailout plays yet another role, which is to increase the perception of competition and hence to reduce the predator's incentive to wait for the full-blown crisis to unfold.

Of course, there is such as a thing as too much of a good thing, as the anticipation of a bailout may increase the incentive to wait by the seller. If the anticipation turns out to be incorrect, this reaction complicates the crisis resolution as it delays external capital injections until it may be too late. The case of AIG and its refusal to accept an offer by J.C. Flowers the weekend before its demise is an example often used to support this position. However, one should note that this is a problem caused by the unpredictability of policy, not by the predictable component of this policy. If the government has

ample access to liquidity, and balance sheets are being destroyed by the reinforcing feedback of acute mispricing and predatory actions, it is important that the private sector can count on this liquidity. That's "good moral hazard," as it would ultimately be too costly for the private sector to hoard liquidity for such episodes.

Along the same vein, when Knightian uncertainty is prevalent, the main problem is too little not too much private risk taking. Within the crisis, markets are on the other side of risk taking relative to the conventional moral hazard concern, and hence inducing a more aggressive use of private liquidity is a positive rather than a negative development. That is, while it is true that excessive risk taking prior to the crisis can be a source of trouble, once a crisis is reached, the greater concern is insufficient risk taking and explicit public support can encourage rather than prevent desirable private sector behavior.

These concerns lead to several observations regarding how the details of the bailout, many of which are yet to be determined, should be arranged. One objective must be to signal to signal the strategic investors waiting in the sidelines that prices will stop falling and thus discourage speculative waiting. Speculators will not expect that prices of securities will be lower than those established at the Treasury's auction (if indeed an auction is used), at least in the period that immediately follows the auction. Thus the date of the auction provides a clear deadline to any speculative waiting. Announcing a timetable for purchasing a given list of securities may therefore have a salutary effect on prices even before the actual purchases take place.

To the extent possible, the first securities to be purchased should be those where the evidence of mispricing is greatest. For instance, certain AAA-rated tranches of subprime mortgage backed securities have been trading at prices that are hard to justify except by the extreme illiquidity of the market. If these securities were first on the Treasury's list, this would send a signal to speculators that the possible gains from speculative waiting will soon disappear.

One risk is that if some of the holders of a particular security are especially distressed, this may lead to fire-sale prices when the Treasury purchases the securities. To some extent, this risk is mitigated by the profits the taxpayers would make on this purchase. Still, there is a concern that purchases at excessively low prices would harm other security-holders, if nothing else, from having to mark-to-market their remaining holdings. One way to partially avoid this situation is to commit to purchasing a sufficiently large amount of each security to minimize the impact that any particular security-holder's distress will have on auction prices.

Finally, the Treasury's plan contains as-yet-unclear provisions for giving the government an equity stake in the companies it assists. Presumably this will involve diluting the holdings of current shareholders. One way to take into account the within-crisis incentives this policy generates would be to give special consideration (for instance, lower dilution) to firms that raised fresh capital since the start of

the crisis, and to those that experienced the most extreme predatory attacks which cannot be justified on the grounds of fundamentals.

To be clear, our position is not that the standard moral hazard concerns should be disregarded. Instead, our argument is that it is important that when designing policies to address it, we are more mindful of the perverse incentives that they may trigger within crises. The "exemplary punishment" approach is one example of a misguided policy along these lines, letting Lehman Brothers fail may have been another one, but there are many post-crisis regulatory responses that could deal with moral hazard without backfiring during the crisis.

Evidence

A defining feature of a flight to quality is a decrease in the relative demand for risky assets. Depending on the elasticity of supply, this may materialize as a fall in their relative price, in the quantity supplied, or in both.[2] For already-issued securities, which at least in the short run are in fixed supply, a flight to quality shows up as a change in relative prices. For newly issued securities or loans, quantities may respond as well. Accordingly, different studies have focused on either quantities or prices when exploring evidence on flights to quality.

Obviously there are more than two possible levels of riskiness ("risky" and "safe") and a flight to quality may involve shifts in relative behavior toward any group or subgroup of assets. For instance, it may involve a preference for bonds over stocks, for AAA bonds over junk bonds, for treasuries over corporate bonds, or many of these at once. Different studies have looked at the evidence on the basis of one or several of these pairings of assets.

Finding 1: The amount and composition of bank loans reveal that flight to quality is countercyclical. This pattern exacerbates the business cycle by depriving lower quality borrowers from financial resources during contractions.

A series of early studies focused on quantities, examining how the composition of firms' external financing varied with macroeconomic conditions. Kashyap, Stein, & Wilcox (1993) found that following tightening of monetary policy there were systematic increases in the relative quantity of commercial paper compared to bank lending. The underlying view is that large firms have access to a commercial paper market whereas small firms are more dependent on bank lending, perhaps because bank monitoring is essential to overcome informational asymmetries. Thus, a relative reduction in bank lending can be interpreted as a flight to quality. Similarly, Gertler and Gilchrist (1993) and Oliner and

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[2] The terms supply and demand are subject to some ambiguity. A decrease in investors' desires to acquire risky claims is customarily described as a decrease in demand in the context of securities, and a decrease in supply in the context of bank loans. This essay follows this customary use unless there is risk of confusion.

Rudebusch (1993) found that the relative proportion of loans to large corporations increases in these episodes, and Lang and Nakamura (1995) found that the fraction of new loans made at rates below prime+1% (which they interpret as relatively safe) is countercyclical and rises after tightenings of monetary policy. Bernanke, Gertler, and Gilchrist (1996) offer evidence consistent with these findings using data from the Department of Commerce's *Quarterly Financial Report* of manufacturing firms, which includes a greater proportion of small (manufacturing) firms. Furthermore, they compare the fluctuations in the growth rates of sales, inventories, and debt in small and large firms and conclude that as much as one third of aggregate fluctuations could be explained by the differences between small and large firms. The broad conclusion of these studies is that financial constraints for lower-quality borrowers tighten in periods of recession or tight money and that they have quantitatively important real consequences.

Finding 2: During mild flight to quality episodes, funds flow toward banks. However, banks' safe haven status weakens for severe flights to quality, where only the safest assets experience inflows.

Gatev and Strahan (2006) study the other side of banks' balance sheets. In data for 1988-2002, they find that when the spread between Treasury bills and high grade commercial paper increases, banks (but not other financial intermediaries) tend to experience inflows of deposits and a decreased cost of funding. This suggests that banks tend to be seen as safe havens in periods of turmoil. Gatev and Strahan attribute this advantage to implicit government backing and suggest that this is one of the reasons why banks are better placed than other institutions to offer liquidity insurance. At least in their sample, flights to quality seem to have been flights *toward* banks rather than *from* banks.

The data for 1998, however, show a very small shift toward banks. Nontransactional deposits in U.S. banks grew 2.5% in the second half of the year, whereas they had grown 5.2% in the first half. Furthermore, although LIBOR and CD rates decreased, their spreads with respect to Treasury rates widened substantially, as did other indicators of risk such as the VIX. Overall, the evidence suggests that the flight to quality also involved a worsening in the relative position of banks compared to the very safest assets. As the figures show, however, the episode was very short lived. By the end of the year both spreads and the VIX were within a normal range.
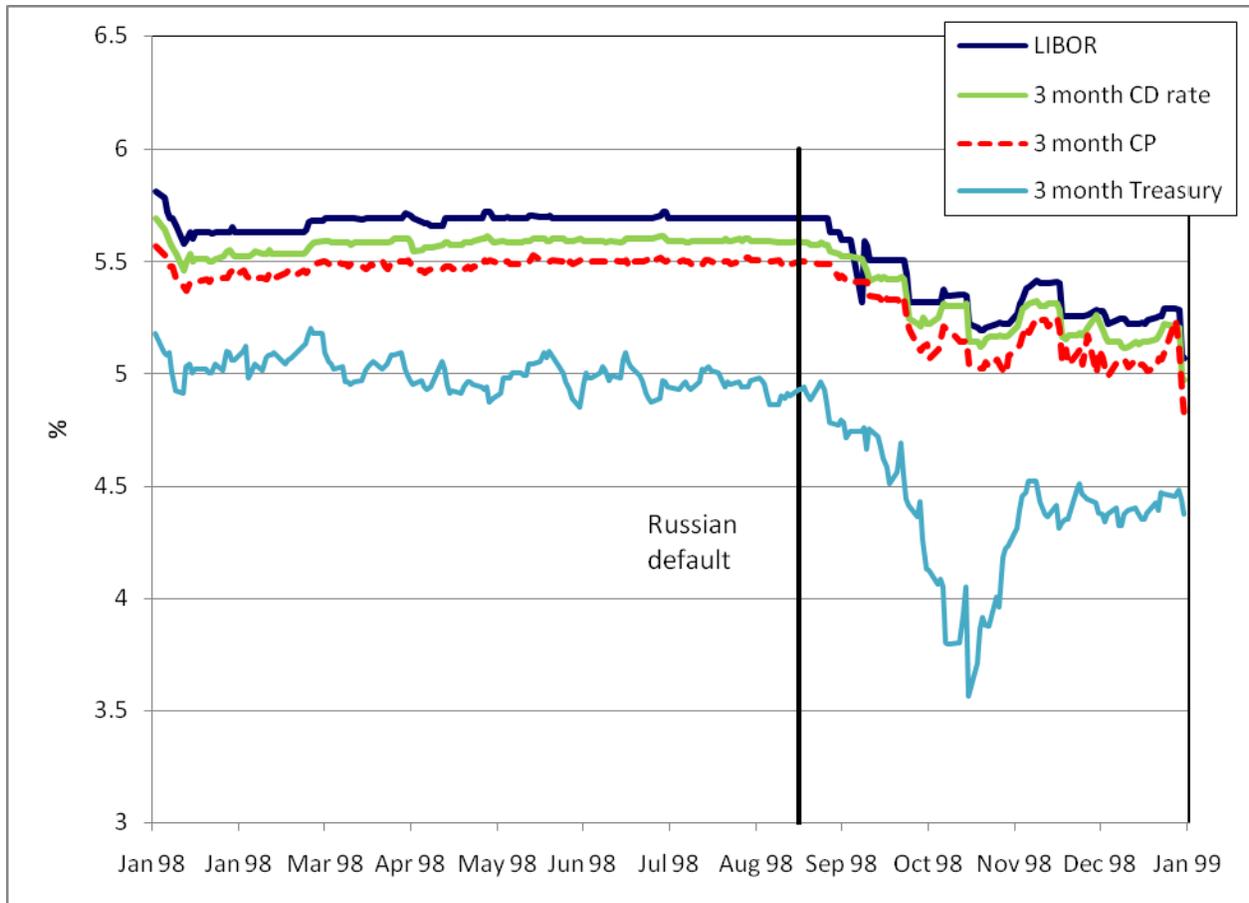
Figure 1. After the Russian default there was a decrease in interest rates, including interest rates paid by banks on CDs and LIBOR

Figure 2. The "TED spread" increased, as did the spread on high grade commercial paper and on long term AAA bonds. There was some degree of flight to quality even within the safest assets. This lasted a very short time.

Figure 3. Other indicators of risk, such as the VIX, increased sharply but briefly.

Finding 3: Both stock market crashes and large reallocation of funds towards bonds are rare, but each increases the likelihood of the other. The US bond market also serves as a safe haven for international equity market crashes.

Both Bernanke et. al. and Gatev and Strahan study long data series that include mostly "normal" times and use the expression "flight to quality" in studies of systematic, but not necessarily large, shifts in the availability of financing for different kinds of firms. It is not clear, however, that the phenomenon they describe constitutes a flight to quality in the same sense that observers of the current financial environment use. Other studies, looking at prices rather than quantities, have focused on a definition that explicitly refers to more extreme events. Hartmann, Straetmans, and de Vries (2004) study whether crashes in stock and bond markets in G5 countries (between 1987 and 1999) tend to occur simultaneously or instead tend to follow a flight to quality pattern, with stock market crashes accompanied by bond market booms. They define a crash as an episode where there is a weekly drop of more than 20% in stock prices (estimated to occur once every 39 years) or a drop of more than 8% in bond prices (estimated to occur once every 30 years). They find evidence of strengthened linkages between different markets at these extreme values, but these are approximately just as likely to go in

either direction, i.e. co-crashes are approximately as frequent as flights to quality. Flight to quality is especially likely toward the US bond market: it is estimated that 4.6% of US, 7.9% of German, 7.7% of French, 8.3% of UK, and 3.0% of Japanese stock market crashes will coincide with a boom in US bond markets. The likelihood of stock market crashes coinciding with non-US bond market booms is much lower, reflecting the greater perceived safety and liquidity of US bonds. Gonzalo and Olmo (2005) find a similar negative association between stock returns and bond returns during periods of distress, but only for short term bonds. Baur and Lucey (2008) find evidence that during crises periods (defined by identifiable events) the correlation between stock and bond markets becomes stronger and negative, and this was especially the case in the Asian crisis of 1997 and the Russian crisis of 1998. They interpret this as evidence of a flight to quality effect. Overall, this literature tends to confirm the view that in periods of uncertainty or distress or bad news there is often a flight from risky assets like stocks to less risky assets like bonds.

It is worth emphasizing that, unlike the typical emerging markets experience, in the U.S. flights to quality have not generally been accompanied by generalized capital flights. Indeed, it is usually the case that non-residents are net purchasers of government bonds in flights to quality. In the flight to quality that accompanied the stock market crash of 1987, net foreign inflows into US government bonds increased from 0.16% to 0.22% of US GDP; in the brief flight to quality before the Gulf war in 1990, they increased from 0.31% to 0.38%, and in 1998 from 0.06% to 0.15%[3].

Finding 4: Flight to quality is perceptible even across nearly equivalent assets.

Stocks and bonds are coarse categories of assets and there is a limit to what can be learned by studying asset prices at that level of aggregation. Several studies have studied the behavior of more narrowly defined assets in order to determine exactly what happens during flights to quality. Longstaff (2004) studied the spreads between bonds issued by Refcorp and comparable US Treasury bonds. Refcorp is a US government agency whose liabilities are guaranteed by the Treasury, so legally the credit risk in its liabilities is identical to that in Treasury bonds. Nevertheless, the yield on Refcorp bonds was, on average between 1991 and 2001, between 10 and 16 basis points higher than on Treasury bonds (depending on maturity). This difference accounted for as much as 10% to 15% of the value of Treasuries. Longstaff labels this spread a flight-to-liquidity premium. He then regresses this premium on a series of time-varying measures of investor sentiment. He finds that increases in the premium are associated with (a) drops in consumer confidence, (b) increases in the amount of funds held in money-market mutual funds (since these are one of the safer asset classes, an inflow of funds presumably

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[3] The comparisons are are the last 3 quarters of 1987 against the previous 3 quarters; the last quarter of 1990 against the third quarter and 2nd half of 1998 against the 1st half respectively, in all cases seasonally adjusted.

indicates a flight to quality[4]) and (c) Treasury buy-backs (since these make Treasury bonds more scarce, their premium tends to increase). Krishnamurthy (2002) finds similar results when comparing the yields on on-the-run and off-the-run Treasury bonds. He finds that higher spreads on off-the-run bonds are associated with higher spreads between commercial paper and Treasuries.

Finding 5: The relative importance of liquidity over credit quality rises during flight to quality episodes.

In both of these studies the authors identify premia that increase in times of distress but do not seem to be associated with credit quality but rather with liquidity. Of course, credit quality and liquidity are closely related and hence it is hard to determine exactly what it is that investors seek. Beber, Brandt, and Kavajecz (2008) address this question by taking advantage of the fact that the credit quality and liquidity of bonds from different Euro-area countries have a slight negative correlation.[5] They have direct measures of the credit quality of different countries from spreads on credit default swaps and construct measures of liquidity on the basis of data on bid-ask spreads and the depth of limit order books. They find that both credit quality and liquidity are significant determinants of bond yields. In normal times, credit quality plays a greater role; however, at times of uncertainty (as measured by the VSTOXX options index), or when there are flights into or out of the bond market (as measured by net order flows), the importance of liquidity for explaining the cross-sectional variation of yields increases. Overall, the evidence from these studies suggests that at times of uncertainty, investors place a premium on assets that are not just safe but have very low transaction costs.

Finding 6: The macroeconomic cost of recent flight to quality episodes in the U.S. has been limited, although this may well be the result of aggressive and successful policy responses.

Asset pricing evidence indicates that from investors' point of view the possibility of flights to quality is a real concern. From a policy point of view the more important concern is to what extent these episodes lead to consequences in the real economy. On this point the evidence is tentative at best, in part due to the difficulty in defining what constitutes a flight to quality. Conceivably, a flight to quality may be associated with either a drop in aggregate investment or a redirection of investment toward less risky projects or toward firms with more solid balance sheets. Bernanke, Gertler, and Gilchrist (1996) and related studies contain suggestive evidence in this direction, but the magnitude of the efficiency losses due to misallocated investment cannot be ascertained.

In the turmoil that followed the Russian default and the collapse of LTCM in the summer of 1998, the U.S. economy did not seem to suffer greatly. Real GDP grew at an annualized rate of 3.6% in

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[4] This statement may have become outdated since Longstaff's paper was written.
[5] For instance, Italian bonds are among the most liquid in Europe despite the fact that Italy has one of the lowest credit qualities.

the first half of 1998 and 5.4% in the second half, investment at 7.2% and 9.8% respectively. This resilience, however, may be due to the relative brevity of the scare. As shown in Figure 2, spreads were back within a normal range by the end of the year after a sharp spike in September. Furthermore, banks increased their volume of loans by 5.0% in the second half of the year (compared to 3.9% in the first half), which partly compensated the decrease in issues of corporate debt and preserved the flow of credit to the real economy. The Fed's aggressive easing of monetary policy (the target rate was lowered by 75 basis points to 4.75% in the second half of 1998) may also have played a role. Finally, the safe haven status of the U.S. as a whole further lowered the cost of capital.

What do these findings tell us about the severity and nature of the current crisis?

The current episode has many of the features of previous flights to quality. Firstly, there have been sharp and opposite movements of bond and stock markets. The S&P 500 index was 27% lower than in June 2007, while the Lehman Brothers Aggregate bond index was more than 10% higher. This is the kind of co-movement studied by Hartmann et. al. (2004), albeit at a lower frequency. In keeping with the pattern of previous episodes (in particular 1998), investors' flight to safe assets (plus the Fed's monetary policy) has led to sharp drops in yields.
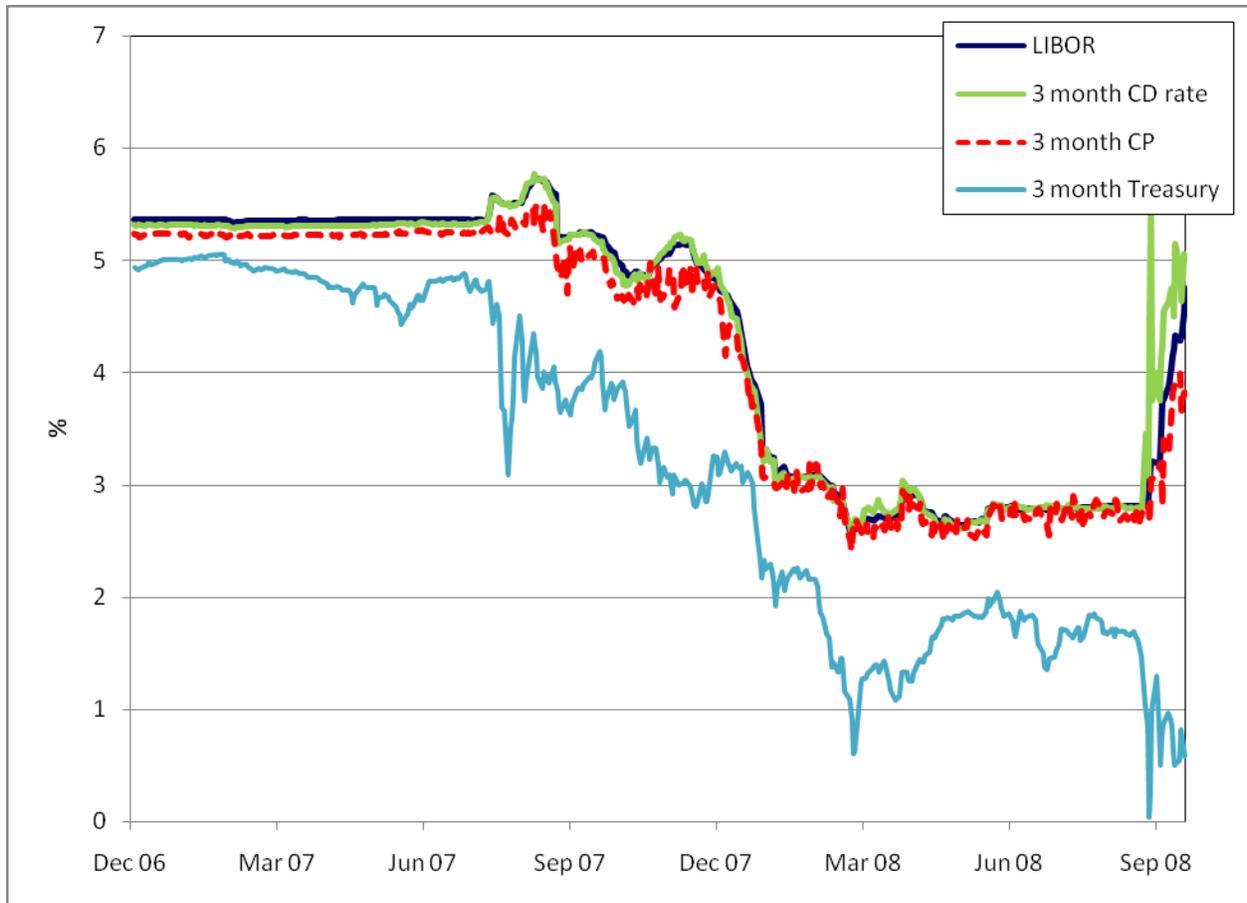
Figure 4. Safe interest rates have gone down since the beginning of the current turmoil in the summer of 2007, as they did in 1998.

The flight to quality is evident even within traditionally very safe asset classes. This feature was also noted in previous episodes but its magnitude and persistence is far greater this time. LIBOR spreads over Treasuries have been between 100 and 200 basis points for most of the past year, reaching peaks of 280 basis points in September. In 1998 the peak spread was approximately 160 basis points and even that only lasted a few days. The force of the flight from banks is proving stronger than the force of the flight towards banks. This may yet translate into the real economy in a way that was not seen in 1998, especially if the credit channels identified by Bernanke et. al. (1996) react strongly.
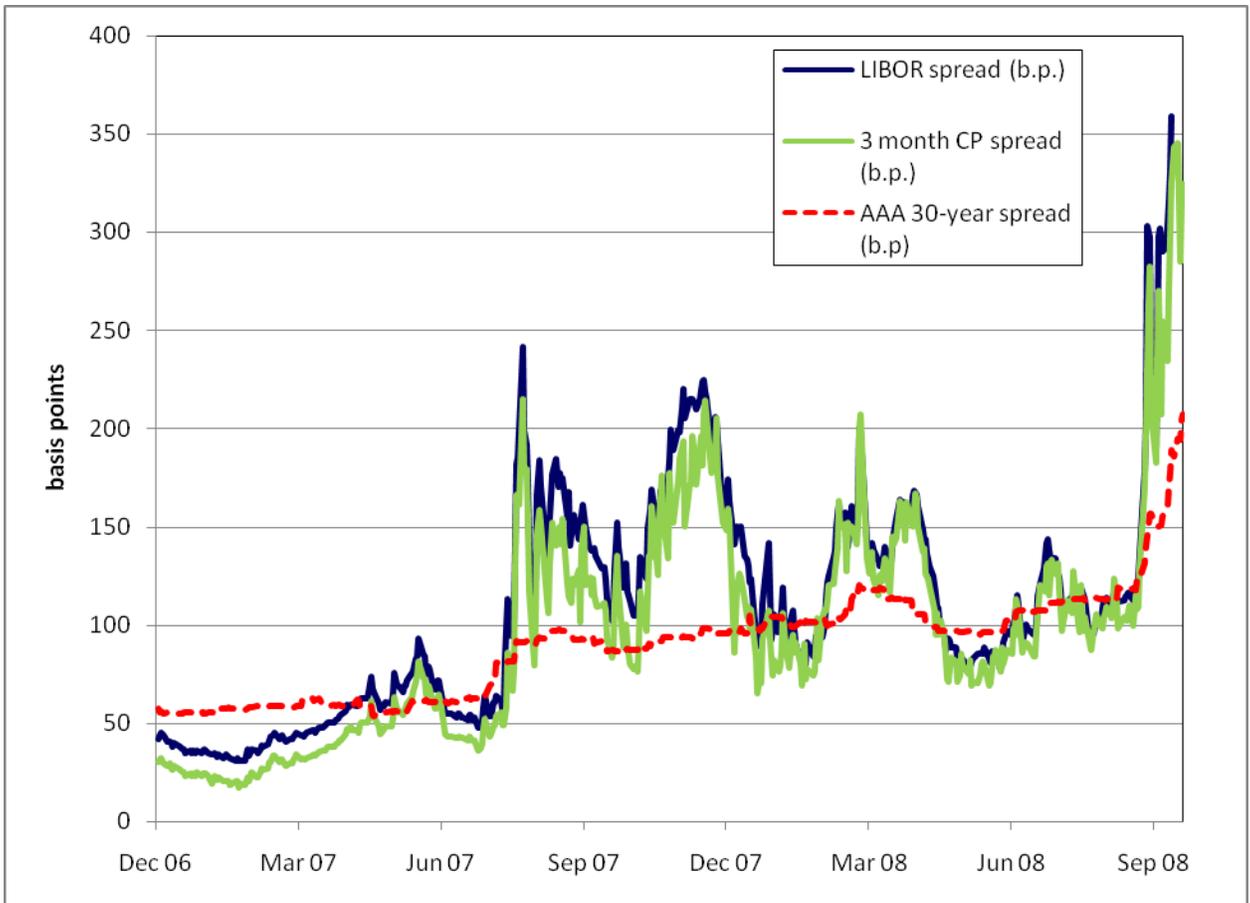
Figure 5. Spreads between Treasuries yields and other safe assets have remained persistently high for over a year.

The VIX index, which was at comparatively low levels at the beginning of 2007, has increased more than threefold since then. It has not reached the peak levels of 1998 but the increase has been much more persistent, evidence of a lasting pullout from volatility.

Figure 6. The VIX index has also remained high for over a year.

Theory

A number of authors have attributed the existence of flights to quality to various institutional features of financial markets, which lead to feedback effects between asset prices and investors' preference for liquidity.

Proposition 1: When asset price volatility rises, illiquidity risk rises and this feeds back into an increase in effective risk aversion.

Vayanos (2004) presents a model that may explain why both risk and illiquidity premia may increase in times of market volatility, which are precisely the features of a flight to quality. In the model, there is one safe asset and many risky assets. The volatility of the risky assets is itself an exogenous stochastic process. The risky assets are illiquid in that each carries a different (exogenous and constant) transaction cost. Investors are assumed to be fund managers whose incentives are governed by the management fee they are paid. This is proportional to assets under management or, if the fund is liquidated, to the liquidation value of the fund (the fund will be liquidated if performance falls below a fixed threshold, as clients withdraw their money). When market volatility is low, managers are not very

concerned with withdrawals and therefore do not care about each asset's transaction cost. However, when the volatility of the market is high, the probability that the fund's performance falls below the threshold increases. This brings two effects. First, managers place greater weight on the liquidation value of each asset, so illiquidity premia increase. Secondly, each risky asset's contribution to the likelihood of the fund's liquidation increases, so effective risk aversion increases and risk premia increase.

Proposition 2: Agency problems limit the amount of risk uninformed investors can bear, which means specialists' capital is pro-cyclical and hence triggers flight to quality during severe contractions.

Building on Holmström and Tirole's (1997) analysis of the role of intermediary capital in connecting uninformed investors to projects, He and Krishnamurthy (2008) study a model related to that of Vayanos. While the latter takes the fact that that poorly performing fund managers will face withdrawals as a given feature of the environment, they instead model the relationship between investment managers and investors explicitly. In their model, investment in a risky asset requires specific skills provided by a specialist. Both specialists and uninformed investors contribute capital to an intermediary institution (such as a bank) and write contracts that govern how much each party receives as a function of the return on the investment portfolio, which is managed by the specialist. There are two limits to what the investors can get the specialist to do on their behalf. First, the specialist may fail to exert effort, which lowers expected returns. To motivate effort, investors must make the payment to specialists a function of realized returns. Second, investors cannot monitor the portfolio composition chosen by the specialist (i.e. what fraction is invested in the risky asset). Hence the specialist will choose a portfolio balance that optimizes his own desired exposure to market risk. These two forces place an upper bound on the proportion of aggregate risk that non-specialist investors can bear: If they wish to increase their exposure to risk they must persuade the specialist to increase the riskiness of the portfolio by reducing sensitivity of his payments to realized returns; however, the need to prevent the specialist from shirking places a limit on how much they can do this. Therefore the equilibrium price of risk will be such that specialists are willing to bear this minimum proportion; since risk aversion is decreasing in wealth there will be a negative relation between specialists' capital and the price of risky assets. Thus the model offers a rationale as to why effective risk aversion (and therefore risk premia) increases in periods where intermediary institutions have suffered losses. In common with Vayanos (2004), this theory focuses on how delegation of investment management may create flight to quality patterns in asset prices at times of distress. By modeling the structure of the agency relationship explicitly, He and Krishnamurthy highlight the role of specialists' capital.

Proposition 3: The tightening of margin requirements during periods of high price volatility reinforces flight to quality, as funds are reallocated from more to less volatile assets.

Krishnamurthy (2008) explores a slightly different channel by which intermediaries' capital may play a role in flights to quality. In his model there are two layers of intermediation. The first intermediary (perhaps a bank) issues a claim at an initial date and commits to repurchase it from investors using its (limited) liquid funds. If few investors request repurchasing, the bank's liquid funds are sufficient and it pays a fair price; if instead many ask for repurchasing, the price is governed by the amount of liquid funds of the bank. Investors in the bank are the second intermediaries (perhaps hedge funds) and they are subject to margin constraints that limit their investment in the asset to a fixed multiple of their equity. The feedback mechanism works as follows: Since hedge funds are leveraged, a decrease in the price of the asset will necessitate a decrease in their holdings to meet margin constraints. Thus they will try to resell the asset to the bank. Since the bank has limited funds, this will lower the equilibrium price of the asset even further. The model has some of the features of models of bank runs like Diamond and Dybvig (1983), such as the possibility of multiple equilibria due to coordination failure. The difference is that the inefficient equilibrium here is not triggered by fear of what others are doing but by institutional features, in particular margin requirements that work through market prices. Margin requirements play a similar role in the model by Brunnermeier and Pedersen (2008). In it, speculators buy and sell risky assets, smoothing temporary imbalances in supply and demand and thus providing liquidity to asset markets (i.e. keeping prices close to fundamental values). Speculators have limited capital and borrow from financiers who set margin constraints to control their own value at risk. Crucially, financiers do not know the fundamental value of the assets and therefore may misinterpret price deviations from fundamentals (which would lead to arbitrage opportunities for speculators and thus reduce risk) as an increase in overall riskiness and thus increase margin requirements. This may lead to liquidity spirals as rising margins means that speculators cannot provide as much liquidity and prices deviate more from fundamentals. Furthermore, this implies that flights to quality will occur since the assets that are least volatile will be subject to lower margin requirements, and therefore their prices will be closer to fundamentals at times of illiquidity.

Proposition 4: When markets are relatively new, they are subject to Knightian uncertainty. This uncertainty has the potential to explain the extreme withdrawal from risk-sharing during severe flight to quality episodes.

A second class of models of flights to quality is based on a distinction between risk and "Knightian" uncertainty. In certain circumstances, the argument goes, market participants lack the information or experience to make precise probabilistic judgments about future events. Instead, they may resort to decision rules that seek to optimize worst-case-scenario outcomes, with possibly destabilizing aggregate consequences. Caballero and Krishnamurthy (2008) model how this form of behavior affects flights to quality. They study an economy where identical agents have an endowment of cash and have to decide when to consume it. The economy may be hit by liquidity shocks, whereby

some agents have a sudden need for cash. Conditional on a first (aggregate) liquidity shock, there is a probability that a second shock, affecting the agents spared by the first shock, also takes place. Agents write insurance contracts that dictate transfers of cash to one another in the event of one of them is hit by either a first shock or a second shock. The efficient allocation is such that agents are more insured against being hit by the first shock than against being hit by the second, simply because this is a more likely event. If agents knew the probabilities of being hit be either shock, this is the allocation a free market in insurance would produce. By assumption, however, agents know aggregate probabilities of shocks but have Knightian uncertainty about whether they will be in the first or second wave. Thus in a free insurance market they seek to insure themselves against the worst possible outcome, which is being hit in the second wave, and are not willing to commit enough of their capital to insuring those hit by the first wave. There is thus an inefficient flight to quality: Out of fear of being part of a second wave of shocks, agents prefer to hoard the safest asset (cash) instead of offering insurance contracts against first wave shock, which as a result, they are underinsured against. Put differently, private liquidity freezes too soon.

Brock and Manski (2008) also study the role of Knightian uncertainty in a model of a market for risky loans. Lenders must decide what fraction of their assets to allocate to loans and what fraction to a safe asset. At some point there is an unexpected shock that lenders do not know how to interpret. Three possible decision rules following the shock are considered: a standard one where lenders place subjective probabilities on the possibility of repayment; one where they seek to maximize their payoffs under the worst possible repayment scenario (maxmin), and one where they minimize the maximum possible regret from their decision (minmax-regret). In calibrated numerical examples, they show that the flight to quality effect (increases in contractual interest rates on loans and decreases in the equilibrium amount of loans) can be greater under the maxmin or minmax-regret criteria.

A question left open by theories that appeal to Knightian uncertainty to explain flights to quality is what exactly triggers robust or max-min decision making by investors in response to aggregate liquidity shocks. Caballero and Krishnamurthy (2008) argue that unfamiliar contexts, often related to recent financial innovation, are prone to this kind of behavior. As an example, they contrast the market's reaction to the demise of LTCM in 1998 to its reaction to the losses suffered by Amaranth in 2006. In the same line, Krischnamurthy (2008) contrasts the reaction of commercial paper investors to Penn Central's default in 1970 to their reaction to Mercury Finance's default in 1997. In each case the argument is that market participants' increased familiarity, with the operations of hedge funds and with commercial paper respectively, accounts for the calm with which the latter event was received. Evidence on the overall relevance of Knightian uncertainty in financial markets is provided by Liu, Pan, and Wang (2005). They find that a model allowing for uncertainty aversion fits the evidence on option prices far better than one with pure risk aversion. In particular, it accounts for the premium on far-out-of-the-money put options.

Proposition 5: When markets turn illiquid and important players become constrained, pricing power develops and this leads to strategic illiquidity exacerbation.

One important feature of the Knightian uncertainty model of Caballero and Krishnamurty (2008) is that market participants fail to pool their liquid assets efficiently, hoarding them in fear of worst-case scenarios instead of insuring each other against intermediately-bad shocks. Acharya, Gromb, and Yorulmazer (2008) provide an alternative explanation for the failure of private coinsurance in the specific context of the interbank loan market, stemming from liquid banks exercising monopoly power over banks that have liquidity needs. They model a bank (bank A) which needs cash and may obtain it in either of two ways. One is by borrowing from a liquid bank (bank B); there is a limit to this because A must retain a large enough stake in its asset portfolio to have incentives to engage in costly monitoring of its assets. Alternatively, bank A may simply sell some of its assets to bank B; by assumption, this can raise more cash since A does not need to retain a stake; however, the assets have varying degrees of specificity and B cannot obtain as much value from them as A would. Under perfect competition, interbank borrowing would always be the preferred option and asset sales would only be used if the maximum cash that can be raised by borrowing were insufficient to meet A's cash needs. If instead B has some degree of monopoly power, the only way to transfer value from A to B is through inefficient asset sales. The mechanism in the paper resembles a flight to quality in that banks hoard liquidity rather than lend to each other. However, they do so for opportunistic and strategic rather than precautionary reasons. One of the reasons for the current high rates observed in the interbank loan market may be that they are not being set competitively as liquid banks speculate with the possibility of purchasing assets at distress prices.

Brunnermeier and Pedersen (2005) also explore strategic considerations and show how they may lead to "predatory trading" during a flight to quality. They model a situation where it becomes known (to a limited number of speculators) that a trader needs to liquidate his position in some asset. The market for this asset is not perfectly liquid, meaning that the distressed trader's sales will have an impact on the price. The optimal reaction by the informed speculators is to trade *in the same direction* as the distressed trader as fast as possible (attempting to "front run"), driving down the price of the asset in order to profit from buying it back at a lower price later. Furthermore, margin constraints may exacerbate the problem. If speculators know that a given trader will become distressed and need to sell if his wealth falls below a given threshold, they may try to provoke this by selling to drive down the price, forcing the trader into distress and profiting from buying back later. This may explain why in a flight to quality, the prices of some risky illiquid assets may fall more sharply than one would expect based on risk considerations alone.

The various theories of flights to quality suggest several mechanisms that can be at play in these episodes. While the specifics are different, some common themes emerge. In particular, a common element in all the theories is an actual or feared weakness in the balance sheet of some market

participants, who by either their specialized skill or information play a key role in the determination of asset prices, risk premia, or the allocation of funds. This observation informs many of the policy recommendations that the theories have inspired.

Policy

Walter Bagehot famously argued in 1873 that in a panic "the holders of the cash reserve must be ready not only to keep it for their own liabilities, but to advance it most freely for the liabilities of others. They must lend to merchants, to minor bankers, to 'this man and that man,' whenever the security is good." What do modern theories have to add to or subtract from this recommendation?

Principle 1: A key aspect of intervention is to "issue a guarantee" to the private sector that extreme flight to quality events will be acted upon aggressively, even if the government has less information than the private sector about asset values .

The implications of the models discussed above are in clear agreement with Bagehot's recommendations. In Krishnamurthy's (2008) model, a loan to intermediaries would enable them to honor their promise to purchase assets at a fair price, eliminating the equilibrium with mis-coordination and depressed prices. A similar effect can be achieved by public purchases of illiquid assets. A central bank acting as either a lender or a market maker of last resort would prevent the fire sales in the same way that it would prevent bank runs. Similarly, Brock, and Manski (2008) argue that the government could allay the fears that lead investors to act in max-min fashion by guaranteeing a minimum return on (at least certain kinds of) investment. A difficulty with this last approach is that it assumes that the government is not subject to the kind of uncertainty faced by the private sector. In practice, determining when private investors are being excessively prudent is not to ascertain..

Caballero and Krishnamurthy (2008) consider a form of intervention that can be useful even if the government is not better informed than the private sector. In their model, the inefficiency arises because agents, fearful of being hit by a second liquidity shock, are excessively unwilling to insure each other against a first shock and prefer to hoard liquidity rather than pool it. They show that the optimal form of intervention is to provide insurance against a second wave of shocks, which persuades private agents to insure each other against a first shock. By acting as a lender of truly *last* resort, the central bank may help overcome private banks' reluctance to act as each other's lenders of "intermediate resort." A practical difficulty with implementing this policy is how to distinguish intermediately severe crisis that the private sector should be encouraged to deal with on its own with true catastrophes that warrant intervention.

Principle 2: Conventional moral hazard concerns are important for regulatory purposes but less so for interventions during crises.

A major concern, known in the days of Bagehot and studied extensively since, is the issue of moral hazard. If financial firms expect to receive emergency financing should they require it, they have an incentive to take on excessive risk. This risk may take the form of excessive leverage or, more subtly, of excess investment in illiquid assets. Due to arbitrageurs' limited resources, each firm that has to sell illiquid assets depresses prices for everyone else, but does not take this effect into account in its decision making. This concern is one of the rationales for the prudential regulation of financial institutions. The current crisis has highlighted that these externalities can be created by institutions other than commercial banks, such as hedge funds. Given their prominent role in supplying liquidity to many asset markets, there may be a case for subjecting them to the kinds of prudential regulations that are imposed on banks, such as limits on leverage and minimum liquidity requirements. Krishnamurthy (2008) argues in this direction, cautioning however that these regulations will necessarily be a blunt tool and may distort decisions in the (usual) non-crisis states of the world.

Referring back back to Caballero and Krishnamurthy (2008), when Knightian uncertainty is prevalent, the main problem is too little not too much private risk taking, and hence inducing a more aggressive use of private liquidity is a positive rather than a negative development. Their model highlights an important policy concern. While it is true that excessive risk taking prior to the crisis can be a source of trouble, once a crisis is reached, the greater concern is insufficient risk taking and public support can encourage rather than prevent desirable private sector behavior.

Principle 3: In the presence of speculative and predatory behavior, there is space for a wide range of intervention tools, including equity support and shortselling constraints.

If the worry is about opportunistic or speculative behavior, several possible policies may be in order. Acharya, Gromb, and Yorulmazer (2008) point out that if monopolistic behavior by liquid banks is what prevents the smooth functioning of interbank markets, a central bank that stood willing to make loans to troubled banks could improve their outside option in bargaining, leading to less inefficient asset sales without the need to ever disburse emergency loans. If instead the concern is about front running by predatory traders, as in Brunnermeier and Pedersen's (2005) model, unorthodox measures like trading halts or limits on shortselling may prove useful. The share price responses to recently announced restrictions on shortselling give some support to this idea. Interestingly, when shortselling of several financial institutions was restricted last July, the share prices of other financial institutions not included in the list reacted similarly to those that were included. This is probably partly due to the fact that the

shortselling constraints were aimed at stabilizing the core of the financial system, which maximizes positive feedbacks.[6]
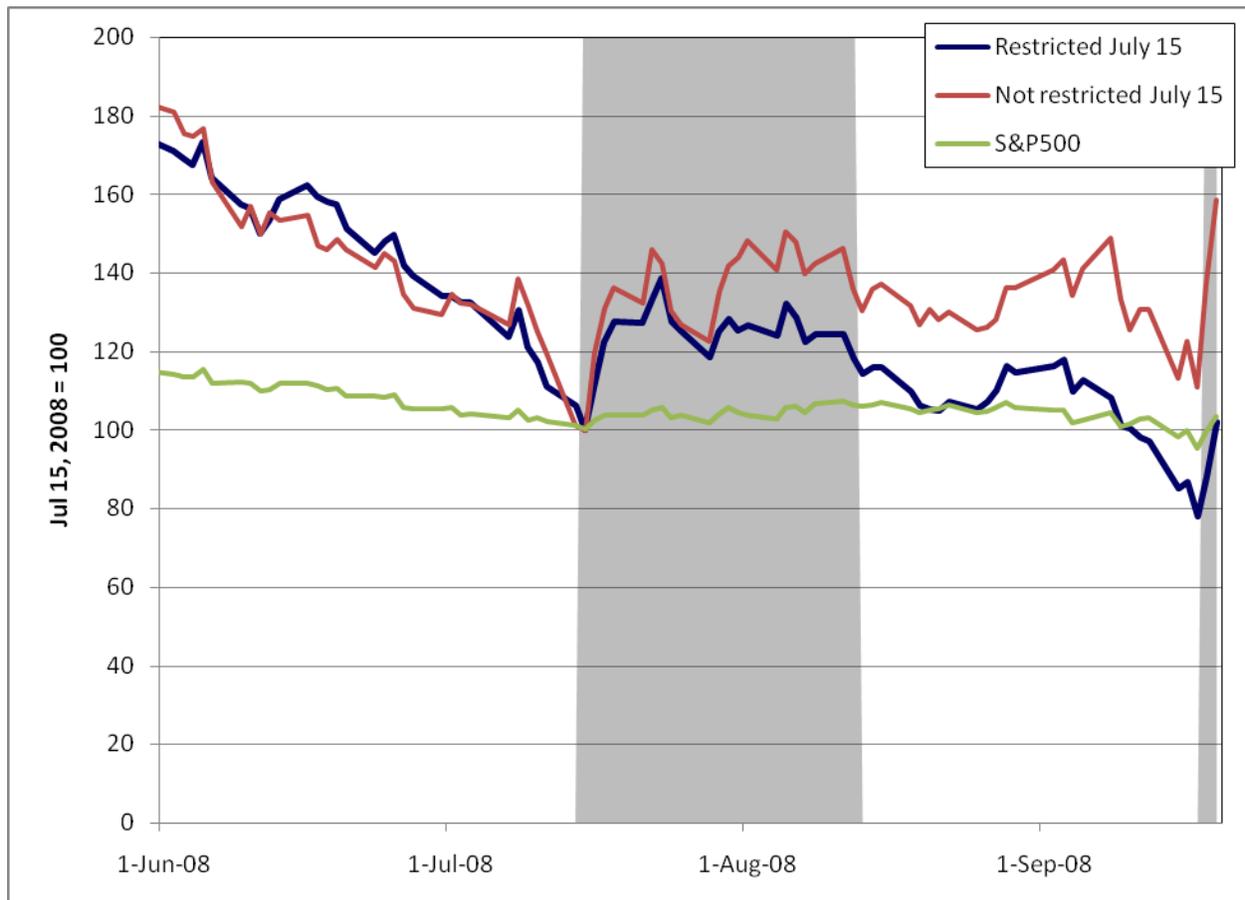

Figure 7. Restrictions on short-selling shares in certain financial firms were announced on July 15 and were in place until August 12. The initial announcement was met by a sharp increase in share prices, but for the companies included in the restricted list and for other financial companies (the graph shows the averages of the companies incuded in the ban and that of the five largest financial companies not included in the ban). The reintroduction of a wider ban on September 19 was also accompanied by a sharp rise.

We close with a brief discussion of important implementation issues which are not well covered by existing theories but rather by only occasional hints.

Conjecture 1: The "political tempo" of intervention is significantly slower than that implied by the models without politicians. This negotiated delay exacerbates uncertainty and flight to quality.

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[6] See also Caballero (1999) for a discussion of the value of equity market interventions in the context of Hong Kong's stock market intervention to fight a speculative attack during the Asian crisis in the late 1990s.

The models assume that the conditions under which the government would intervene can be precisely formulated ex-ante and are well understood by market participants. In practice, decisions are taken by a political process that is subject to disputes about how the costs and benefits of intervention are to be allocated among distressed firms, other market participants, and taxpayers. The process is therefore subject to both delays and uncertainty about outcomes. This may make it harder to defuse a flight to quality since measures that could be sufficient if they were promptly and credibly announced might not calm investors' fears if they do not know when, whether, or how they will be implemented. An important quality of any intervention policy is the promptness and predictability of its political implementation process.

Conjecture 2: Agents learn within a crisis, which raises the intervention threshold as time goes by.

Unfamiliar conditions, financial instruments, or events are particularly susceptible to flights to quality. However, what is unfamiliar at the beginning of a crisis may rapidly become familiar. Many market participants were caught unaware by the collapse of Bear Sterns, whereas the collapse of Lehman Brothers was more widely anticipated. If market participants understand the situation progressively better, their assessment of risks should become more firmly grounded and their reliance on worst-case scenarios diminished. If this is so, then private co-insurance should gradually take precedence over public insurance, and the threshold for intervention should become increasingly demanding.

Conjecture 3: Conventional lender of last resort interventions are insufficient once capital constraints become binding.

A lender of last resort is useful when availability of cash is the binding constraint that prevents financial institutions from either meeting their obligations or extending credit, as may be the case with a firm facing a run. If instead the binding constraint is that insufficient capital prevents financial institutions from taking on risk, then traditional lending of last resort will not be able to relax this. The main usefulness of lending of last resort in this context is to reduce one particular source of risk, the risk of a traditional bank run. To the extent that this is not the main risk that investors are worried about, this form of intervention is of limited usefulness.

Conjecture 4: Whether intervention should be done through asset buybacks or direct equity injections depends on which market is experiencing the largest distortions.

Intervention should be designed to achieve the greatest possible impact per dollar. If there is confidence that certain assets held by financial institutions are significantly undervalued, then limited asset buybacks can (i) sustain asset prices, allowing financial institutions to escape the rigors of mark-to-

market accounting at fire-sale prices; (ii) deliver a profit to (or limit the losses of) financial institutions, an indirect way of recapitalizing them; and (iii) ensure a profit for taxpayers. This, however, is only possible in the cases of securities that are significantly undervalued, which creates a sufficiently large wedge between current valuations and fair prices to allow for profits for both the seller and the taxpayer. The behavior of liquidity premia during flights to quality suggests that this may be the case for the *most illiquid* securities, including new and untried ones.

Assessing fair values of illiquid securities is a considerable practical challenge. If it is hard to identify obviously undervalued assets, direct equity injections are a more straightforward approach. This policy simultaneously capitalizes financial institutions and most likely yields a high return to taxpayers (see, e.g., Caballero 1999).

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