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SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS

FOR THE HEARING

"THE END OF EXCESS (PART ONE): REVERSING OUR ADDICTION TO DEBT AND LEVERAGE"

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HOW BANKS PLAYED THE LEVERAGE GAME AND WHAT CAN BE DONE ABOUT IT

"Good morning, Mr. Chairman and members of the Subcommittee. My name is Viral Acharya. I am a Professor at the Leonard Stern School of Business at New York University. I have worked extensively in the area of systemic risk of financial institutions and its prudential regulation. Along with my colleagues at the Stern School of Business, I have co-edited two books[1] and co-authored several research papers (cited below) that help understand how the financial sector played the leverage "game" in the build-up to this crisis and what can be done about it in future. Much of what I say below is based on this research. Importantly, it has implications also for leverage of the household sector, corporations and the government.

1. Leverage represents the oldest mode of doing financial transactions. It is natural for a lender, wary of what the borrower might do with the funds, to demand a flat repayment. Then, in the event of borrower's default, the lender forces a repayment, for instance, by liquidating the borrower's collateral. This way, leverage allows finance to take place in quantities that are far greater than what could be intermediated in other modes, say equity financing, wherein the financier is exposed to the full risk of activities that the borrower undertakes and has relatively weak rights to force a repayment. Unsurprisingly, lending institutions – most notably, banks – have over time been at the forefront of contributing to finance and economic growth.

2. And yet, we seem to witness, on a somewhat regular basis, episodes during which the financial intermediaries are all over-extending credit, are themselves funded with excess leverage, and when the economic cycle turns downward, fail in a wholesale manner, necessitating government interventions to ensure the orderly functioning of markets and of the real

[1] Acharya and Richardson (2009) and Acharya, Cooley, Richardson and Walter (2010b).

economy. While leverage has its bright side in expanding finance for the real economy, its dark side is precisely the boom and bust cycle it appears to bring with it. Unfortunately, this dark side of leverage has become enduring as with each cycle comes in place government intervention, accordance of explicit guarantees (such as deposit insurance) and implicit guarantees (such as "too big to fail" and "too systemic to fail"), and the resulting moral hazard from banks effectively lending with "other people's money".

3. One of the most salient such episode was the period of 2004-2Q 2007 during which the financial sector in the United States, and in most parts of the Western world, had grown its balance-sheet at an unprecedented speed and done so mainly through leverage, rather than equity ("capital"). Given its scale, the bursting of this leverage boom since 3Q 2007 has proved to be particularly costly. To many observers, this episode has been surprising given that propensity of the financial sector to lever up at the expense of taxpayers has been well-recognized for some time. Indeed, financial regulation was put in place over the past two decades, in the form of the Basel capital requirements, with the overall purpose of guarding financial stability against the moral hazard of banks taking on excessive leverage and risks.[2]

4. ***There were three primary failures that led to the leverage boom in spite of bank capital regulation. These were (i) mis-priced government guarantees to large parts of the financial sector; (ii) ineffective enforcement that allowed capital regulation to be "arbitraged" by a sophisticated financial sector; and, (iii) in some cases, just poor design of regulation.*** Broadly speaking, the end effect of these failures was that large, complex financial institutions (LCFI's) that were too big and too systemic to fail were operating at reported and regulatory leverage that was far below their true leverage (which for many institutions reached a pre-crisis high of 25:1, in other words, 24 dollars of leverage on a 25 dollar balance-sheet). Specifically,

    - Commercial banks (the world over) exploited loopholes in the Basel capital regulation to park illiquid loans and mortgage-backed securities (MBS) in off-balance sheet entities that were financed with close to 100% leverage. The off-balance sheet entities had direct recourse to the sponsor banks' balance sheets in case loans and MBS went bad. More than 90% of the commercial banks did not pay any fee between 1997 and 2006 for issuing deposits with federal deposit insurance.[3]

[2] Acharya, Cooley, Richardson and Walter (2010a) provide a much longer historical context of this view, explaining how the Banking Act of 1934 in the United States prudently combined the creation of the Federal Deposit Insurance with investment restrictions on commercial banks via the Glass-Steagall Act. Over time, however, the Glass-Steagall Act was informally, and eventually formally, repealed. One advantage of the proposed "Volcker rule" that recommends separation of proprietary trading from other banking activities is to ensure that access to government-insured deposits does not fund highly cyclical and speculative trading activities.

[3] See Acharya, Schnabl and Suarez (2009) for a detailed description of the "regulatory arbitrage" involved in setting up of these off-balance sheet entities (asset-backed commercial paper – ABCP – conduits). Authors refer to these

- Investment banks – the so-called "broker dealers" of the United States – were allowed to employ internal risk-assessment models that essentially ignored any downside risks. This way they managed to hold more and more of sub-prime linked MBS, financed almost entirely with overnight debt.

- Government-sponsored enterprises (GSEs) in the United States – Fannie and Freddie, in particular, joined the fray too, raising leverage with the implicit government guarantee but without paying for the guarantee, and engaging in hedge-fund style purchases of illiquid, sub-prime backed MBS.

- A traditional insurance firm in the United States sold guarantees on the risk of default on loans and mortgages made in most parts of the world (and their re-packaged versions), but kept aside relatively little in terms of reserves or liquidity. This was achieved by picking its own regulator to ensure it could remain weakly capitalized even while guaranteeing over half a trillion of notional amount of credit risk.

Much of this leverage growth happened in the "shadow banking world", the less-regulated (or un-regulated) part of the financial sector consisting of off-balance sheet entities, repurchase agreements between financial institutions and over-the-counter (OTC) derivatives. Also, for most part, the leverage was extremely short-term in nature, to be rolled over at overnight or weekly frequencies. Such levels and forms of leverage exposed the financial system to great risk from a secular economic downturn and reduction in the ability to continue borrowing, especially because the leverage had been used to finance and hold risky and illiquid MBS, much backed by sub-prime loans, whose values fell dramatically with the downturn.[4]

5. Thus, facilitated by access to explicit or implicit government guarantees in raising leverage and unconstrained by weak or poorly designed capital requirements, LCFI's took a cheaply-financed, massive one-way bet on the economy, what my colleagues and I call "manufacturing tail risk".[5] The willingness of the LCFI's to take on such tail risk, in turn, allowed mortgage originators to make bad loans and simply pass them down the chain to LCFI's, who together held over 50% of the AAA-rated tranches of sub-prime MBS, securities that would be super-safe only if there was not a secular downturn in house prices. As a result, when this tail risk materialized in 3Q 2007, the balance sheets of these institutions were so heavily leveraged, so illiquid, and so large (11 financial firms controlling over 60% of economy's assets) that in most cases, the government or the Federal Reserve had to backstop some or all of the losses.

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entities as a form of "securitization without risk transfer". Effectively, commercial banks had employed securitization to concentrate rather than disperse risks from their balance sheets.

[4] Adrian et al (2010) document that shadow banking assets grew from an amount close to zero in 1980 to somewhere between $15 to $20 trillion by 2008.

[5] Acharya, Cooley, Richardson and Walter (2010a).

6. What can be done about this leverage game and the attendant boom and bust cycle? It is clearly important to limit the contingencies under which government guarantees have to be accorded to the financial sector. This requires improving the ability of regulators to wind down LCFI's when they get into trouble.[6] In interest of time and space, however, I focus here only on those regulatory options that deal directly with leverage growth in good times. A key lesson is that financial sector regulation needs to take on a macro-prudential role, and not just a micro-prudential one: Simply ensuring the safety of each individual bank is not sufficient to ensure stability of the financial system. Banks may seem safe individually but be perfectly correlated, e.g., all bet on the housing market. To address this, ***supervision conducted by the regulators (the Federal Reserve and/or the proposed Financial Stability Oversight Council), should examine leverage and asset exposures of the financial sector as a whole.***

7. Two important steps in this direction would be the following:

- ***Current Basel capital regulation does not take any account of the liability structure of a financial firm's balance-sheet. This is a major shortcoming that should be addressed.*** There are three ways to proceed:
  - *Tax leverage*: This would be akin to one of the levies recently proposed by the International Monetary Fund. By itself, it reduces (or eliminates) the corporate tax deductions given to the taxed part of leverage. Its significant weakness is that it takes no account of differences in asset holdings of financial institutions and may in fact constrain certain types of financial intermediation.
  - *Introduce leverage caps*: This approach seems somewhat more prudent and has been successfully adopted by other countries, most notably Canada. Even at the worst point of the crisis, stable banks such as JPMorgan Chase and HSBC had assets to equity ratios that did not exceed 15:1. A leverage cap to not exceed such a limit also has the advantage of being simple to harmonize internationally.
  - *Combine leverage information in supervisory stress tests*: The Federal Reserve System is considering whether to perform on an ongoing basis a supervisory "stress test" (similar to the one it conducted in Spring 2009) with the objective of ensuring that systemically important financial institutions have sufficient capital buffers to withstand losses in extreme economy- and market-wide scenarios. Such a test could also take account of short-term, rollover nature of liabilities of these institutions, and with better transparency, also include contingent liabilities through derivative contracts.
- ***The regulation of the "shadow banking world" needs to be brought in synchronization with the on-balance sheet regulation of financial firms.*** This is because banks may be

[6] The full range of available options is discussed in Acharya, Cooley, Richardson and Walter (2010b).

arbitraging limits of capital regulation and supervision so that leverage and risks show up in the shadow banking world rather than on bank balance-sheets. Further, any attempt to regulate leverage that ignores the shadow banking world would only lead to even more growth in regulatory arbitrage activity and off-balance sheet leverage. Avoiding this requires regulation to expand its scope to off-balance sheet entities, money market funds, repurchase agreements, and derivatives that remain over-the-counter even after proposed migration to centralized clearinghouses. At the least, greater transparency of the shadow banking world needs to be legislated so that regulators have timely information to understand the full risk and leverage exposure of regulated entities. Some timely disclosures of aggregated risk and leverage reports can also help strengthen market discipline that financial firms impose on each other.

8. It would be inaccurate, however, to put all blame of the crisis on the financial sector. While the financial sector offered, households stood ready to take on leverage, not just to own houses but also to consume. Indeed, the ratio of household debt to home values in the United States stood at a staggering 89% in 2008 compared to just 68% in 2005, and 56% twenty years earlier, in 1985. However, losing control of the financial sector's leverage ruled out a potentially effective tool that regulators had to protect the economy from the household urge to borrow.

9. Interestingly, ***while there is hope that better regulation of the financial sector can constrain household (and corporate) leverage, there is less of such hope with regard to constraining the growing leverage of the government balance-sheet***. The ratio of government debt to GDP in the United States is now approaching 100% (and by some other measures, close to 120%, its level in 1945 following the World War II). The steady rise in government debt to GDP ratio since 2001 (when it was under 40%) is an alarm for concern as the economy's recovery remains practically jobless, house prices stagnant, and global economy fragile. Any further rise in federal leverage is unlikely to be sustainable in wake of a significant global shock (such as further weakening of sovereigns in the Euro-zone or slowdown of economic growth in Asia). There are at least three responses that warrant consideration.

    - First, as a part of its stimulus, government has provided a non-trivial quantity of guarantees to the financial sector and the GSEs. Fiscal planning should take account of these guarantees and recognize that government's contingent leverage is significantly higher than its current leverage. Wherever possible, the government should plan for a graceful exit from the guarantees.

    - Second, the GSE's have out-lived their original purpose and in search of a new business model starting 2004, have imposed a huge cost on the taxpayers at large. There is no certainty that this won't happen again. Indeed, the reform of the GSE's has been excluded in proposals being discussed for financial sector regulation. The mandate of GSE's should be restricted right away to the original objective of guaranteeing only the highest-quality mortgages. Their hedge-fund style functions should be disbanded altogether. This would be like "tying Odyseeus to the mast" so that we do not give in to

the "call of the sirens", in this case, the American dream of universal home ownership, which has by most indications also out-lived its utility at this stage of growth and development of the United States.

- While the status of the United States Dollar as the reserve currency ensures that capital flows into the United States facilitate the fiscal stimulus of the economy, this status and inflows should not be taken for granted. If the government balance-sheet looks increasingly leveraged to the rest of the world in future, as did the financial sector's balance-sheet starting the second half of 2007, there is the risk of significant reversal of capital flows and pressure on ability to borrow any further except at elevated costs. Fiscal restraint may now be necessary, even if that entails a somewhat slower recovery.

10. In Conclusion, the most recent leverage-fueled boom and bust cycle can be traced at its roots in government guarantees and ineffective capital regulation of the financial sector. The cycle ensnared most of the financial and the household sector, put at risk the corporate sector, and exposed the indebtedness of the government balance sheets worldwide, and in particular, also in the United States. The desired prudential response now – from households, corporations, financial firms, and the government – is the same as what is always necessary to avoid a costly leverage cycle: to save for a rainy day!"

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Appendix

1. **"Securitization without Risk Transfer"** by Viral V. Acharya, Philip Schnabl, and Gustavo Suarez (First Draft: March 1, 2009; This Draft: April 15, 2010; 68 pages)

2. **"Manufacturing Tail Risk: A Perspective on the Financial Crisis of 2007-09"** by Viral V. Acharya, Thomas Cooley, Matthew Richardson, and Ingo Walter (*Forthcoming, Foundations and Trends in Finance*, volume 4, 2010; 85 pages)

3. **Acharya Resume** (10 pages)

Securitization Without Risk Transfer[1]

Viral V. Acharya[2], Philipp Schnabl[3], and Gustavo Suarez[4]

First draft: March 1, 2009

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Abstract

We analyze asset-backed commercial paper conduits which played a central role in the early phase of the financial crisis of 2007-09. We document that commercial banks set up conduits to securitize assets worth $1.3 trillion while insuring the newly securitized assets using guarantees. The guarantees were structured to reduce bank capital requirements, while providing recourse to bank balance sheets for outside investors. Consistent with such recourse, we find that during the first year of the crisis, asset-backed commercial paper issuance fell and spreads increased, especially for conduits with weaker guarantees, riskier banks, and lower quality assets; that banks with more exposure to conduits had lower stock returns; and that losses from conduits remained with banks rather than outside investors. These results suggest that banks used this form of securitization to concentrate, rather than disperse, financial risks in the banking sector while reducing their capital requirements.

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Securitization was traditionally meant to transfer risks from the banking sector to outside investors and thereby disperse financial risks across the economy. Since the risks were meant to be transferred, securitization allowed banks to reduce regulatory capital, except on pieces they retained, typically the first-loss piece in order to ensure they had some "skin in the game". However, in the period leading up to the financial crisis of 2007-09, banks increasingly devised securitization methods that allowed them to concentrate risks on their balance sheets, and yet did not hold much capital against these risks, a practice which eventually led to the largest banking crisis since the Great Depression. In this paper, we analyze one form of securitization, namely asset-backed commercial paper conduits (henceforth, conduits), as an example of how banks exposed themselves to such under-capitalized risks.

Conduits are special purpose vehicles set up primarily by large commercial banks. Conduits exhibit a significant maturity mismatch between assets and liabilities as they mostly hold medium- to long-term assets, which are financed by issuing short-term asset-backed commercial paper. Conduits are thus similar to regular banks in many ways and form an integral part of financial intermediation that has over time come to be called "shadow banking". Put simply, shadow banking is that part of the intermediation sector that performs several functions that we traditionally associate with commercial and investment banks, but which runs in the "shadow" of the regulated banks in that it is off-balance sheet and less regulated.[5] As shown in Figure 1, before the financial crisis, asset-

[5] Adrian et al (2010) document that shadow banking assets grew from an amount close to zero in 1980 to somewhere between $15 to $20 trillion by 2008. In 2007, conduits represented about 25% of total assets newly transported to shadow banking. In terms of the stock of assets, as of July 2007, conduits held over $1.2 trillion, compared to securities lending of $0.6 trillion, broker-dealer repo of $2.5 trillion, and financial commercial paper of $0.8 trillion.

backed commercial paper grew from US$650 billion in January 2004 to US$1.3 trillion in July 2007. At that time, asset-backed commercial paper was the largest short-term debt instrument in the United States. For comparison, the second largest instrument was Treasury Bills with about $940 billion outstanding. However, the rise in asset-backed commercial paper came to an abrupt end in August 2007.

On August 9, 2007, the French bank BNP Paribas halted withdrawals from three funds invested in mortgage-backed securities and suspended calculation of net asset values. Even though defaults on mortgages had been rising throughout 2007, the suspension of withdrawals had a profound effect on the asset-backed commercial paper market.[6] As shown in Figure 2, the interest rate spread of overnight asset-backed commercial paper over the Federal Funds rate increased from 10 basis points to 150 basis points within one day of the announcement. Subsequently, the market experienced the modern-day equivalent of a bank run and asset-backed commercial paper outstanding dropped from $1.3 trillion in August 2007 to $833 billion in December 2007. Apparently investors in asset-backed commercial paper, primarily money market funds, became concerned about the credit quality and liquidation values of collateral backing asset-backed commercial paper and stopped refinancing the maturing asset-backed commercial paper.

[6] The announcement read: "[T]he complete evaporation of liquidity in certain market segments of the US securitization market has made it impossible to value certain assets fairly regardless of their quality or credit rating […] Asset-backed securities, mortgage loans, especially subprime loans, don't have any buyers […] Traders are reluctant to bid on securities backed by risky mortgages because they are difficult to sell […] The situation is such that it is no longer possible to value fairly the underlying US ABS assets in the three above-mentioned funds." (Source: "BNP Paribas Freezes Funds as Loan Losses Roil Markets," Bloomberg.com, August 9, 2008).

Our main conclusion in this paper is that, somewhat surprisingly, this crisis in the asset-backed commercial paper market did not result (for the most part) in losses being transferred to outside investors in asset-backed commercial paper. Instead, the crisis had a profoundly negative effect on commercial banks because banks had insured outside investors in asset-backed commercial paper by providing guarantees to conduits, which required banks to pay off maturing asset-backed commercial paper at par. Effectively banks had used conduits to securitize assets without transferring the risks to outside investors.

We establish this finding of securitization *without* risk transfer using a hand-collected panel dataset on the universe of conduits from January 2001 to December 2009. We document and describe the structure of the guarantees that effectively created recourse from conduits back to bank balance sheets. These guarantees were explicit legal commitments to repurchase maturing asset-backed commercial paper in case conduits could not roll their paper, not a voluntary form of implicit recourse.[7] The guarantees were mostly structured as "liquidity enhancements", a design that would reduce their regulatory capital requirements to at most a tenth of capital required to hold for on-balance sheet assets. For the majority of conduits, the guarantees were structured to cover the assets' credit and liquidity risks and absorb all possible losses of outside investors. Hence, this form of securitization practically retained the risks of the securitized assets with banks rather than outside investors. For a minority of conduits, the guarantees did not cover all of the assets' liquidity and credit risks and required banks to cover only a share of the losses.

[7] However, there was some scope for implicit recourse in the case of weaker credit guarantees.

Consistent with the motive for setting up conduits being one of regulatory arbitrage, we find that most guarantees were structured as liquidity enhancements. We show that sponsoring institutions other than commercial banks (which among financial institutions are subject to the most stringent capital requirements) were far less likely to use such structures. Also, we note that the growth of asset-backed commercial paper stalled in 2001 after U.S. bank regulators discussed an increase in capital requirements for conduit guarantees (following the failure of Enron which had employed conduit-style structures to create off balance-sheet leverage) and picked up again after regulators decided against the increase in 2004. We also note that banks based in countries such as Spain and Portugal that do not allow such regulatory arbitrage do not sponsor conduits.

Next, we examine the effect of guarantees on the conduit's ability to roll over maturing asset-backed commercial paper. We use a novel conduit-level data set to study daily issuances and spreads of asset-backed commercial paper both before and after the start of the financial crisis. We show that starting August 9, 2007, conduits experienced substantial widening of spreads and a decline in asset-backed commercial paper outstanding (or in other words, a decrease in their ability to roll over maturing asset backed commercial paper). We show that conduits with weaker guarantees had a larger decline in outstandings and a larger increase in spreads after the start of the financial crisis. The result is robust to controlling for observable asset categories, which suggest that the strength of the guarantee does not simply proxy for the quality of conduit assets. We further find that the results are stronger for riskier banks (as measured by credit default swap spreads). These results suggest that the lack of risk transfer, as measured by

the strength of guarantees, is central to conduits' ability to roll-over asset-backed commercial paper after the start the financial crisis.

We then examine the extent of realized risk transfer by analyzing whether investors could rely on the guarantees offered by financial institutions during the crisis. We take the perspective of an investor that was holding asset-backed commercial paper at the start of the crisis and examine whether the investor suffered losses by not refinancing maturing asset-backed commercial paper. Using announcement data from Moody's Investors Services, we identify all conduits that defaulted on asset-backed commercial paper in the period from January 2007 to December 2008. We find that all outside investors covered by strong guarantees were repaid in full. We find that investors in conduits with weak guarantees suffered small losses. In total, only 2.5% of asset-backed commercial paper outstanding as of July 2007 entered default in the period from July 2007 to December 2008. Hence, about 97.5% of losses on conduit assets remained with sponsoring banks. Assuming loss rates of 5% to 15%, we estimate that commercial banks suffered losses of $68 billion to $204 billion on conduit assets.

Lastly, we examine the impact of conduit exposure on bank stock returns. To identify the impact of conduit exposure separately from other bank observables, we focus on a narrow event window around the start of the financial crisis on August 9, 2007. An increase in conduit exposure (measured as the ratio of asset-backed commercial paper to bank equity) from 0% to 100% (e.g., Wells Fargo to Citibank) reduced stock returns by 1.5 percentage points in a three-day window around the start of the financial crisis. The effect of conduit exposure on stock returns increases to 2.9 percentage points when we expand the event-window to one month. The result is robust to using alternative

measures of conduit exposure and controlling for a large set of observable bank characteristics.

We note that the lack of ex-post risk transfer to conduit investors coupled with the ex-ante structure of guarantees that allowed close to zero capital requirements is highly suggestive of leverage-seeking or capital-reducing incentives on parts of commercial banks. Equally important, the lack of risk transfer suggests that any explanation of the financial crisis must explain why banks chose to concentrate under-capitalized risks in this manner. In particular, it is not sufficient, and in fact is likely inadequate, to simply assert that banks created "safe" assets, which were sold to uninformed outside investors, and that these assets turned out to be risky.

We emphasize that all of our evidence on the performance and effects of conduits is necessarily ex post. It is possible that ex ante it was efficient for individual banks to build up leveraged exposures through conduits. It is equally possible that ex ante the risks of guarantees were ignored by bank management due to poor risk management that did not keep pace with that of financial engineering, or ineffective corporate governance, or simply short-termism – phenomena that may have been the result of deeper underlying causes such as increased competition in banking activities, resulting erosion of margins and franchise values, and the moral hazard due to government guarantees such as deposit insurance and the too-big-to-fail doctrine. Investigating these underlying causes is an important question for future work.

The remainder of this paper is organized as follows. Section 1 presents the related literature. Section 2 discusses the institutional background. Section 3 provides our theoretical framework. Section 4 presents the data and discusses our empirical

results. Section 5 analyzes the incentives of banks to set up conduits. Section 6 concludes.

1. Related literature

Gorton and Souleles (2005), Gorton (2008), Brunnermeier (2009), and Kacperczyk and Schnabl (2009) provide examples of maturity transformation outside the regulated banking sector. Our focus, in contrast to theirs, is to provide an in-depth analysis of the structure of asset-backed commercial paper conduits: how risk transfer was designed to take place through conduits and how it materialized and contributed to the start of the financial crisis of 2007-09.

Ashcraft and Schuermann (2008) present a detailed description of the process of securitization of subprime mortgages, of which conduits were one component. Nadauld and Sherland (2008) study the securitization by investment banks of AAA-rated tranches – "economic catastrophe bonds" as explained by Coval et al. (2008) – and argue that the change in the SEC ruling regarding the capital requirements for investment banks spurred them to engage in excessive securitization. Nadauld and Sherland (2008) view the banks as warehousing these risks for further distribution whereas Shin (2009) argues that banks were concentrating highly-leveraged risk exposures (given the low capital requirements) by so doing.

Our view in this paper is more along the lines of Shin (2009), Acharya and Richardson (2009), and Acharya and Schnabl (2009a), that banks were securitizing without transferring risks to outside investors, and in particular, conduits were a way of taking on systemic risk of the underlying pool of credit risks. In an analysis focused on

the economic causes of the increasing propensity of the financial sector to take such risks (in one class of conduits – the "credit arbitrage" vehicles), Arteta et al. (2008) provide evidence consistent with government-induced distortions and corporate governance problems being the root causes (see also the arguments in Calomiris (2009)). Beltratti and Stulz (2009) examine bank stock returns during the financial crisis and find that stricter country-level capital regulation is correlated with better bank performance during the crisis. Covitz et al. (2009) use data on asset-backed commercial paper and show that the decline in securitized assets was driven by both market-wide factors and program fundamentals.

Our results on the difficulty in rolling over asset-backed commercial paper and the rise in their spreads are somewhat akin to the analysis of the run on the repo market by Gorton and Metrick (2009). They document that a counterparty risk measure for the banking sector as a whole, the "LIB-OIS" spread, explained over time the variation in the credit spreads of a large number of securitized bonds and the rise in repo haircuts, that is, the difference between the market value of an asset and its secured borrowing capacity. However, there are important differences between our "laboratory" and theirs. While conduits resemble repo transactions to some extent, the presence of explicit guarantees to conduits by sponsoring financial institutions establishes a direct linkage between the ability to issue commercial paper and the guarantee provided by the sponsor. We can therefore test directly for the impact of the guarantees on commercial paper issuance and spreads using variation across and within conduit sponsors over time, rather than relying on market-wide measures of banking sector health.

2. Institutional Background

2.1. Conduit structure

Figure 3 illustrates the typical conduit structure. A conduit is set up by a sponsoring financial institution (henceforth, sponsor). The sole purpose of a conduit is to purchase and hold financial assets from a variety of asset sellers. The conduit finances the assets by selling asset-backed commercial paper to outside investors such as money market funds or other "safe asset" investors.

Conduits typically exhibit a significant maturity mismatch. Most of the conduit assets are medium- to long-term assets with maturities of three to five years. Most of the conduit liabilities are asset-backed commercial paper with a maturity of 30 days or less. Conduits regularly roll over their liabilities and use proceeds from new issuances of asset-backed commercial paper to pay off maturing asset-backed commercial paper.

Most conduits minimize their credit risk by holding a diversified portfolio of high quality assets. Typically, they are restricted to purchasing AAA-rated assets or unrated assets of similar quality. Some conduits exclusively purchase unrated assets originated by their sponsoring financial institutions. Other conduits mostly purchase securitized assets originated by other financial institutions. Many conduits combine the two strategies by purchasing both securitized and unsecuritized assets from several financial institutions.

Outside investors consider asset-backed commercial paper a safe investment for three reasons. First, the pool of conduit assets is used as collateral to secure the asset-backed commercial paper. Second, the conduit's sponsor provides guarantees to the conduit, which ensures that the sponsor repays maturing asset-backed commercial paper

in case the conduit is unable to pay off the maturing paper itself. Third, asset-backed commercial paper is very short-term, so that investors can easily liquidate their investment by not rolling over maturing asset-backed commercial paper.

Conduits can generate significant risks for the sponsor. The sponsor's guarantee typically covers the conduit's roll-over risk, which is the risk that a conduit cannot refinance maturing commercial paper, possibly because of a deterioration of conduit asset values. In that case, the sponsor has to assume the losses from lower asset values, because under the guarantee sponsors are required to repurchase assets at par. In exchange for assuming this risk, the sponsor receives the conduit profits.

From an incentive perspective, the use of guarantees to align risks and rewards within the sponsor is consistent with the optimal allocation of control rights under asymmetric information. Sponsors often use conduits to purchase assets originated by their customers, their own origination department, or other close parties, and may be better informed about asset quality than outside investors. The use of guarantees thus avoids the incentive problem inherent in other forms of securitization, in which the asset originator transfers most of the risks associated with the assets to outside investors. Instead guarantees ensure that sponsors have strong incentives to screen the conduit's asset purchases (e.g. see Ramakrishnan and Thakor (1984), Calomiris and Mason (2004) and Keys et al. (2009)).

The guarantees are also important because they ensure that asset-backed commercial paper qualifies for the highest available rating from accredited national rating agencies. The high ratings are important because the main purchasers of asset-backed commercial paper are money market funds, which are legally restricted to invest in

securities with such ratings (Kacperczyk and Schnabl (2009)). Hence, the key issue with guarantees is whether the recourse of conduits to sponsor bank balance sheets is recognized as balance sheet risk and capitalized adequately.

2.2. Type of guarantees

Conduit sponsors use four different types of guarantees which provide different levels of insurance to outside investors. The four types of guarantees, ranked from strongest to weakest, are full credit guarantees ("full credit"), full liquidity guarantees ("full liquidity"), extendible notes guarantees ("extendible notes"), and guarantees arranged via structured investment vehicles ("SIV"). We briefly describe the structure of each guarantee.

Full credit guarantees are guarantees that require the sponsor to pay off maturing asset-backed commercial paper independent of the conduit's asset values. As discussed in more detail below, from a regulatory perspective, full credit guarantees are considered equivalent to on-balance sheet financing because they expose banks to the same risks as assets on the balance sheet. In practice, these guarantees are infrequently used by financial institutions that have to satisfy bank capital requirements but are more common among financial institutions that follow other forms of capital regulation.

Full liquidity guarantees are similar to full credit guarantees with the main difference being that the sponsor only needs to pay off maturing asset-backed commercial paper if the conduit assets are not in default. Hence, there is a possibility that full liquidity guarantees expire before the asset-backed commercial matures. However, full liquidity guarantees are structured to make this event highly unlikely. As discussed in

detail below, the key idea is to define asset default as a function of a slow-moving variable such that the asset-backed commercial paper expires prior to the date at which the assets are declared in default. Indeed, as we show below, throughout the entire financial crisis there is not a single instance in which a full liquidity guarantee expired before the assets were declared in default.

Extendible notes guarantees are similar to full liquidity guarantees with the main difference being that the conduit issuer has the discretion to extend maturing commercial paper for a limited period of time (usually 60 days or less). By extending the maturity of the commercial paper, it is more likely that the conduits assets are in default before the commercial paper matures. From the viewpoint of an outside investor, extendible notes guarantees are therefore riskier than full liquidity guarantees. This guarantee was used by financial institutions with lower financial strength and by conduits with ex-ante higher quality assets.

SIV guarantees are also similar to full liquidity guarantees with the main difference being that SIV guarantees only cover a share of the conduit liabilities (usually around 25%). However, conduits with SIV guarantees also issue longer-maturity debt such as medium-term notes and subordinated capital notes. Since SIV guarantees do not cover all conduit liabilities, we consider SIV guarantees as providing partial insurance to outside investors. SIV guarantees were primarily used by commercial banks and other financial institutions to cover higher quality assets.

The partial transfer of risk, as in the case of extendible notes and SIVs guarantees, is consistent with security design models. In contrast, lack of any risk transfer, as in the case of full credit and full liquidity conduits is at odds with such models unless the

underlying assets are mostly all of low quality, an unlikely scenario especially when these conduits were set up.

3. Theoretical Framework

The economic rationale for imposing capital requirements on banks comes from the premise that individual banks do not internalize the costs their risk-taking impose on other parts of the economy, in particular, other banks and the real sectors. For example, Diamond and Rajan (2000) explain why the market discipline provided by demandable debt may have to be counteracted with bank capital when bank assets contain aggregate risk. Acharya (2001) focuses on collective risk-shifting by banks in the form of herding to exploit their limited liability options and higher capital requirements on aggregate risky assets can serve as a way to counteract this incentive. Indeed, Gordy (2003) provides the foundation for the Basel I capital requirement framework based on the assumption that each bank is holding a diversified portfolio of economy-wide loans, thereby holding aggregate risk, and the job of the Basel I capital weights is to ensure that the resulting aggregate risk does not erode bank capital beyond a desired likelihood.

In effect, capital requirements increase the bank cost of capital with the intention of preventing them from undertaking certain risks that would otherwise seem privately attractive to banks. For instance, banks inherently perform maturity transformation, which is to borrow short and lend long. However, both on their (uninsured) liabilities and asset side, they are typically exposed to aggregate risk. To the extent that banks make profits by earning interest margins on the asset side over and above their cost of financing, they have a private incentive to raise leverage to reduce the cost of financing

and undertake greater aggregate risk so as to earn higher risk premiums. In a world with imperfectly imposed capital requirements, banks would thus have incentives to "arbitrage" regulation and devise ways of synthesizing leveraged exposures to aggregate risks. In this paper, we examine this regulatory arbitrage hypothesis to explain the structure and performance of asset-backed commercial paper conduits. In particular, we test three hypotheses.

The first hypothesis is that commercial banks set up conduits to minimize regulatory capital requirements. In particular, commercial banks set up more conduits, and more so, with guarantees. This is because (i) banks taking deposits may have a natural advantage in providing guarantees (e.g., lines of credit), as argued by Kashyap, Rajan and Stein (2002), or because commercial banks have access to federal deposit insurance which causes economy's savings to move into bank deposits during times of aggregate stress, as documented by Gatev and Strahan (2005) and Pennacchi (2006); and, (ii) commercial banks are subject to strictest capital requirements in the financial sector and thus have greater benefits from regulatory arbitrage. Conversely, sponsors other than commercial banks set up conduits with weaker or no guarantees, and must substitute for absence of guarantees by choice of better assets, so that ex ante conduits with different guarantees reflect similar levels of risk or costs of borrowing.

The second hypothesis is that, ex post, when asset quality deteriorates and there is credit and liquidation risk to assets, conduits experience a "run" from their short-term credit providers, experiencing reduced ability to roll over debt and at higher spreads. The cost of redeeming debt that could not be rolled over and higher spreads are borne by conduit sponsors. The impact of asset quality deteriorates is larger for (i) weaker

guarantees; (ii) weaker sponsor banks; and (iii) assets affected worst by the economic shock.

The third hypothesis is that no realized losses are passed on to creditors of conduits that are guaranteed, with some losses passed on to creditors of other conduits. Banks with greater exposure to conduits (relative to their size) experience worse stock returns once the run on conduits is initiated.

Put together, these hypotheses amount to establishing that a significant part of the conduit activity is a form of securitization without risk transfer, that is, a way for banks to concentrate aggregate risks rather than disperse them, and do so in an under-capitalized manner.

4. Empirical Analysis

4.1. Data and Summary Statistics

We use several different data sources for the analysis in this paper. We start by collecting ratings reports for asset-backed commercial paper conduits that cover all conduits rated by Moody's Investors Service for the period from January 2001 to December 2009. During this period, Moody's Investors Service issued reports on 938 conduits. The rating reports are typically three to five pages and contain information on conduit sponsor, conduit type, conduit assets, credit guarantees, and a verbal description of the conduit. Moody's Investors Service publishes the first report when a conduit receives its first rating and subsequently updates the reports annually. For some larger conduits, Moody's Investors Service also publishes monthly monitoring reports. Monthly reports are typically one page and comprise information on conduit size,

guarantees, and conduit assets. In addition, Moody's Investors Service publishes a quarterly spreadsheet that summarizes basic information on all active conduits.

Our dataset is the universe of conduits collected from Moody's Investors Service's quarterly spreadsheets. We augment the dataset with information collected from the ratings reports. Some conduits have more than one observation because they have funding operations in both U.S. dollars and Euro. Since the funding operations belong to the same conduit, we merge these observations. We drop asset-backed commercial paper issued by collateralized debt obligations because their credit guarantees are not comparable to the rest of the sample (292 out of 9536 observations).

We merge this data set with a proprietary data set on all asset-backed commercial paper transactions conducted in the United States from January 2007 to February 2008. The data set contains 777,758 primary market transactions by 349 conduits over 292 trading days. The data are provided by the Depository Trust and Clearing Corporation (DTTC), the agent that electronically clears and settles directly- and dealer-placed commercial paper. For each transaction, DTCC provides the identity and industry of the issuer, the face and settlement values of the transaction, and the maturity of the security.

Using the DTCC data, we compute prices and quantities for asset-backed commercial paper. We compute overnight spreads as the yield on asset-backed commercial paper minus the federal funds target rate. We calculate the conduit-level weekly growth as the percentage change in asset-backed commercial paper. We merge the DTCC data set with the Moody's Investors Service data set.

We then use the Moody's rating reports to identify the sponsoring institution that is providing guarantees to the conduit. We first identify the type of sponsor (e.g.,

commercial bank, mortgage originator, structured finance group, monocline, etc.). If the sponsoring institution is a commercial bank, we look for the sponsor in the bank data set Bankscope. If we cannot identify a sponsor via Bankscope, we conduct an internet search. We match the sponsor to the consolidated financial company (e.g., we match conduits sponsored by Citibank South Dakota to Citigroup).

We construct a data set of the 300 largest banks as of January 2007 using the Bankscope database. If a consolidated company and its subsidiaries have more than one entry in Bankscope, we only keep the consolidated company. We use the ISIN identifier to match Bankscope data to share price data and stock return data from Datastream. If a bank does not have an ISIN identifier, we verify with the company website that the bank is not listed on a stock exchange. This data set allows us to compare banks that sponsor asset-backed commercial paper conduits with banks that do not sponsor asset-backed commercial paper conduits.

Finally, we use Moody's Investors Service Weekly Announcement Reports of rating downgrades from January 2007 to December 2008. We identify all conduits that were downgraded or were withdrawn during the analysis period. For all such conduits, we search for an affirmative statement by Moody's Investors Service that all outside investors were repaid prior to the downgrade or withdrawal. If there is no such affirmative statement we use announcements by the sponsor or other rating agencies to determine whether investors were repaid. If we do not find an affirmative statement that all investors were repaid, we assume that the conduit entered default. We note that this coding procedure may overestimate the extent of investor liquidation because investors

may have been repaid without an affirmative announcement by either the sponsor or the rating agencies.

Panel A of Table 1 shows the ten largest conduits ranked by asset-backed commercial paper outstanding as of January 1, 2007. Most conduits hold highly rated assets originated in the United States or the United Kingdom. If a conduit hold assets that are not rated, the Moody's reports usually state that the conduit holds assets of similar quality as highly rated assets. The main asset classes are residential mortgages and asset-backed securities.

Panel B of Table 1 shows the ten largest sponsors ranked by total asset-backed commercial paper outstanding as of January 1, 2007. In the United States, the largest sponsor is Citigroup with conduit assets of $92.7 billion. For comparison, Citigroup's regulatory capital (Tier 1 Capital) is $90 billion. In Europe, the largest sponsor is ABN Amro with $68 billion of conduits assets. ABN Amro's regulatory capital $31.2 billion (ABN Amro later merged with Royal Bank of Scotland). Most sponsors are large commercial banks based in the United States and European countries.

Panel A of Table 2 provides summary statistics for all conduits authorized to issue asset-backed commercial paper as of January 1, 2007. Panel A shows that there are 301 conduits with total commercial paper outstanding of $1,236 billion. The average conduit size is $4.1 billion with a standard deviation of $5.1 billion. About 61% of asset-backed commercial paper is covered by full liquidity guarantees, 13% is covered by full credit guarantees, 18% is covered by extendible notes guarantees, and 7% is covered by SIV guarantees.

In terms of assets, we use Moody's classification for a conduit's main asset types. About 31% of conduits assets are invested primarily in asset-backed securities. Moody's rating reports suggest that this asset category includes mortgage-backed securities, collateralized debt obligations, and collateralized loan obligations. About 5% of conduits assets are invested primarily in loans. Moody's rating reports suggests that most loans are mortgage loans that are warehoused for future securitization. Some conduits also own student loans, auto loans, corporate loans, and consumer loans. About 35% of conduit assets are invested in receivables. Moody's reports suggest that most receivables are trade receivables and credit card receivables. About 22% of conduits assets are invested in a mix of asset-backed securities, loans, and receivables. The remaining 7% of conduit assets are invested in other asset classes, which include repurchase agreements and government guaranteed loans.

We understand from the Moody's rating \reports that almost all conduits are hedged against currency and interest rate exposure. The most common way for conduits to hedge their currency exposure is by matching the currency of the assets with the currency of the liabilities. Consistent with our earlier observation that most assets are originated in the United States, we find that 75% of asset-backed commercial paper is issued in U.S. dollars. About 18% is issued in Euro and the remainder is issued in Yen, Australian dollars, and New Zealand dollars.

Panel B of Table 2 presents summary statistics for all sponsors as of January 1, 2007. We define a sponsor as a single consolidated company and aggregate asset-backed commercial paper at the holding level. In total, there are 127 sponsors, each of which, on average, sponsors $9.7 billion of asset-backed commercial paper. The largest sponsor

type is commercial banks, which sponsor $911 billion of asset-backed commercial paper. The second largest type is structured finance groups which sponsor $156 billion in asset-backed commercial paper. Contrary to commercial banks, structured finance groups usually do not have the financial resources to provide guarantees. Instead they purchase guarantees from other financial institutions. Unfortunately our data do not contain information to identify the provider of guarantees to conduits of structured finance groups. There is some evidence from industry publications that investment banks are large providers of guarantees to structured finance groups. Other large sponsor types are mortgage lenders ($76 billion), investment managers ($18 billion) and investment banks ($11 billion).

In terms of geography, the majority of conduits are sponsored by financial institutions based in the United States with $491 billion of asset-backed commercial paper. A large number of sponsors are based in Germany and the United Kingdom with asset-backed commercial paper of $204 billion and $195 billion, respectively. The remaining $347 billion are sponsored by financial institutions based in other countries, including financial institutions based in Australia, Belgium, Canada, France, Netherlands, and Japan.

4.2. Capital Requirements

Bank regulation requires banks to hold a certain amount of capital against its investments. One way to reduce one's capital requirements is to transfer the risks of investments to outside investors. Over the last two decades, securitization has emerged as one of the main risk transfer mechanism for banks. Bank regulators have recognized

such risk transfer and modified bank capital regulation to reduce capital requirements accordingly. However, our analysis suggests that banks used asset-backed commercial conduits for securitization without transferring risks to outside investors. To explain the mechanics of such securitization, we first describe the capital regulation of asset-backed commercial paper conduits. Since almost all conduits were sponsored by banks based in the United States and European countries, we focus on bank regulation in these countries. We start by describing bank capital regulation in the United States.

Historically, bank regulators in the United States made a clear distinction between full credit and full liquidity guarantees. Full credit guarantees were considered to cover credit risk and thus considered equivalent to on-balance sheet financing. As a result, assets covered by full credit guarantees required the same regulatory capital charges as assets on the balance sheet. In contrast, full liquidity guarantees were considered to cover liquidity risk, which did not require regulatory capital. Similarly, extendible notes guarantees and SIV guarantees were considered weaker forms of full liquidity guarantees and did not have capital charges either. As a result, there was a sharp discontinuity between the regulatory requirements of full credit guarantees and the regulatory requirements of other types of guarantees.

In response to this regulation, banks developed guarantees which were classified as full liquidity guarantees but effectively covered credit risk. The guarantees were structured as follows. The sponsor committed to repurchase assets at par value from the conduit if the conduit was unable to pay off maturing debt *and* the assets in the conduit were not in default. The banks were careful to make the guarantee conditional on asset default because otherwise regulators classified such guarantees as full credit guarantees.

The most important aspect of this guarantee was to define asset default such that assets almost never defaulted before the asset-backed commercial paper was due. In practice, most sponsors defined asset default as downgrades below investment grade (rated assets) or increases in delinquency rates above pre-specified thresholds (unrated assets). Given the requirement that most assets were highly rated, or of similar quality, it was unlikely that assets entered default quickly. The reason was that rating agencies usually provided ample warnings prior to downgrades (rated assets) and delinquency rates only moved slowly (unrated assets). Moreover, asset-backed commercial paper was very short-term with a median maturity at issuance of overnight and a median maturity of outstanding asset-backed commercial paper of less than 30 days.

Hence, even though it was possible that assets entered default prior to the expiration of the asset-backed commercial paper, it was highly unlikely. Instead, outside investors could simply stop rolling over asset-backed commercial paper upon adverse news about the credit or liquidity risk of conduit assets. In fact, the guarantees were mostly likely to be drawn in the states of the world in which assets were expected to suffer losses. As a result, full liquidity guarantees effectively covered the assets' credit risk without requiring banks to hold regulatory capital.

A number of industry publications describe the benefits of circumventing capital requirements by using this type of guarantees. For example, a publication by Moody's Investor Services (2003) on the fundamentals of asset-backed commercial paper describes conduits as follows: "If a bank were to provide a direct corporate loan, even one secured with the same assets, it would be obligated to maintain regulatory capital for it. An ABCP program permits the sponsor to offer financing services to its customers

without using the Sponsor's balance sheet or holding incremental regulatory capital (p. 15)"

In 2001, the Financial Accounting Standards Board (FASB) in the United States started a review of guarantees to conduits. FASB initiated this review because of the bankruptcy of the energy company Enron. Enron had used off-balance sheet vehicles for concealing its true leverage and these off-balance sheet vehicles were structured similarly to asset-backed commercial paper conduits. This review of conduits generated considerable concern in the banking industry. For example, in July 2002 Moody's Investor Services (2002a) reports under the headline "FASB reacts to Enronitis" that FASB is proposing the consolidation of asset-backed commercial paper conduits on bank balance sheets. In October 2002, Moody's published a special report titled "The FASB Consolidation Proposal: The End of ABCP as we know it?" which suggests that sponsors may have difficulties with consolidation because it would raise regulatory capital requirements and might lead banks to violate their debt covenants.

In January 2003, FASB issued a directive for the consolidation of conduits under Interpretation No. 46 (FIN 46). In response, Forbes (2003) reported that "FASB Puts Banks in a Bind" because conduit consolidation would negatively affect bank balance sheets. The article quotes the FASB chairman as saying that "If you have risk and reward related to the operation, we thought it was enough to say it ought to be on your books". However, the FASB proposal was considered unclear with respect to certain implementation issues and several banks requested more guidance from FASB.

In May 2003, Standard & Poor's (2003) reports that a "Panelist from OOC acknowledges […] Regulatory Relief at S&P seminar". The Standard & Poor's report

states that a representative of the Office of the Comptroller of the Currency (OCC) acknowledged that his agency and other regulatory bodies are putting together an approach that would reduce capital requirements required under the FASB proposal. However, the relief would only last until the end of 2003 or March 2004. In December 2003, FASB issued a new directive called FIN 46R ("R" for revision) which clarified the consolidation issues. The new directive effectively required commercial banks to consolidate asset-backed commercial paper conduits.

However, in July 2004, a consortium of bank regulators, namely the Office of the Comptroller of the Currency, the Federal Reserve Board, the Federal Deposit Insurance Corporation, and the Office of Thrift Supervision (henceforth, the Agencies), issued a new rule for computing capital requirements of asset-backed commercial paper conduits. The official press release (Federal Reserve Board, 2004) by the Agencies states that "[t]he final rule will permanently permit sponsoring banks, bank holding companies, and thrifts (collectively, sponsoring banking organizations) to exclude from their risk-weighted asset base those assets in ABCP programs that are consolidated onto sponsoring banking organizations' balance sheets as a result of FIN 46R". Hence, the bank regulator effectively issued an exemption of capital requirements for asset-backed commercial paper conduits. Under the exemption, assets in conduits were not considered assets for the purpose of calculating capital requirements. Instead, bank regulators required that banks had to hold capital at a conversion factor of 10% against the amount covered by full liquidity guarantees. This implied that regulatory charges for conduit assets were 90% lower than regulatory charges for on-balance sheet financing (Gilliam (2005)).

Consistent with the regulatory arbitrage motive, Figure 3 shows that the growth of asset-backed commercial paper conduits stalled in late 2001, around the time when FASB started its review of conduits. From late 2001 to late 2004, asset-backed commercial paper outstanding is flat after several years of significant growth. However, starting in late 2004, at the time bank regulator issued their exemption, growth in asset-backed commercial paper picks up again. This time-series evidence indicates that lower capital requirement played an important role in the decision to set up conduits.

In Europe, the history of capital requirements for asset-backed commercial paper conduits was slightly different. Before 2004, most European countries had similar capital requirements for guarantees as in the United States. Full credit guarantees were considered to cover credit risk and required the same regulatory charges as on-balance sheet financing. Full liquidity guarantees were considered to cover liquidity risk and had no capital charges.

The main difference between the United States and Europe was that European banks started to adopt International Financial Reporting Standards (IFRS) in the early 2000s. IFRS, contrary to U.S. General Accepted Accounting Principles (GAAP), do not recognize asset transfers to conduits as a true sale. As a result of this regulation, European banks were required to consolidate conduits on their balance sheets. However, most European regulators did not change capital requirements in accordance with IFRS. Hence, for the purpose of computing regulatory requirements and risk weighted assets, conduits were considered off-balance sheet and European banks did not have to hold regulatory capital against conduit assets.

Another difference between the United States and European countries was that European bank regulators were in the process of adopting the Basel II framework (U.S. commercial banks were still operating under Basel I). Under the Basel II standardized approach, the capital requirements for conduit assets covered by full liquidity guarantees increase from 0% to 20% relative to on-balance sheet financing. Moreover, Basel II assumes lower risk weights for highly rated securities, which reduces the level of regulatory charges for both off-balance sheet and on-balance sheet financing. At the start of the financial crisis, several European banks had adopted Basel II rules, while others were still operating under Basel I. Importantly, both Basel I and Basel II rules allowed for "regulatory arbitrage" of capital requirements, although the benefit of regulatory arbitrage was smaller under Basel II than under Basel I.

We note that two European countries, Spain and Portugal, differed in their regulation of capital requirements from other European countries. These countries required sponsors to hold the same amount of regulatory capital for assets on balance sheets and for assets in asset-backed commercial paper conduits. Consistent with the regulatory arbitrage motive, we find that Spanish and Portuguese banks did not sponsor asset-backed commercial paper conduits (Acharya and Schnabl, 2009b).

We also note that the incentive to use guarantees for circumventing capital requirements was particularly strong for commercial banks. Commercial banks were considered to have the strictest capital regulation of all financial institutions because of their special status as deposit-taking institutions. Commercial banks should therefore derive the largest benefits from using guarantees to reduce capital requirements.

Consistent with this motive, Table 3 shows that commercial banks are the main sponsors of asset-backed commercial paper. They sponsor asset-backed commercial paper worth $911 billion, or 73.7% of total asset-backed commercial paper outstanding. Also, commercial banks are more likely than other financial institutions to use full liquidity guarantees with 74% of its conduit assets covered by full liquidity guarantees. For comparison, the second-largest group of sponsors, structured finance groups, sponsor $156 billion, or 12.6% of total asset-backed commercial paper outstanding. Contrary to commercial banks, the main guarantees used by structured finance groups are full credit guarantees covering 37% of conduit assets.[8]

4.3. Impact of Guarantees on Spreads and Outstandings

In this section, we examine the importance of guarantees in rolling over maturing asset-backed commercial paper after the start of the financial crisis. As shown in Figure 1, asset-backed commercial paper declined dramatically after the start of the financial crisis on August 9, 2007. By the end of year, the asset-backed commercial paper market was roughly 30 percent smaller than it was at its peak in July. Importantly for our analysis, the extent of the decrease varied substantially by type of guarantee.

To test for the importance of guarantees in rolling over asset-backed commercial paper after August 9, 2007, we exploit cross-sectional variation in types of guarantees. As discussed, full credit and full liquidity guarantees cover almost all risks associated

[8] We do not have data on the providers of guarantees to structure finance groups. However, some industry reports indicate that the main providers were large U.S. investment banks, which used internal rating models for computing capital charges (Nadauld and Sherlund, 2008). Internal rating models made less distinction between full credit and full liquidity guarantees.

with conduits assets. However, extendible guarantees are weaker guarantees because they allow conduits to extend commercial paper for a limited period of time, an option that issuers are likely to exercise when there is adverse news about conduit assets. SIV guarantees are also weaker guarantees because these guarantees only cover asset-backed commercial paper outstanding but not other liabilities such as medium term notes and capital notes.

To understand the selection of sponsors and assets into guarantees, it is important to understand the sponsor's objective. Usually, sponsors aim to put together a conduit structure (consisting of the guarantee, conduit assets, and the sponsor's financial strength) which allows the sponsor to issue highly rated asset-backed commercial paper at rates similar to the Fed Funds rate (overnight) or LIBOR (30-days). Sponsors trade off various characteristics to achieve this pricing on the asset-backed commercial paper. For example, conduits with higher quality assets are usually covered by weaker guarantees. Also, sponsors with lower financial strength tend to provide weaker guarantees and have to provide higher quality assets.

Table 4 provides summary statistics on assets and sponsor types by guarantees. For full liquidity guarantees, the main sponsor type is commercial banks covering 89.9% of asset-backed commercial paper outstanding. The three main asset types covered by full liquidity guarantees are receivables (42.6%), asset-backed securities (29.2%), and mixed assets (20.8%). For full credit guarantees, the main sponsor types are commercial banks (62.4%) and structured finance groups (36.5%). The three main asset types are mixed assets (39.4%), receivables (37.9%), and asset-backed securities (10.2%). These results suggests that conduits covered by full liquidity and full credit guarantees are

similar in terms of assets. Regarding sponsors, the main difference is that structured finance groups are more likely to provide full credit guarantees than full liquidity guarantees.

For extendible notes guarantees, we find that the main sponsor types are commercial banks (33.8%), mortgage originators (27.1%), and structured finance groups (23.6%). The main asset types are asset-backed securities (28.8%), receivables (24%), mixed assets (23%), and loans (15.6%). For SIV guarantees, the main sponsor types are commercial banks (61.8%) and structured finance groups (34.5%). SIVs only invest in asset-backed securities (91.3%) and loans (8.7%). These summary statistics suggest that financial institutions with less financial strength, such as mortgage originators, are more likely to provide weaker guarantees, in particular extendible notes guarantees. Also, extendible and SIV guarantees are more likely to cover asset-backed securities, which were considered of higher quality before the financial crisis.

We note that the average spread of overnight asset-backed commercial paper over the Fed Funds rate was only one basis point prior to the financial crisis. Importantly, there was no variation across guarantees, which suggest that, from an ex-ante perspective, outside investors perceived conduits with different guarantees to have similar risks.

To test the cross-sectional impact of guarantees formally, we compute asset-backed commercial paper outstanding and spreads of overnight asset-backed commercial paper both before and after the start of the financial crisis. We restrict our sample to the period three months before and three months after the start of the financial crisis on August 9, 2007. We choose this period because it captures the main decline in asset-backed commercial paper but excludes later events that may confound our analysis (e.g.,

Bear Stearns merger, Lehman bankruptcy). We find qualitatively and quantitatively similar results if we extend our data set to the period six months before and six months after the start of the financial crisis. We include all sponsors in our main results. For our results on sponsor quality, we restrict our sample to conduits that we can match to the sponsor's credit default swap (CDS) spread.

We first examine the impact of guarantees non-parametrically. Figure 5 shows that asset-backed commercial paper covered by extendible guarantees and SIV guarantees decreased significantly more than asset-backed commercial paper covered by full credit and full liquidity guarantees. Similarly, Figure 6 shows that the overnight spread on asset-backed commercial paper covered by extendible guarantees and SIV guarantees increased more than the spread on asset-backed commercial paper covered by full credit and full liquidity guarantees.[9] The figures indicate that there was a negative shock to the supply of funds provided by outside investors leading to a large decline in quantity and a large increase in price.

We test whether the patterns on issuance and spreads by type of guarantee are statistically significant and robust to controlling for sponsor and conduit characteristics. Our baseline specification is:

$$\log(CP_{it}) = \alpha + \beta Guarantee_j + \gamma After_t * Guarantee_j + Time_t + \varepsilon_{it}$$

where $\log(CP_{it})$ represents the natural logarithm of the face value of commercial paper outstanding of conduit *i* in week *t*. $Guarantee_j$ is a fixed effect by type of guarantee. $After_t$ is an indicator variable that equals one after the start of the crisis (after August 9,

[9] We focus on overnight spreads because most newly issued ABCP has maturities of one to four days. According to data from the Federal Reserve Board, roughly 60 percent of newly issued ABCP in the U.S. has maturities of one to four days prior to the crisis. Our results are similar when considering one-month spreads (one month is the second most frequent maturity after overnight).

2007) and zero before the crisis. $Time_t$ represent fixed effects by sponsor and by week. We also estimate regression in which we control for conduit fixed effects and sponsor-time fixed effects.

We are primarily interested in the coefficient γ on the interaction of $After_t$ and $Guarantee_j$, which captures the average change in commercial paper outstanding by guarantee after the start of the financial crisis. The omitted guarantee category is full liquidity guarantees. We cluster standard errors at the conduit level because our variable of interest varies at the conduit level and we want to allow for the correlation of error terms within conduits.

If the financial crisis makes investors more concerned about conduit risks, we expect that the interactions between indicator variables for weak guarantees and the $After_t$ indicator to be more negative than those for strong guarantees. Furthermore, if full credit and full liquidity guarantees provide the same level of protection for outside investors, we expect that the interaction between the indicator variable for full credit support and the $After_t$ dummy to be statistically insignificant. Together these hypotheses are aimed at uncovering whether guarantees were important for outside investors to roll over maturing asset-backed commercial paper upon adverse news about asset quality.

Column (1) in Table 5 reports the results of estimating our baseline specification. The significant coefficient on the interaction between the $After_t$ indicator and the dummies for programs with extendible notes and SIVs suggest that asset-backed commercial paper decreased more for conduits with weaker guarantees compared to conduits with stronger guarantees. The coefficient on the interaction between the $After_t$

indicator and the dummies for full credit programs shows that there is no statistically significant difference between full liquidity and full credit guarantees. Column (2) adds controls for time fixed effects. The time fixed effects control for a non-parametric time-trend but have no effect on the coefficients of interest. Column (3) adds controls for conduit fixed effects. The conduit fixed effects control for the average amount of asset-backed commercial paper outstanding. We find no change in the coefficients of interest. These results suggest that conduits with weaker guarantees experienced a significantly larger decline in asset-backed commercial paper outstanding.

One possible concern with these results is that guarantees proxy for the quality of the sponsor. If sponsors of full liquidity and full credit guarantees are of higher quality after the start of the financial crisis, this may bias our results. To control for time-varying sponsor quality, Column (4) adds controls for sponsor-time fixed effects. These variables control for time-varying changes at the sponsor level such as changes in the financial strength of the sponsor. Put differently, the coefficients are identified off variation within sponsors at a given point in time (e.g., comparing conduits with full credit guarantees, full liquidity guarantees, extendible guarantees, and SIV guarantees for the *same* sponsor). We find that the point estimates are robust to controlling for these fixed effects. The standard errors are larger than in Columns (1) to (3), but the effect of extendible guarantees remains marginally statistically significant. This result suggests that guarantees significantly affect the conduit's ability to roll over asset-backed commercial paper even after controlling for changes in sponsor quality.

Another possible concern is that our results may reflect differences in asset quality across conduits with different guarantees. As discussed above, conduits with

weaker guarantees are more likely to hold asset-backed securities and are less likely to hold receivables. Even though asset-backed securities may have been of higher quality ex-ante, they may be of lower quality ex-post which could bias our result. We therefore control for asset quality by including indicator variables for asset types and interactions between the $After_t$ indicator and asset type indicators.

Columns (5) to (8) report the results. Based on our baseline specification, we find that the coefficients of interest are almost unchanged after controlling for asset classes (Columns 1 and 5). We find similar results in specifications that control for time fixed effects (Columns 2 and 6), conduit fixed effects (Columns 3 and 7) and sponsor-time fixed effects (Columns 4 and 8).

We note that our asset controls have some explanatory power for changes in asset-backed commercial paper outstanding. In particular, the coefficient on the interaction of the $After_t$ indicator and loans is always negative and statistically significant. This result indicates that loans, which are primarily mortgage loans, had a negative impact on the conduit's ability to roll over asset-backed commercial paper. The coefficient on the interaction of the $After_t$ indicator and receivables is usually positive but not statistically significant. The point estimate indicates that receivables, which are primarily trade receivables and credit card receivables, had a positive impact on the conduit's ability to roll over asset-backed commercial paper.

Hence, even though our asset controls can explain a conduit's ability to roll over asset-backed commercial paper, they have little impact on the coefficients of interest. This result suggest that guarantees are an important determinant of a conduit's ability to roll over asset-backed commercial paper upon adverse news, even after accounting for

the quality of the assets. However, we caution our interpretation because we cannot perfectly control for asset quality.

We also examine whether the impact of guarantees is stronger for riskier banks. We measure the riskiness of the sponsor using the sponsor's CDS spread. We expect that the decrease in asset-backed commercial paper of conduits with weaker credit guarantees is more pronounced if the sponsor is risky. We test this hypothesis by adding sponsor CDS spreads and their two-way interactions with the dummies for type of guarantee and the $After_t$ indicator to the baseline specification. We note that this estimation uses a smaller sample because we restrict the analysis to sponsors with CDS spreads.

Table 6 reports the results. Columns (1) to (4) estimate our baseline specification using the restricted sample. We note that the results are similar to Table 5. Columns (5) to (8) add the triple interaction of the $After_t$ indicator, the $Guarantee_j$ indicators, and the CDS spread. The regressions also include all two-way interactions. Columns (5) and (6) find a negative and statistically significant effect on the interaction of sponsor CDS spreads with extendibles in the post-period. This finding suggests that the impact of weak guarantees is larger for riskier banks. However, the results become insignificant once we control for conduit fixed effects or sponsor-time fixed effects. This result suggests that the financial strength of the sponsor affects the conduit's ability to roll-over asset-backed commercial paper but the effect is not very robust.

We also estimate the impact of guarantees on overnight spreads of asset-backed commercial paper. Again, our baseline specification is:

$$Spread_{it} = \alpha + \beta Guarantee_j + \gamma After_t * Guarantee_j + Time_t + \varepsilon_{it}$$

where $Spread_{it}$ is the overnight spread (1 to 4 days of maturity) over the Federal Funds rate on new issues by conduit *i* on day *t*. All right-hand side variables have the same interpretation as in the issuance regression, but time-dependent variables are now measured daily.

Column (1) in Table 7 reports the results of estimating our baseline specification. The significant coefficients on extendible notes and SIVs suggest that spreads increase more for conduits with weaker guarantees compared to conduits with stronger guarantees. The coefficient on full credit guarantees shows that there is no statistically significant difference between full credit and full liquidity guarantees. Columns (2) and (3) show that the results are robust to controlling for time fixed effects and conduit fixed effects. Column (4) controls for sponsor-time fixed effects, such that the coefficients are estimated off variation across guarantees for the same sponsor. We find that results are robust but the point estimate on extendible is not statistically significant. Overall, these results suggest that guarantees affect the spreads on overnight asset-backed commercial paper even after controlling for changes in sponsor quality.

Column (5) to (8) control for asset classes using indicator variables for asset classes and interactions of the $After_t$ indicator and asset classes. We find that coefficients on the interaction of the $After_t$ indicator and extendibles decreases after controlling for asset classes and are not statistically significant. However, all point estimates remain positive. The coefficients on the $After_t$ indicator and SIV guarantees remain almost unchanged and are statistically significant. Moreover we find that the coefficient on the interaction of the $After_t$ indicator and the loans indicator is generally positive and the coefficient on the interaction of the $After_t$ indicator and receivables

indicator is positive. Overall, the results are suggest that spreads increase more for weaker guarantees even after controlling for asset classes.

Table 8 examines whether the impact of guarantees is stronger for riskier banks using CDS spreads. Again, we report the baseline specifications for the restricted sample in Columns (1) and (4). The results for the restricted sample are similar to Table 7. Columns (5) to (8) report specification with triple interactions of the $After_t$ indicator, the $Guarantee_j$ indicators, and the CDS spread. We include all two-way interactions. Columns (5) and (6) find a stronger effect of extendibles for riskier banks. There is no statistically significant effect for SIV guarantees. After controlling for conduit-fixed effects and sponsor-time fixed effects, the coefficients become insignificant. Overall, these results suggest that the impact of guarantees is stronger for riskier banks but the results are not very robust.

In summary, we find that after the start of the financial crisis conduits with weaker guarantees decreased issuance more and paid higher spreads than conduits with stronger guarantees. These patterns are somewhat stronger for weaker sponsors as measured by CDS prices, suggesting that quantities and prices in the asset-backed commercial paper market are correlated with the strength of the sponsoring banks. Also, the patterns suggest that the full credit guarantees and full liquidity guarantees were an important part of rendering asset-backed commercial paper risk-free for outside investors.

4.4. Losses of Outside Investors

This section examines the extent of realized risk transfer by analyzing whether outside investors in asset-backed commercial paper were fully repaid after the start of the

financial crisis. The analysis complements the analysis of the impact of guarantees on asset-backed commercial paper outstanding and asset-backed commercial paper spreads. We take the perspective of an investor that was holding asset-backed commercial paper at the start of the crisis and examine whether the investor suffered losses by not rolling over maturing asset-backed commercial paper.

We test the performance of credit guarantees using Moody's Investors Service announcement data from January 2007 to December 2008. Since all conduits are rated, Moody's Investors Service always issues an announcement if a conduit defaults on its obligation to pay off maturing asset-backed commercial paper.

Table 9 presents the results on the ex-post risk transfer. Column (1) reports asset-backed commercial paper outstanding per credit guarantee in July 2007. Columns (2) to (4) show the value-weighted percentage in three categories: conduits that were closed down and repaid all maturing asset-backed commercial paper before December 2008, conduits that remained active and repaid all maturing commercial paper up to December 2008, and conduits that failed to repay maturing asset-backed commercial paper and entered default by December 2008.

The table shows that not a single conduit covered by full credit or full liquidity guarantees defaulted by December 2008. In contrast, 7.4% of conduits covered by extendible notes guarantees and 16.7% of conduits covered by SIV guarantees defaulted by December 2008, respectively. Regarding the sponsor type, we find that conduits sponsored by structured finance firms and mortgage companies were significantly more likely to enter default than conduits sponsored by commercial banks. Overall, we note that 97.5% of outside investors in asset-backed commercial paper were fully repaid.

We do not have data on the losses on conduit assets. The losses depend on the loss rate on conduit assets and unfortunately there is no publicly available information with respect to such loss rates. However, we can use different pieces of information to form an estimate. For example, State Street (2009) announced an after-tax loss of $3.7 billion on conduit asset of $21.8 billion, which amounts to a loss-rate of 22.6% (assuming a tax rate of 25%). Also, the AAA-tranche of ABX-index suggests that the value of collateralized mortgage obligations backed by subprime mortgages dropped by up to 60 percent in months after the start of the financial crisis. The losses on conduit assets are likely to be smaller because many conduits both non-mortgage assets such as receivables. We therefore assume more conservative loss rates of 5% and 15%. Under this assumption, we estimate total losses on conduit assets of $68 billion and $204 billion, respectively. The estimated losses for outside investors are $1.8 billion and $5.2 billion respectively. Consistent with the lack of risk transfer, this analysis shows that most of the losses were borne by sponsors rather than outside investors. However, the level of the estimated losses is only suggestive because we lack the data to compute actual losses.

4.5. Effect of Conduit Exposure on Sponsor Stock Returns

This section analyzes whether banks with higher conduit exposure experienced lower stock returns during the financial crisis. The difficulty in testing this hypothesis is that the financial crisis also affected banks in other ways, some of which may be correlated with conduit exposure. Hence, if we observe that banks with higher conduit exposure have lower returns, then this result may be driven by other bank activities that negatively affect stock prices and are correlated with conduit exposure.

To address this identification issue, we focus on the start of the crisis in the asset-backed commercial paper market on August 9, 2007. We believe this provides a good setting to identify the impact of conduit exposure for two reasons. First, the financial crisis arguably started with the announcement of difficulties in the subprime mortgage market. As shown in Figures 1 and 2, starting on August 9, 2007, investors drastically reduced refinancing of maturing asset-backed commercial paper and, as a result, overnight spreads jumped from 10 basis points to 150 basis points. Hence, it is unlikely that the event study is confounded by other events that happened just prior to August 9, 2007. Second, our analysis focuses on the narrow three-day window around August 9, 2007. This short event window reduces the likelihood that the results may be confounded by other events that happen around the same time.

We start by examining observable characteristics of banks with and without conduit exposure. We restrict our sample to banks with assets of $5 billion or more as of January 1, 2007, because only these banks had the financial strength to support conduits (our results are robust to including smaller banks). We further restrict our analysis to commercial banks based in Europe and the United States and to banks for which share price data is available. We choose this restriction because some countries outside the United States and Europe (in particular Canada) allowed for differently structured credit guarantees which are not comparable.

Table 10 shows the distribution of banks by conduit exposure. We measure conduit exposure as asset-backed commercial paper outstanding relative to equity capital as of January 1, 2007. We sort banks into three groups: banks without conduits, banks with low conduit exposure, and banks with high conduit exposure. Consistent with our

main hypothesis, we find that stock returns were lower for banks with higher conduit exposure. In fact, the data suggest that stock returns monotonically decrease in conduit exposure.

To control for difference in observable characteristics, we estimate the baseline specification:

$$R_i = \alpha + \beta ConduitExp_i + \gamma X_i + \varepsilon_i$$

where R_i is the cumulative stock return of bank *i* computed over the three-day period from August 8, 2007, to August 10, 2007, $ConduitExp_i$ is bank *i*'s conduit exposure, X_i are bank *i*'s observable characteristics as of January 1, 2007, and ε_i is a bank-specific error term. We estimate this specification using robust standard errors to allow for correlation across error terms.

Table 11 presents the results. Column (1) shows that an increase in conduit exposure from 0% to 100% (e.g., Wells Fargo to Citibank) reduces the stock return during the three-day event window by 2.6 percentage points. Column (2) controls for banks size using the natural logarithm of assets and the natural logarithm of equity. The coefficient on conduit exposure decreases to 1.4 percentage points but remains statistically significant. Column (3) adds controls for the equity ratio and the result remains unchanged. Columns (4) and (5) add control variables for funding sources such as the share of deposit funding and the share of short-term debt funding and the results are unaffected. Column (6) adds indicator variables for the country of the sponsoring institution's headquarters. Again, the coefficient of conduit exposure is unaffected and remains statistically significant.

We interpret these results as evidence that banks with higher conduit exposure were more negatively affected by the crisis in the asset-backed commercial paper market. The coefficient is probably a lower bound of the impact, because investors may have underestimated the severity of the downturn or may not have been fully aware of the (relatively opaque) credit guarantees provided to conduits. Also, investors may have anticipated some of the losses because of prior announcements about losses on subprime assets.

To ensure that the results are not driven by outliers, we construct an alternative measure of exposure. We compute the mean exposure of all banks with positive exposure to conduits and divide the banks in two groups: banks with low exposure (below mean) and banks with high exposure (above mean). We estimate the baseline specification using indicator variables for banks with low exposure and bank with high exposure and in unreported results find qualitatively and quantitatively similar effects. We also drop outliers in terms of conduit exposure and banks with less than $50 billion in assets and our results are qualitatively and qualitatively unchanged.

We also examine the relation of conduit exposure and stock returns in the months prior to August 2007. For each month from January 2007 to August 2007, we estimate the same set of regressions as in Table 11 including all controls. Table 12 presents the results. We find no statistically significant relationship between conduit exposure and stock returns from January 2007 to July 2007. However, in the month of the crisis in the asset-backed commercial paper market, August 2007, we find a negative and statistically significant effect of conduit exposure on stock returns after controlling for the full set of observables. The coefficient is twice as large as the coefficient in Table 10. Again, this

finding suggests that investors revised their expectation of the negative effect of conduit exposure on stock returns upwards for several days after the start of the financial crisis. However, we caution our interpretation because the estimation is over a longer event window and therefore may be confounded by other factors.

5. Benefits to banks of securitization without risk transfer

The empirical analysis shows that banks suffered significant losses because conduits were unable to roll over maturing asset-backed commercial paper. This raises the question of how large was the benefit to banks from by setting up conduits.

We can assess the benefits to banks by quantifying how much profit conduits yielded to banks from an ex-ante perspective using a simple back-of-the-envelope calculation. Assuming a risk weight of 100% for underlying assets, banks could avoid capital requirements of roughly 8% by setting up conduits relative to on-balance sheet financing. We assume that banks could finance debt at close to the riskless rate, which is consistent with the rates paid on asset-backed commercial paper before the start of the financial crisis. Further assuming an equity beta of one and a market risk premium of 5%, banks could reduce the cost of capital by 8%*5%=0.004 or 40 basis points by setting up conduits relative to on-balance sheet financing.

It is difficult to estimate the profits generated by conduits because only a few banks report revenues from conduits. For example, Deutsche Bank reports in its annual report in December 2007 that conduits generated fees of Euro 6 million relative to a total commitment of Euro 6.3 billion. Similarly, Bank of New York Mellon reports in December 2006 revenues of $3 million relative to a commitment of $3.2 billion (Arteta et

al., 2008). Assuming that conduits have no costs and revenues are equal to profits, banks earned about 10 basis points on conduit assets.

Comparing this cost and benefit of conduits, it seems clear that conduits would not have been profitable if banks had been required to hold equity against their assets in conduits. In fact, banks would have made a loss of 30 basis points on each dollar invested. However, given that banks were not required to hold equity, they could earn a "profit" of 10 basis points. Conduits were thus a relatively low-return activity but offered a way for banks to attract money-market savings and increase bank size without increasing regulatory capital.

Table 13 lists the 30 largest conduit sponsors. We find that missing capital - the additional capital if conduit asset had been on bank balance sheet - was on average 6.1% of total equity or about $68 billion in total across banks. This is not necessarily a large amount of equity capital, but it masks considerable heterogeneity across banks as the proportion of missing capital ranges from 1.7% to 79.9% of capital levels. The bank with the largest exposure, Sachsen Landesbank, was the first large bank to be bailed out on 17 August 2007 because it was unable to provide the guarantees it had extended to its conduits. Other banks with large exposure such as Westdeutsche Landesbank and ABN Amro (later bought by Royal Bank of Scotland) also suffered large losses due to recourse from conduits and had to be bailed out. Hence, for some smaller banks the conduit activities were in fact large enough to wipe out the entire bank capital. For lager banks, conduit activities were small enough to withstand the losses on conduit assets, but these banks were weakened as the financial crisis continued.

In summary, we point out that an ex-ante capital requirement of 8% against conduit assets would not have been sufficient to cover all possible losses from conduits when the assets declined in value. However, the key observation is that a full capital charge would have been sufficient to discourage banks from setting up conduits in the first place.

6. Conclusion

In this paper we analyze asset-backed commercial paper conduits and show how the structure of risk-sharing in these conduits implies recourse back to bank balance-sheets. We find that outside investors who purchased asset-backed commercial paper had little loss even when collateral backing the conduits deteriorated in quality, supporting our main finding that conduits were a form of securitization without risk transfer. We also find that the stock price deterioration of banks at the start of the financial crisis was linked to the extent of their conduit exposure relative to equity capital. Once the crisis broke out, asset-backed commercial paper spreads rose and issuance fell, and more so where guarantees were weaker and sponsoring banks were weaker.

Our analysis makes it clear that from an economic standpoint conduits are "unregulated" banks that operate in the shadow banking world, but with recourse to regulated entities, mainly commercial banks, that have access to government safety net. Our results also indicate that when these unregulated banks do not have such recourse (extendible notes and SIVs), they struggle to survive a systemic crisis. While some may interpret this finding to justify the accordance of government safety net to all those parts of the shadow banking world that perform maturity mismatch like banks, the bigger

lesson in our view is that the shadow banking world needs to be brought under the purview of prudential regulations.

In particular, the structure of credit guarantees to asset-backed commercial paper conduits was designed by commercial banks to arbitrage regulatory capital requirements. Such possibilities – whereby government-insured banks effectively operate at higher leverage by putting assets off-balance sheet but granting them recourse – deserve regulatory scrutiny, especially when they operate at a scale that conduits did. Regulation should either treat off-balance sheet activities with recourse as on-balance sheet for capital requirement and accounting disclosure purposes, or, require that off-balance sheet activities do not have recourse to bank balance sheets. The current treatment appears to be a recipe for disaster, from the standpoint of transparency as well as capital adequacy of the financial intermediation sector as a whole.

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Figure 1: Asset-backed Commercial Paper Outstanding

This figure shows total asset-backed commercial paper outstanding in the U.S. market from January 2001 to April 2010. The figure is based on weekly data published by the Federal Reserve Board.

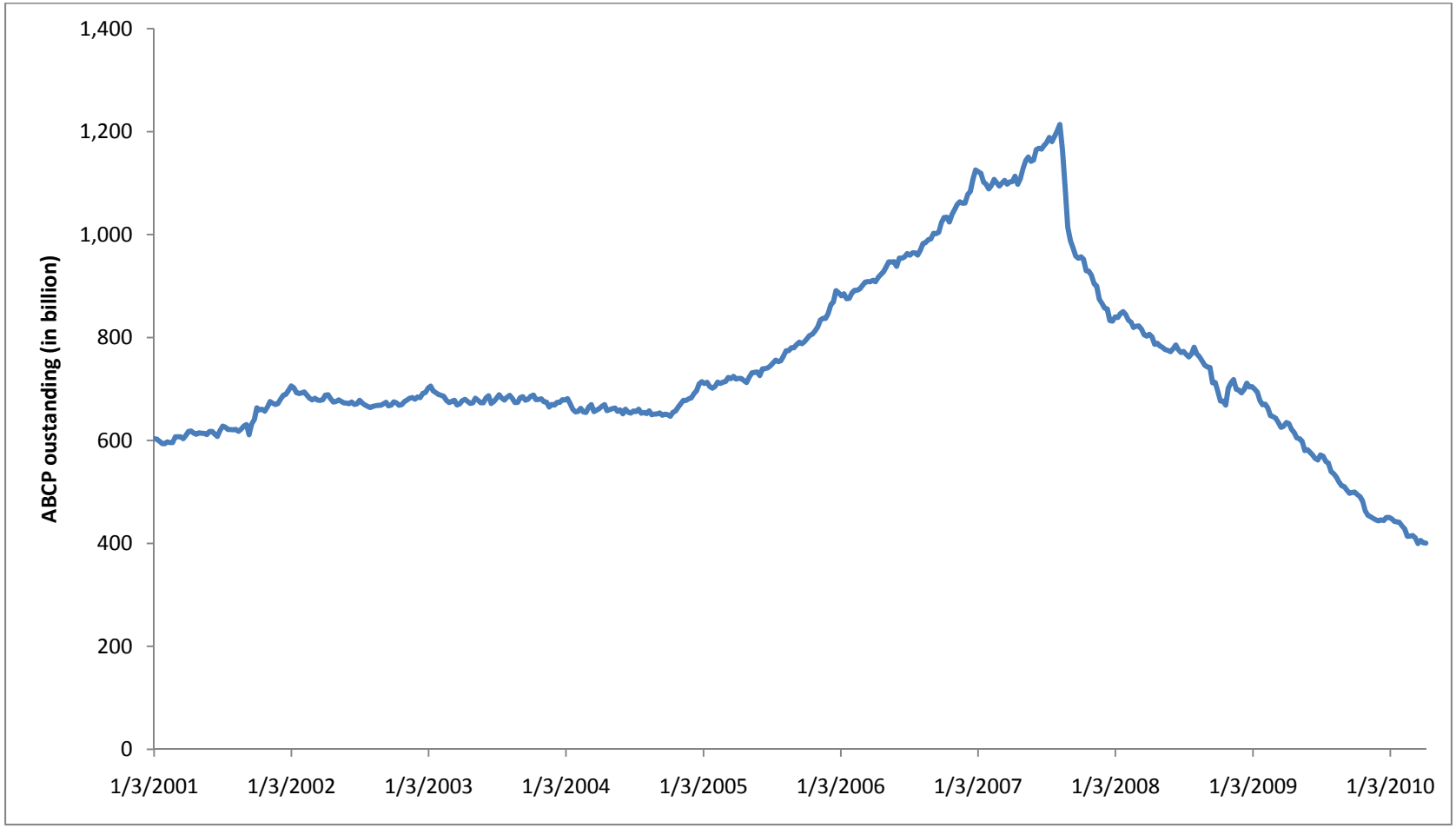

Figure 2: Asset-Backed Commercial Paper Spread

This figure shows the spread of overnight asset-backed commercial paper over the Federal Funds rate from January 2007 to August 2008. The figure is based on market data published by the Federal Reserve Board.

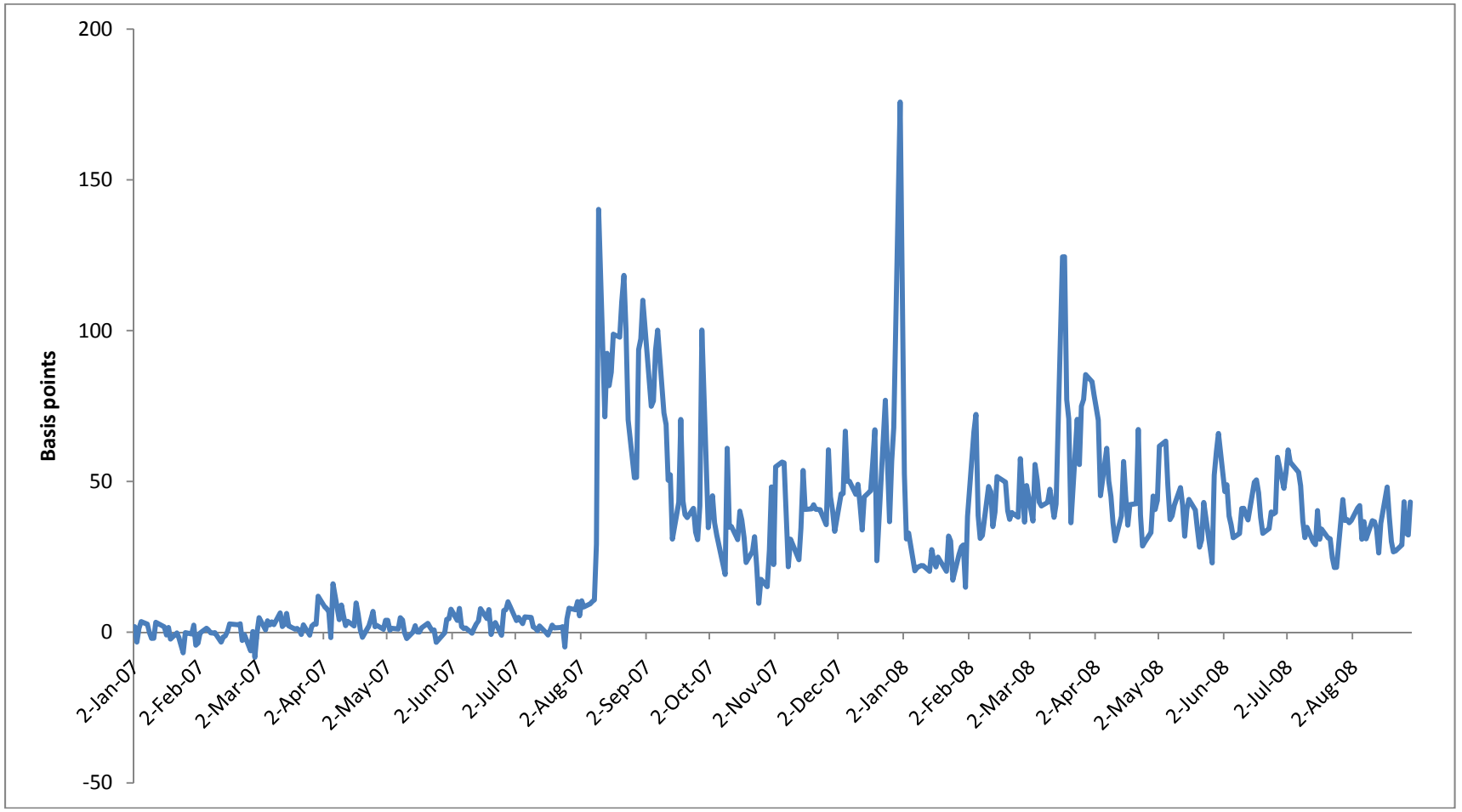

Figure 3: Conduit Structure

This figure illustrates how a conduit is related to its sponsors, outside investors, and asset sellers.

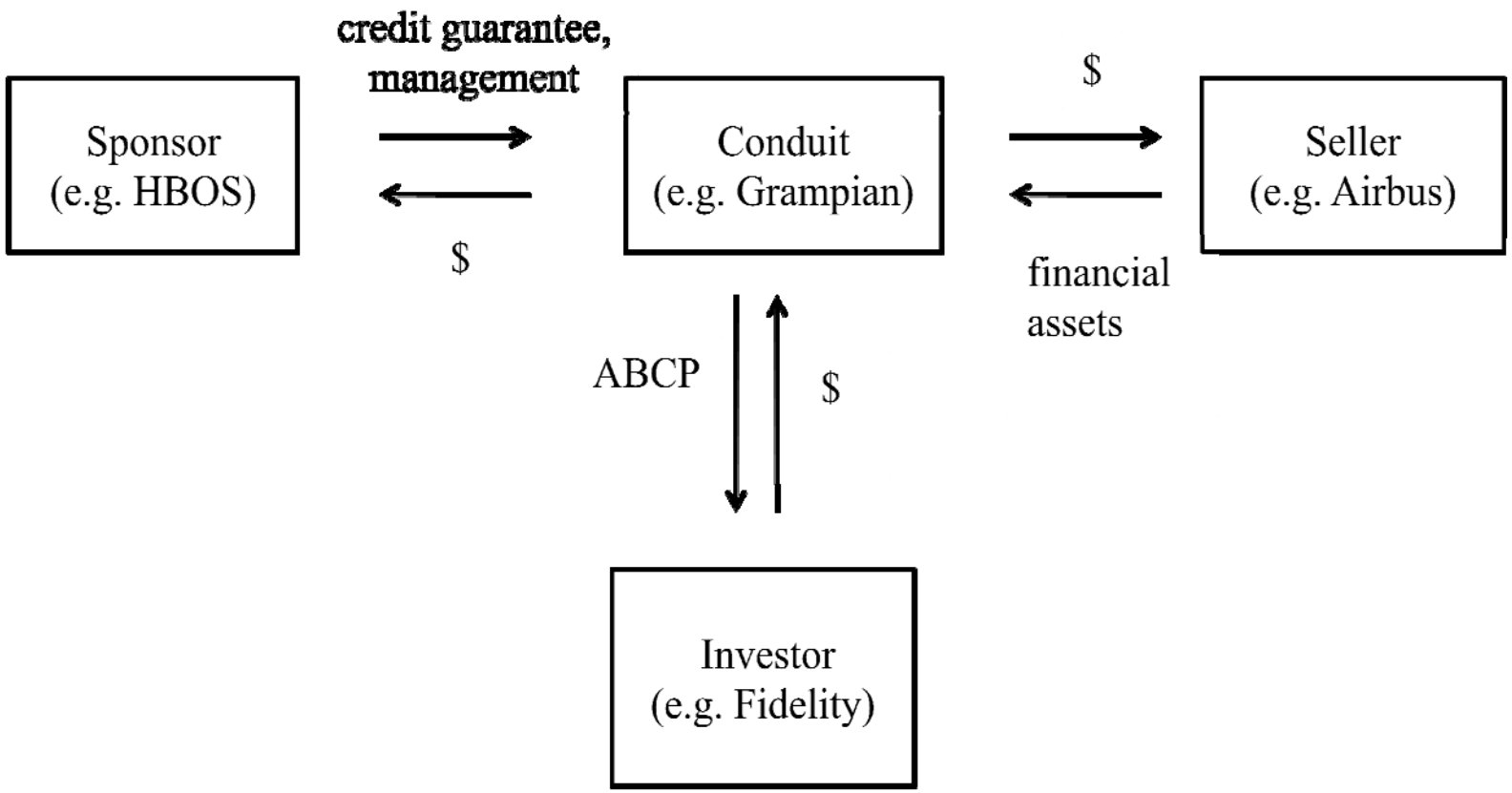

Figure 4: Capital regulation and ABCP outstanding

This figure shows total ABCP outstanding from January 2001 to December 2006. The figure also shows the timeline of regulatory decisions on regulatory capital required for guarantees provided to conduits. The references for the regulatory decisions are in the text.

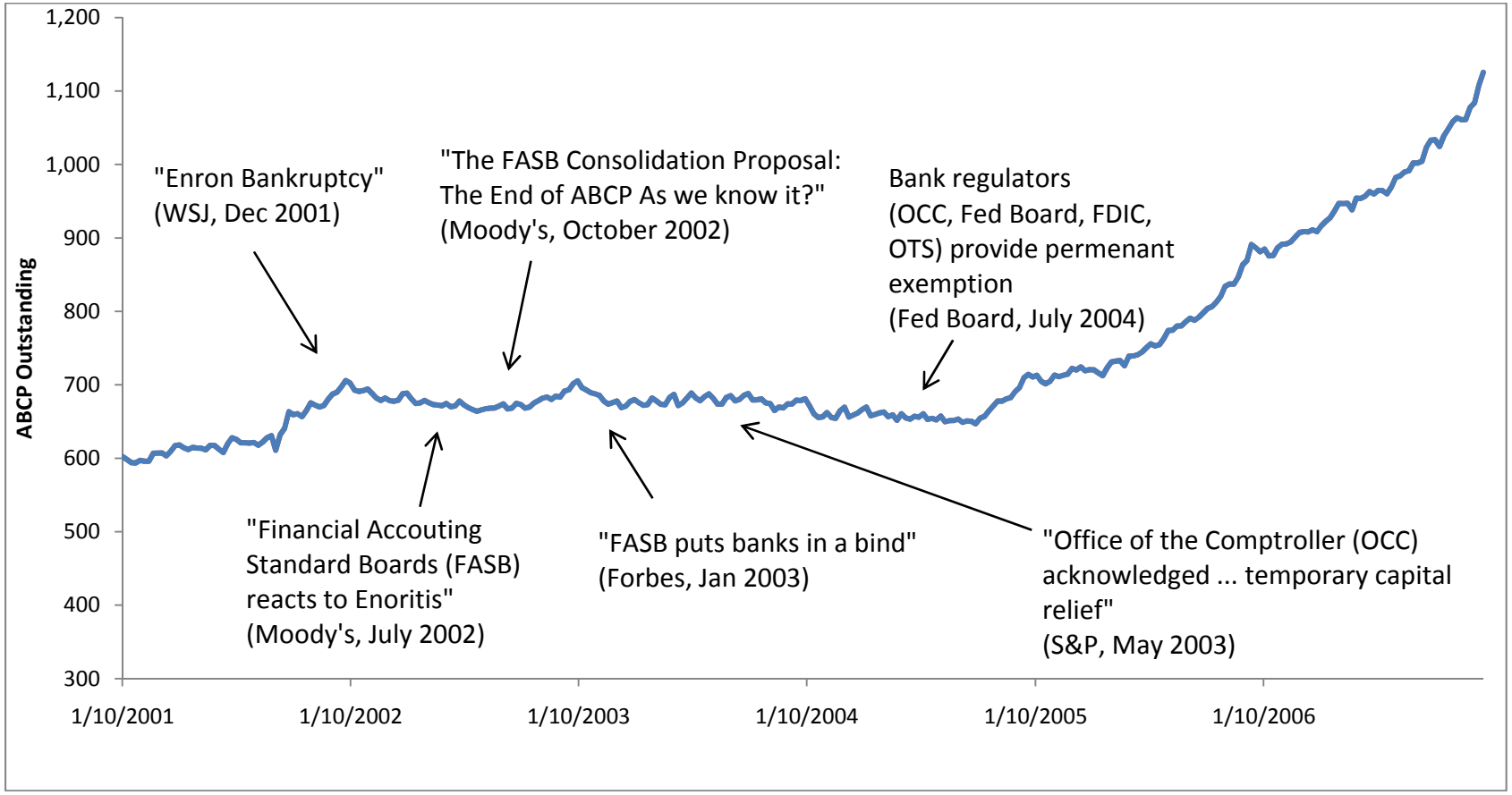

Figure 5: Asset-backed Commercial Paper Outstanding by Credit Guarantee

This figure shows the natural logarithm of asset-backed commercial paper outstanding by the type of credit guarantee three months before and three months after the BNP Paribas announcement (April 11, 2007 to December 12, 2007). Asset-backed commercial paper outstanding is normalized to zero as of one day before the BNP Paribas announcement (August 8, 2009). The figure is based on weekly data from DTCC and reports from Moody's Investors Service.

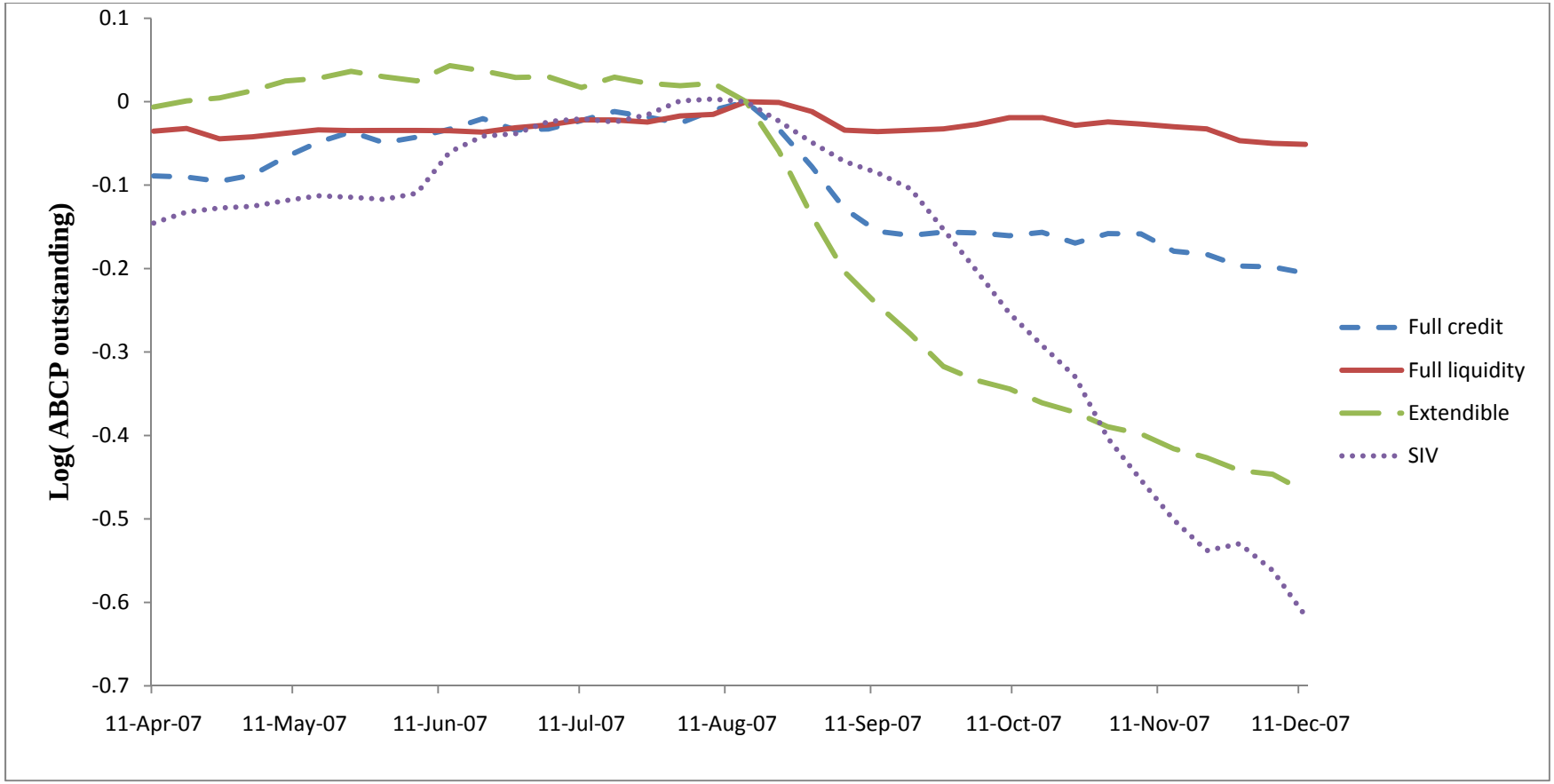

Figure 6: Asset-backed Commercial Paper Spreads by Credit Guarantee

This figure shows spreads of overnight asset-backed commercial paper over the Federal Funds rate by the type of credit guarantee three months before and three months after the BNP Paribas announcement (April 11, 2007 to December 12, 2007). The figure is based on weekly data from DTCC and reports from Moody's Investors Service.

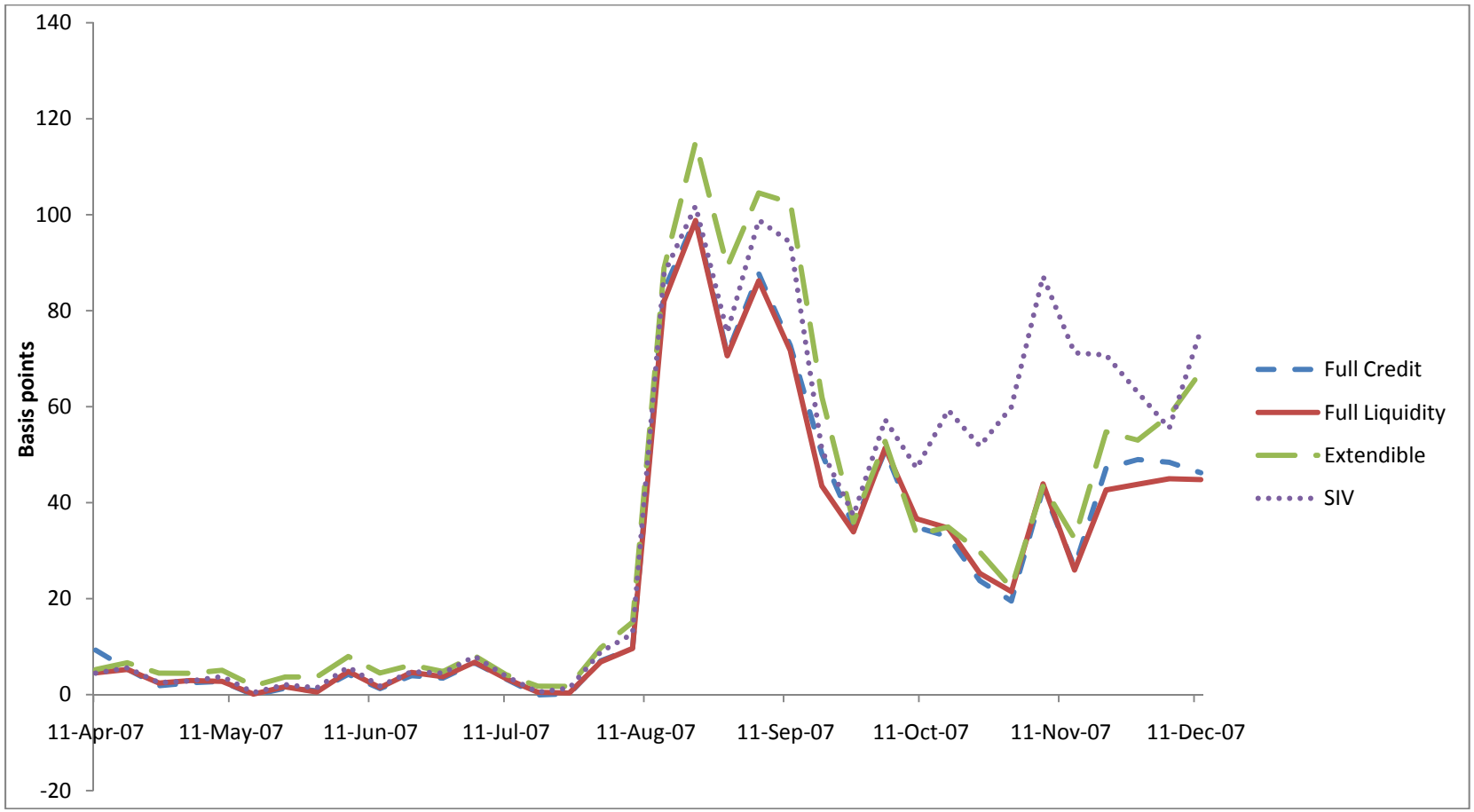

Table 1: Conduits and Sponsors

This table shows the ten largest conduits and sponsors as of 1/1/2007. The sample is restricted to bank-sponsored conduits. The information is collected from Moody's Rating Reports and Bankscope. "ABCP (bn)" denotes asset-backed commercial paper outstanding per conduit and sponsor, respectively. "Asset Origin," "Asset Rating," and "Asset Type" denote characteristics of the main asset class owned by a conduit.

Panel A: Ten Largest Conduits

Program Name	Sponsor	ABCP (bn)	Guarantee	Asset Origin	Asset Rating	Asset Type (Share %)
Grampian Funding	HBOS	37.9	Full Liquidity	United States	AAA	Residential Mortgages (36%)
Amstel Funding	ABN Amro	30.7	Full Liquidity	Netherlands	AAA	CDO/CLO (84%)
Scaldis Capital	Fortis Bank	22.6	Full Liquidity	United States	AAA	Asset backed securities (77%)
Sheffield Receivables	Barclays	21.4	Full Liquidity	n.a.	NR	Mortgages (43%)
Morrigan TRR	Hypo Public	18.9	Full Credit	n.a.	n.a.	Bonds (51%)
Cancara Asset	Lloyds	18.8	Full Liquidity	Great Britain	AAA	Residential Mortgages (43%)
Solitaire Funding	HSBC	18.5	Full Liquidity	United States	AAA	Residential Mortgages (45%)
Rhineland Funding	IKB	16.7	Full Liquidity	United States	AAA	CDO/CLO (95%)
Mane Funding	ING	13.7	Full Liquidity	n.a.	AAA	Asset backed securities (91%)
Atlantis One	Rabobank	13.5	Full Liquidity	United States	NR	Commercial Loans (100%)

Panel B: Ten Largest Sponsors

Sponsor	Country	ABCP (bn)	Assets (bn)	Tier 1 Capital (bn)	ABCP/Tier1 (%)	Tier1 Ratio (%)
Citigroup	United States	92.7	1,884.3	90.9	102.0%	8.6%
ABN Amro	Netherlands	68.6	1,300.0	31.2	219.5%	8.5%
Bank of America	United States	45.7	1,459.7	91.1	50.2%	8.6%
HBOS Plc	Great Britain	43.9	1,161.7	44.0	99.7%	8.1%
JP Morgan	United States	42.7	1,351.5	81.1	52.7%	8.7%
HSBC	Great Britain	39.4	1,860.8	87.8	44.9%	9.4%
Deutsche Bank AG	Germany	38.7	2,070.0	31.0	125.0%	8.5%
Société Générale	France	38.6	1,260.2	29.4	131.3%	7.8%
Barclays Plc	Great Britain	33.1	1,956.7	45.2	73.2%	7.7%
Rabobank	Netherlands	30.7	732.9	34.8	88.3%	10.7%

Table 2: Conduit and Sponsor Statistics

This table includes all conduits rated by Moody's Investors Service as of 1/1/2007. Panel A shows summary statistics by conduit. "Risk Transfer" refers to the guarantees provided by the sponsor. "Assets" is the main asset type as provided by Moody's Investors Service. "Currency" is the conduit's issuing currency. Panel B aggregates conduits by sponsor. "Sponsor Type" is the type of sponsoring institution. "Country of Origin" denotes the sponsor's headquarters.

Panel A: Conduits				
	Total		Per Conduit	
	# Conduits	Size (bn)	Mean	Std.
All Conduits	301	1,236.2	4.1	(5.1)
Risk Transfer				
Full Liquidity	163	752.9	4.6	(5.7)
Full Credit	55	159.9	2.9	(4.6)
Extendible Notes	55	230.9	4.2	(4.5)
SIV	28	92.6	3.3	(3.4)
Assets				
Asset-backed Securities	91	387.4	4.2	(5.9)
Loans	39	65.3	1.6	(2.4)
Receivables	88	436.7	3.5	(4.9)
Mixed asset categories	59	272.9	4.6	(5.3)
Other	24	74.0	4.9	(4.7)
Currency				
U.S. Dollar	233	973.0	4.2	(4.6)
Euro	33	220.0	6.7	(8.4)
Other	35	43.2	1.2	(1.6)
Panel B: Sponsors				
	Total		Per Sponsor	
	# Sponsors	Size (bn)	Mean	Std.
All Programs	127	1,236.2	9.7	(14.7)
Sponsor type				
Commercial Banks	67	911.4	13.6	(17.6)
Structured Finance	19	155.8	8.2	(13.7)
Mortgage Lender	18	75.5	4.2	(5.8)
Investment Manager	5	17.6	3.5	(3.3)
Investment Banks	4	11.0	2.7	(2.2)
Other	14	64.8	4.6	(6.2)
Country of Origin				
United States	67	491.8	7.3	(14.7)
Germany	15	204.1	13.6	(11.6)
United Kingdom	10	195.7	19.6	(17.0)
Other	35	344.5	9.8	(14.4)

Table 3: Asset-backed Commercial Paper by Sponsor Type and Guarantee

This table includes all conduits that were rated by Moody's Investors Service as of 1/1/2007. The 'Total' shows total asset-backed commercial paper outstanding as of 1/1/2007 per type of sponsor. The 'Guarantee' shows the breakdown of asset-backed commercial paper by type of credit guarantee.

	Total		Guarantee			
	# Sponsors	Size (bn)	Full Liquidity	Full Credit	Extendible	SIV
Commercial Banks	64	911.4	74.2%	10.9%	8.6%	6.3%
Structured Finance	19	155.8	7.0%	37.2%	34.7%	21.1%
Mortgage Lender	18	75.5	14.3%	0.0%	82.8%	2.9%
Investment Manager	5	17.6	0.0%	1.3%	98.7%	0.0%
Investment Banks	4	11.0	54.9%	0.0%	45.1%	0.0%
Other	14	64.8	74.8%	2.3%	22.9%	0.0%

Table 4: Conduits and Sponsor Statistics by Guarantee

This table reports the breakdown of asset-backed commercial paper (ABCP) outstanding by type of guarantee, sponsor, and main asset holdings for all conduits that were rated by Moody's Investors Service as of 1/1/2007. The column 'Total' shows total ABCP outstanding in dollars as of 1/1/2007 per type of guarantee: Full Liquidity, Full Credit, Extendibles, and Structured Investment Vehicles (SIVs). The column 'Spreads' shows the mean spread of overnight asset-backed commercial paper over the Fed funds rate in percentage points in the period from 1/1/2007 to 8/1/2007 per type of guarantee. The standard deviation is below in brackets. The column 'Sponsor' reports, for each type of guarantee, the percent of ABCP outstanding by type of sponsor: Banks, Structured Finance groups (SF), Mortgage Finance companies, and Other. The column 'Asset' reports, for each type of guarantee, the breakdown of ABCP outstanding by asset type: Asset-Backed Securities, Loans, Receivables, Mix of the previous categories, and Other.

Guarantee	Total (bn)	Spread (%)	Sponsor	%	Asset	%
Full Liquidity	752.9	0.010	Banks	89.9%	Asset-backed securities	29.2%
		(0.091)	SF	1.5%	Loans	3.7%
			Mortgage	1.4%	Mix	20.8%
			Other	7.2%	Other	3.6%
					Receivables	42.6%
Full Credit	159.9	0.025	Banks	62.4%	Asset-backed securities	10.2%
		(0.155)	SF	36.5%	Loans	0.5%
			Mortgage	1.1%	Mix	39.4%
			Other	0.0%	Other	11.9%
					Receivables	37.9%
Extendibles	230.9	0.017	Banks	33.8%	Asset-backed securities	28.8%
		(0.081)	SF	23.6%	Loans	15.6%
			Mortgage	27.1%	Mix	23.0%
			Other	15.6%	Other	8.5%
					Receivables	24.0%
SIV	92.6	0.022	Banks	61.8%	Asset-backed securities	91.3%
		(0.040)	SF	34.5%	Loans	8.7%
			Mortgage	2.4%	Mix	0.0%
			Other	1.4%	Other	0.0%
					Receivables	0.0%

Table 5: Effect of Guarantee on Asset-Backed Commercial Paper Outstanding

This table shows the effect of credit guarantees on asset-backed commercial paper outstanding. The sample covers the period April to December 2007. The dependent variable is the log of paper outstanding measured in millions of dollars at a weekly frequency. "Full Credit," "Extendible Notes," and" SIV" are indicator variables for the type of credit guarantee. The indicator variable "After" denotes dates after the crisis starting on August 9, 2007. "Receivables" ("Loans") is an indicator for variable conduits that report to Moody's Investors Service that the main type of asset in their portfolio are receivables (loans). Columns (4) to (8) include dummies for main type of asset type (Asset-Backed Securities (the omitted category), Loans, Receivables, Mix of the previous types, and Other) and their interaction with the "After" indicator. For compactness, we report the coefficient on "Receivables" and "Loans" only. Standard errors in brackets are clustered at the conduit level. * significant at 10%; ** significant at 5%; *** significant at 1%

	Log(ABCP outstanding)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Full Credit*After	-0.068	-0.062	0.061	-0.005	-0.026	-0.016	0.065	0.023
	(0.124)	(0.125)	(0.130)	(0.202)	(0.132)	(0.134)	(0.135)	(0.212)
Extendible*After	-0.725***	-0.748***	-0.880***	-0.681*	-0.750***	-0.775***	-0.818***	-0.683*
	(0.201)	(0.204)	(0.200)	(0.404)	(0.198)	(0.201)	(0.201)	(0.404)
SIV*After	-0.697***	-0.694***	-0.563***	-0.454	-0.575***	-0.570***	-0.451**	-0.391
	(0.156)	(0.157)	(0.157)	(0.290)	(0.168)	(0.169)	(0.176)	(0.330)
Receivables*After					0.179	0.184	0.198	0.211
					(0.175)	(0.174)	(0.155)	(0.244)
Loans*After					-0.742**	-0.789**	-0.556*	-0.507*
					(0.304)	(0.310)	(0.284)	(0.293)
After	-0.213**				-0.144			
	(0.084)				(0.158)			
Observations	7630	7630	7630	7630	7630	7630	7630	7630
R-squared	0.053	0.057	0.849	0.937	0.156	0.162	0.853	0.938
Time-fixed effects?	No	Yes	Yes	No	No	Yes	Yes	No
Sponsor-time-fixed effects?	No	No	No	Yes	No	No	No	Yes
Conduit-fixed effects?	No	No	Yes	Yes	No	No	Yes	Yes

Table 6: Effect of Sponsor Risk on Asset-Backed Commercial Paper Outstanding

This table shows the effect of sponsor risk on asset-backed commercial paper outstanding. The sample covers the period April to December 2007. The dependent variable is the log of paper outstanding measured in millions of dollars at a weekly frequency. "Full Credit," "Extendible Notes," and" SIV" are indicator variables for the type of credit guarantee. The indicator variable "After" denotes dates after the crisis starting in August 9, 2007. "CDS" is the CDS Spread of the sponsor. Columns (4) to (8) include all two-way interactions of "Sponsor CDS". Standard errors in brackets are clustered at the conduit level. * significant at 10%; ** significant at 5%; *** significant at 1%

	Log(ABCP outstanding)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Full Credit*After	0.032	0.036	0.068	0.037	-0.483	-0.598	-0.144	-0.147
	(0.151)	(0.152)	(0.148)	(0.211)	(0.418)	(0.432)	(0.222)	(0.294)
Extendible*After	-0.665*	-0.705**	-0.856**	-0.438	-0.464	-0.476	-0.525	-1.275*
	(0.345)	(0.356)	(0.385)	(0.438)	(0.424)	(0.433)	(0.456)	(0.746)
SIV*After	-0.577**	-0.576**	-0.489**	-0.535	-0.108	-0.174	0.233	0.19
	(0.222)	(0.224)	(0.229)	(0.336)	(0.497)	(0.486)	(0.511)	(0.724)
CDS*Full Credit*After					2.024*	2.267*	0.483	0.537
					(1.079)	(1.154)	(0.437)	(0.628)
CDS*Extendible*After					-0.983*	-1.032**	-0.529	3.023
					(0.510)	(0.510)	(0.358)	(1.737)
CDS*SIV*After					-1.733	-1.611	-1.569	-1.842
					(1.109)	(1.108)	(1.159)	(1.500)
After	-0.270***				-0.282			
	(0.085)				(0.172)			
Time-fixed effects?	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Conduit-fixed effects?	No	No	Yes	Yes	No	No	Yes	Yes
Sponsor-time fixed effects	No	No	No	Yes	No	No	No	Yes
Observations	4,448	4,448	4,448	4448	4,448	4,448	4,448	4,448
R-squared	0.141	0.147	0.844	0.909	0.153	0.362	0.849	0.912

Table 7: Effect of Guarantee on Overnight Asset-Backed Commercial Paper Spreads

This table shows the effect of guarantees on asset-backed commercial paper spreads. The sample covers the period April to December 2007. The dependent variable is the overnight asset-backed commercial paper spread over the Fed Funds rate in the primary market measured daily. The explanatory variables are defined the same way as in Table 5. Columns (4) to (8) include dummies for main type of asset type (Asset-Backed Securities (the omitted category), Loans, Receivables, Mix of the previous types, and Other) and their interaction with the "After" indicator. For compactness, we report the coefficient on "Receivables" and "Loans" only.. Standard errors shown are clustered at the conduit level. * significant at 10%; ** significant at 5%; *** significant at 1%

	Spread							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Full Credit*After	0.023	0.025	0.041	-0.004	-0.007	-0.004	-0.015	-0.1
	(0.055)	(0.055)	(0.058)	(0.103)	(0.054)	(0.054)	(0.054)	(0.077)
Extendible*After	0.129**	0.093**	0.135***	0.068	0.047	0.013	0.021	-0.119
	(0.054)	(0.047)	(0.050)	(0.110)	(0.063)	(0.057)	(0.061)	(0.214)
SIV*After	0.316***	0.254***	0.260***	0.315**	0.244**	0.196**	0.166	0.245**
	(0.099)	(0.082)	(0.093)	(0.132)	(0.108)	(0.091)	(0.109)	(0.107)
Loan*After					0.216	0.215	0.122	0.437***
					(0.165)	(0.165)	(0.172)	(0.105)
Receivables*After					-0.142*	-0.128	-0.164**	-0.162
					(0.076)	(0.079)	(0.077)	(0.106)
After	0.474***				0.484***			
	(0.026)				(0.072)			
Observations	14,862	14,862	14,862	14,862	14,862	14,862	14,862	14,862
R-squared	0.444	0.717	0.843	0.952	0.493	0.766	0.865	0.960
Time-fixed effects?	No	Yes	Yes	No	No	Yes	Yes	No
Sponsor-time-fixed effects?	No	No	No	Yes	No	No	No	Yes
Conduit-fixed effects?	No	No	Yes	Yes	No	No	Yes	Yes

Table 8: Effect of Sponsor Risk on Overnight Asset-Backed Commercial Paper Spreads

This table shows the effect of credit guarantees on asset-backed commercial paper spreads. The sample covers the period April to December 2007. The dependent variable is the asset-backed commercial paper spread on overnight commercial paper in the primary market measured daily. The explanatory variables are defined the same way as in Table 6. Columns (4) to (8) include all two-way interactions of "Sponsor CDS". Standard errors shown are clustered at the conduit level. * significant at 10%; ** significant at 5%; *** significant at 1%

	Overnight spread							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Full Credit*After	-0.098	-0.1	-0.038	-0.074	-0.03	-0.088	-0.05	-0.105
	(0.073)	(0.072)	(0.072)	(0.123)	(0.082)	(0.095)	(0.081)	(0.111)
Extendible*After	0.191	0.083	0.215**	0.186	-0.216***	-0.190***	0.016	0.26
	(0.127)	(0.089)	(0.108)	(0.148)	(0.059)	(0.051)	(0.262)	(0.434)
SIV*After	0.205*	0.163*	0.182**	0.305***	0.389***	0.256*	0.280**	0.410***
	(0.112)	(0.087)	(0.091)	(0.114)	(0.141)	(0.152)	(0.115)	(0.137)
CDS*Full Credit*After	0.466***				-0.240*	-0.016	0.054	0.229
	(0.032)				(0.122)	(0.117)	(0.180)	(0.200)
CDS*Extendible*After					0.823***	0.550***	0.328	-0.3
					(0.192)	(0.072)	(0.319)	(0.731)
CDS*SIV* After					-0.572	-0.268	-0.273	-0.254
					(0.394)	(0.320)	(0.259)	(0.263)
After	-0.270***				0.471***			
	(0.085)				(0.035)			
Time-fixed effects?	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Conduit-fixed effects?	No	No	Yes	Yes	No	No	Yes	Yes
Sponsor-time fixed effects	No	No	No	Yes	No	No	No	Yes
Observations	9510	9510	9510	9510	9510	9510	9510	9510
R-squared	0.401	0.676	0.839	0.932	0.408	0.68	0.84	0.932

Table 9: Estimated Losses for Sponsors and Outside Investors

This table shows the ex-post risk transfer by credit guarantee. "Pre-crisis" denotes total asset-backed commercial paper outstanding as of 7/1/2007. Post-crisis denotes the value-weighted share that is "Active" (conduit continues to issue), "Repaid" (conduit closed and repaid investors), and "In Default" (Conduit closed and investor not repaid). "Estimated losses" estimates the losses of sponsor and outside investors assuming a recovery rate on conduit assets of 95% and 85%, respectively.

	Pre-Crisis	Post-Crisis			Estimated Loss (bn)			
					Loss rate: 5%		Loss rate 15%	
	ABCP (bn)	Active	Repaid	In Default	Sponsor	Investor	Sponsor	Investor
All	1,395.50	76.60%	20.80%	2.50%	68.0	1.7	204.1	5.2
Risk Transfer					0.0	0.0	0.0	0.0
Full Liquidity	844	87.90%	12.10%	0.00%	42.2	0.0	126.6	0.0
Full Credit	204.2	70.90%	29.10%	0.00%	10.2	0.0	30.6	0.0
Extendibles	243.1	47.00%	45.50%	7.40%	11.3	0.9	33.8	2.7
SIV	104.1	65.70%	17.70%	16.60%	4.3	0.9	13.0	2.6
Sponsor Type					0.0	0.0	0.0	0.0
Commercial Bank	1,035.60	83.00%	16.40%	0.60%	51.5	0.3	154.4	0.9
Structured Finance	199.2	58.10%	36.40%	5.50%	9.4	0.5	28.2	1.6
Mortgage Lender	60.2	44.50%	40.20%	15.30%	2.5	0.5	7.6	1.4
Other	100.4	63.30%	24.40%	8.90%	4.6	0.4	13.7	1.3

Table 10: Event Study Summary Statistics

This table shows summary statistics by conduit exposure. We sort banks in three groups: bank with no conduit exposure, banks with low conduit exposure, and banks with high conduit exposure. We restrict the sample to commercial banks that (i) are among the 300 largest financial institutions, (ii) are located in the Europe or the United States, and (iii) have share price data available. We measure 'Stock Return' as the total stock return in the three-day window from August 8,2007, to August 10, 2007, 'Exposure' is the asset-backed commercial paper outstanding relative to equity, 'Log Assets' is the natural logarithm of assets, 'Log Equity' is the natural logarithm of equity, 'Equity Ratio' is equity as share of assets, 'Share Deposits' is deposits as share of assets, and 'Share Short-Term Debt' is short-term debt as share of assets. All variables are measured as of January 1, 2007. 'United States' is an indicator variable whether a bank is headquartered in the United States.

		Conduit Exposure		
Sample:	All	No	Low	High
	(1)	(2)	(3)	(4)
Stock return Aug 8th - Aug 10th	-0.004	0.007	-0.028	-0.046
	(0.052)	(0.055)	(0.024)	(0.026)
Conduit Exposure	0.169	0.000	0.248	1.199
	(0.532)	0.000	(0.131)	(1.155)
Log(Assets)	3.961	3.154	6.379	6.325
	(2.284)	(1.987)	(1.077)	(1.280)
Log(Equity)	1.355	0.670	3.671	3.025
	(2.043)	(1.832)	(0.877)	(1.161)
Equity Ratio	0.091	0.101	0.076	0.043
	(0.099)	(0.111)	(0.038)	(0.026)
Share Deposits	0.602	0.63	0.530	0.504
	(0.208)	(0.223)	(0.112)	(0.145)
Share Short-Term Debt	0.073	0.050	0.122	0.167
	(0.084)	(0.050)	(0.117)	(0.129)
US Indicator Variable	0.542	0.613	0.400	0.250
	(0.501)	(0.490)	(0.507)	(0.452)
N	107	80	15	12

Table 11: Effect of Conduit Exposure on Stock Returns (August 8, 2007 – August 10, 2007)

This table shows the effect of conduit exposure on stock return. We restrict the sample to commercial banks that (i) are among the 300 largest financial institutions (ii) are located in the Europe or the United States, and (iii) have share price data available. The dependent variable is the total stock return over the three-day period from August 8, 2007 to August 10, 2007. We measure 'Conduit Exposure' as asset-backed commercial paper relative to equity. Columns (2) to (6) include control variables for the ratio of short-term assets to debt, the ratio of equity to assets, log(Assets) and log(Equity). All control variables are measured as of January 1, 2007. Column (6) includes fixed effects for Germany, Great Britain, and the United States. Robust standard errors are in parentheses below coefficients. * significant at 5%; ** significant at 1%

	Dependent Variable: Stock Return					
	(1)	(2)	(3)	(4)	(5)	(6)
Conduit Exposure	-0.026	-0.014	-0.011	-0.013	-0.014	-0.015
	(0.007)**	(0.004)**	(0.003)**	(0.003)**	(0.003)**	(0.004)**
Log(Assets)		-0.007	-0.022	-0.024	-0.027	0.005
		(0.005)	(0.008)**	(0.008)**	(0.009)**	-0.015
Log(Equity)		-0.004	0.012	0.013	0.015	-0.016
		(0.007)	(0.009)	(0.009)	(0.009)	(0.015)
Equity-Assets Ratio			-0.099	-0.103	-0.137	-0.006
			(0.029)**	(0.031)**	(0.037)**	(0.065)
Share Short Term Debt				0.066	0.063	0.039
				(0.041)	(0.041)	(0.042)
Share Deposits					-0.027	-0.017
					(0.017)	(0.026)
Constant	0.000	0.033	0.079	0.082	0.111	0.036
	(0.005)	(0.015)*	(0.025)**	(0.026)**	(0.032)**	(0.042)
Country FE	N	N	N	N	N	Y
Observations	107	107	107	107	107	107
R-squared	0.068	0.277	0.289	0.297	0.303	0.359

Table 12: Conduit Exposure and Stock Return in Months before Start of Financial Crisis (January to August 2007)

This table shows the effect of conduit exposure on stock return in the months before the start of the financial crisis. We restrict the sample to commercial banks that (i) are among the 300 largest financial institutions, (ii) are located in the Europe or the United States, and (iii) have share price data available. The dependent variable is the total stock return for the month indicated at the top of each column. We measure 'Conduit Exposure' as bank-sponsored ABCP outstanding relative to equity. All columns include control variables for the ratio of short-term assets to debt, the ratio of equity to assets, log(Assets), and log(Equity), and geographic controls. All control variables are measures on 1/1/2007. Robust standard errors are in parentheses below coefficients. * significant at 5%; ** significant at 1%

	Dependent Variable: Stock Return							
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure	0.008	-0.006	0.003	-0.005	0.004	0.006	0.014	-0.029
	(0.012)	(0.005)	(0.005)	(0.009)	(0.010)	(0.008)	(0.011)	(0.009)**
Log(Assets)	-0.026	-0.03	-0.033	-0.005	-0.042	-0.012	-0.037	-0.006
	(0.024)	(0.018)	(0.023)	(0.024)	(0.021)	(0.021)	(0.032)	(0.025)
Log(Equity)	0.033	0.031	0.029	0.02	0.043	0.01	0.043	-0.002
	(0.024)	(0.018)	(0.024)	(0.023)	(0.021)*	(0.022)	(0.031)	(0.026)
Equity-Assets Ratio	-0.058	-0.117	-0.134	0.016	-0.2	0.105	-0.098	-0.058
	(0.120)	(0.082)	(0.099)	(0.112)	(0.110)	(0.078)	(0.172)	(0.115)
Share Short Term Debt	-0.036	-0.081	0.096	0.078	-0.064	0.064	0.012	0.029
	(0.044)	(0.041)	(0.050)	(0.072)	(0.090)	(0.048)	(0.071)	(0.106)
Share Deposits	-0.053	-0.013	-0.005	-0.021	-0.055	0.071	0.057	0.008
	(0.036)	(0.028)	(0.035)	(0.046)	(0.052)	(0.056)	(0.086)	(0.052)
Constant	0.08	0.092	0.168	0.04	0.149	-0.077	0.082	0.009
	(0.067)	(0.051)	(0.059)**	(0.066)	(0.059)*	(0.050)	(0.092)	(0.068)
Country FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	107	107	107	107	107	107	107	107
R-squared	0.648	0.337	0.376	0.522	0.301	0.196	0.295	0.258

Table 13: Missing Capital

This table lists the 30 largest banks sponsors of ABCP as of 1/1/2007. For each bank, we compute the required capital assuming ABCP requires a capital charge of 8%, i.e. ABCP*0.08=Total, expressed in billions of US dollars.. We also compute the 'missing capital' as a share of a bank's equity. We measure equity as Tier 1 Capital. If a bank does not report Tier 1 Capital, we multiply shareholder equity with the average Tier 1/equity shareholder ratio of banks that report both shareholder equity and Tier 1 ratio.

			Missing Capital	
Name	Tier 1	ABCP	Total	%
Citigroup Inc	90.9	92.672	7.4	8.2%
ABN Amro Holding NV	31.2	68.575	5.5	17.6%
Bank of America Corporation	91.1	45.691	3.7	4.0%
HBOS Plc	44.0	43.9	3.5	8.0%
JP Morgan Chase & Co.	81.1	42.714	3.4	4.2%
HSBC Holdings Plc	87.8	39.426	3.2	3.6%
Deutsche Bank AG	31.0	38.736	3.1	10.0%
Société Générale	29.4	38.639	3.1	10.5%
Barclays Plc	45.2	33.07	2.6	5.9%
Mitsubishi UFJ Financial Group	68.5	32	2.6	3.7%
Rabobank Nederland	34.8	30.773	2.5	7.1%
WestLB AG	9.5	29.946	2.4	25.1%
ING Groep NV	54.3	26.417	2.1	3.9%
Dresdner Bank AG	18.7	23.191	1.9	9.9%
Fortis	16.4	22.596	1.8	11.0%
Bayerische Landesbank	15.8	22.352	1.8	11.3%
Bayerische Hypo-und Vereinsbank AG	14.1	22.263	1.8	12.6%
State Street Corporation	24.1	21.855	1.7	7.2%
Crédit Agricole S.A.	6.5	19.48	1.6	24.1%
Hypo Real Estate Holding AG	4.5	18.931	1.5	33.4%
Lloyds Banking Group Plc	6.1	18.782	1.5	24.6%
Countrywide Financial Corporation	25.2	18.305	1.5	5.8%
GMAC LLC	15.4	17.539	1.4	9.1%
Royal Bank of Scotland	75.2	15.847	1.3	1.7%
Royal Bank of Canada RBC	52.3	15.602	1.2	2.4%
Bear Stearns Companies LLC	19.1	13.845	1.1	5.8%
KBC Group	22.9	12.606	1.0	4.4%
Sachsen Landesbank	1.3	12.528	1.0	79.9%
BNP Paribas	62.3	11.647	0.9	1.5%
Bank of Montreal	45.3	11.528	0.9	2.0%
Total	1,124.0	861.5	68.9	6.1%

MANUFACTURING TAIL RISK:

A PERSPECTIVE ON THE FINANCIAL CRISIS OF 2007-09

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ABSTRACT: *We argue that the fundamental cause of the financial crisis of 2007-09 was that large, complex financial institutions ("LCFIs") took excessive leverage in the form of manufacturing tail risks that were systemic in nature and inadequately capitalized. We employ a set of headline facts about the build-up of such risk exposures to explain how and why LCFIs adopted this new banking model during 2003-2Q 2007, relative to earlier models. We compare the crisis to other episodes in the United States, in particular, the panic of 1907, the failure of Continental Illinois and the Savings and Loan crisis. We conclude that several principal imperfections, in particular, distortions induced by regulation and government guarantees, developed in decades preceding the current one, allowing LCFIs to take on excessive systemic risk. We also examine alternative explanations for the financial crisis. We conclude that while moral hazard problems in the originate-and-distribute model of banking, excess liquidity due to global imbalances and mispricing of risk due to behavioral biases have some merit as candidates, they fail to explain the complete spectrum of evidence on the crisis.*

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I. INTRODUCTION

There is virtually universal agreement that the fundamental cause of the global economic and financial crisis of 2007-09 was the combination of a credit boom and a housing bubble. In the five-year period covering 2002-2007, the ratio of debt to national income in the United States increased from 3.75 : 1 to 4.75 : 1. It had taken the whole preceding decade to produce an increase in aggregate debt of this magnitude. Moreover, from 2002 to 2007, house prices grew at an unprecedented rate of 11 percent per year. Why? With the benefit of hindsight, an extraordinary flood of liquidity and accommodative monetary policy that ignored asset prices produced extraordinarily low expected real interest rates. This appeared to have left investors scrambling for "alpha" – the so-called "search for yield" – that encouraged all kinds of borrowers to use maximum leverage. Households, corporations, financial firms, investors, and even countries borrowed heavily. When the "bubble" burst, a severe economic crisis was bound to come. At the household level, families whose homes were highly leveraged and whose equity represented 35 percent of their wealth would not be able to consume as they did through 2007. The real economy was bound to feel the brunt of the inevitable correction.

It is much less clear, however, why this combination of events led to such a severe financial crisis -- why we had such widespread and sometimes catastrophic failures of financial institutions along with the freezing-up of capital markets. The systemic crisis that ensued reduced the supply of capital to creditworthy institutions and individuals, resulted in a sudden sharp decline in global trade and production, and amplified the effects on the real economy worldwide.

We argue that what made the this economic shock unique, and led to such a severe financial crisis was the behavior of many of the large, complex financial institutions (LCFIs) — the universal banks and financial conglomerates, investment banks, insurance companies, and (in rare cases) even hedge funds — that today dominate the financial industry. These LCFIs ignored their own business model of securitization and chose *not* to transfer credit risk to other investors. Instead, they employed securitization to manufacture and retain tail risk that was systemic in nature and inadequately capitalized. Institutions matter, and in this case the robustness of the financial architecture built over two decades or so showed severe weaknesses.

The legitimate and valuable purpose of securitization is to spread risk. It does so by removing large concentrations of risk from the balance sheets of financial institutions, and placing small concentrations into the hands of a large number of investors who get paid an acceptable price for bearing that risk. But especially from 2003 to 2007, the main purpose of securitization appeared not to have been to share risks with investors, but to make an end-run around capital-adequacy regulations applied to financial intermediaries. The net result was to keep the risk concentrated in the financial institutions themselves — and, indeed, to keep that risk at a greatly magnified level because of the overleveraging that it allowed. When the risk actually materialized – the housing bubble burst – these institutions experienced wholesale failures, resulting in the greatest systemic crisis we have seen since the Great Depression.

Our assessment can be restated in a different way. It is now well recognized that given limited liability, levered firms have incentives to shift the profile of their assets towards higher risk (the so-called "risk-shifting" argument of Jensen and Meckling, 1976). Left to market devices, agency costs arising due to these incentives should be priced by creditors. In turn, the firms should have incentives to limit agency costs *ex ante*. In this view, all outcomes are

assumed to be second best in equilibrium. However, this view needs to be refined for financial firms, since they have an important set of creditors - the government and the taxpayer - as a consequence of implicit and explicit subsidies. Government guarantees are often not priced fully (or at all). This distorts financial firms' cost of capital and their capital budgeting, inducing a preference for higher risk and higher leverage. Recognizing this moral hazard problem, regulation such as capital requirements are put in place.

As a result, the objective function of financial firms can be viewed as maximizing shareholder value given the mis-pricing of agency costs in government guarantees and subject to capital adequacy requirements. While these firms can maximize their objective functions by enhancing overall value, that is, taking positive net present value investments, they can also circumvent capital requirements if regulation is lax and the resulting "regulatory arbitrage" is opaque and complex enough that markets cannot fully price the resulting agency costs. Viewed in this perspective, LCFI behavior during 2003-07 clearly shows profit maximization by extensively exploiting gaps in the regulatory constraint rather than by undertaking positive net present value investments. The end result was the classic excessive leverage build-up in the financial sector. But since the manner in which such gaps were exploited was complex and opaque, the crisis that resulted was not well-anticipated by markets and led to severe spillovers to both financial and real sectors of the economy.

Section II of this paper begins with a brief history of how the U.S. financial system evolved into its current form. We pay special attention to the risk-taking incentives of financial institutions and the breakdown of the regulatory system-wide protections that had emanated from the experience of the Great Depression.

Section III proposes a set of headline facts about the precise manner in which banks built tail (systemic) risk exposures during 2003-2Q 2007 in large measure to get around capital requirements, in contrast to their earlier business models. We explain how lax regulation contributed to these outcomes, especially during the 2003-05 period.

In light of these headline facts, Section IV examines alternative explanations for the financial crisis: (1) Failure of the originate-and-distribute model, and the role played by rating agencies; (2) Panics in response to efficient securitization undertaken by the financial sector; (3) Global imbalances; (4) "Animal spirits" and mispricing of risks; (5) Loose monetary policy, especially in the United States; and, (6) Illiquidity-induced crisis (rather than an insolvency-induced one). By and large, we conclude that global imbalances and loose monetary policy were relevant proximate contributors to the crisis by producing an asset-price bubble in the United States that ultimately led to the large negative economic shock; concomitantly, the contemporaneous business model of LCFIs to concentrate tail risks on their balance-sheets rather than distribute them translated the economic shock into a full-blown crisis in the financial sector which was soon transferred to the real sector. We explain why none of the other alternative explanations does much to help explain the complete spectrum of available evidence on risks undertaken by banks.

Section V provides concluding remarks and a brief discussion of possible remedies to charge banks for manufacturing tail risks and to contain such propensity in the first place. Though we focus on the United States for most of our discussion, we also discuss risk-taking and realized losses by LCFIs in other parts of the world. This latter discussion is contained in Section IV, where we consider the role of global imbalances, and in a separate Appendix.

II. HOW DID WE GET THERE?

Financial crises have many common features. Preceding any crisis, there is almost invariably some sort of asset price bubble, a corresponding credit boom, and large capital inflows into the economy (see, for example, Reinhart and Rogoff (2008)). This is not too surprising. A financial crisis by definition involves a precipitous drop in nominal wealth and an increase in volatility, which widen credit spreads. That said, it remains likely that, while these characteristics are necessary, they are not sufficient to define a true financial crisis. Its severity fundamentally depends on the underlying financial sector's exposure to such conditions together with the overall market's uncertainty about the financial sector's exposure to the developments at hand.

This section maps out how the U.S. financial system got to the point at which the crisis of 2007-2009 emerged. We begin a century earlier, with the panic of 1907.

A. The Panic of 1907 and Its Aftermath

The panic of 1907 was triggered in the curbside "shadow" stock market that was organized outside the New York Stock Exchange (NYSE).[2] Many companies were traded literally on the street curb in a vibrant market that eventually became the American Stock Exchange. Why? Because the market was more efficient and more accessible than the NYSE at the time. In October of 1907, two brothers, Augustus and Otto Heinze, tried to corner the market in United Copper Company stock by executing a short squeeze. Their scheme failed, and the price of United Copper plummeted. The Heinze brothers who had hatched the scheme turned out to have been heavily involved with a number of banks and brokerages. When their curb market scheme collapsed, it quickly raised concerns about the safety of the banks that had lent the money to

[2] The best recent account of the Panic of 1907 is Bruner and Carr (2007).

back their scheme. Within days a state bank in Montana owned by Augustus Heinze failed. Augustus was also President of the Mercantile National Bank of New York at the time, and was forced to resign because of his association with the corner and the failed Montana Bank. News of his resignation immediately created a panic that caused a run on the Mercantile Bank.

The panic spread and led to pressure on other banks' stocks and deposits in those banks – a classic case of contagion. Noteworthy was the Knickerbocker Trust Co., the third largest trust bank in New York, whose President Charles Barney was suspected of having helped to finance the Heinze scheme. The run on the Knickerbocker Trust Co. forced it to close its doors and suspend operations. Charles Barney committed suicide not long after. The panic continued to spread to other trust companies and, within days, a large number of banks had failed.

The problem that faced banks - and financial markets more broadly at the time - was the contradiction inherent in fractional reserve banking. All such institutions were engaged in intermediation of one form or another with less than 100% reserves. When depositors became concerned and demanded their money back, even solvent financial institutions could find their cash and gold reserves insufficient to meet demands for cash and were forced to shut their doors. The institutions that had evolved (see Gorton, 1985) to address the problem of temporary liquidity shortages were bank clearing house associations that pooled resources to provide liquidity to individual members in times of stress and perform many of the functions of a central bank. But two problems emerged in this arrangement during the Panic of 1907. The first was that a private clearinghouse association can itself face the risk of default. The second was that trust companies in New York were excluded from membership in the banks' Clearing House Association.

Some calm was restored during the 1907 panic by the intervention of J.P. Morgan, who assumed a central role in trying to prevent it from spreading. Morgan had examined the books of the Knickerbocker Trust and concluded it was insolvent and had to be closed. When the panic spread to the Trust Company of America it too turned to Morgan for help. He and his associates concluded that the bank was indeed solvent, but would need a great deal of liquidity to survive. Morgan met with other bankers, the Secretary of the Treasury and John D. Rockefeller, and convinced them to work together to stop the panic.

The joint effort turned out to be successful in the short run. Morgan had temporarily saved the day, but that was not the end of his intervention. Short-term loans were unavailable. Call money rates soared to 60% and more, and no loans took place. The troubles of the banks spread to the stock exchange, which lost 48% of its value in a matter of weeks. Many prominent brokerages were threatened with collapse. New York City was on the verge of bankruptcy. And, within a short time the Trust Companies themselves were again on the verge of collapse. J.P. Morgan invited the most prominent banking and trust company leaders to a meeting at his home and, famously, locked them in the library until they agreed to a plan to help the weakest of their members through the crisis.

There were many lessons to be learned from the Panic of 1907, most notably concerning liquidity and capital, which would play out over the next quarter century and remained trenchant a hundred years later. On the liquidity front, it became accepted that there needed to be a credible lender of last resort who can restore trust in the system and its institutions. And on the capital front, it was realized that since information regarding solvency of financial institutions is

difficult to gather and incredibly valuable, if there is no institution to provide it, the risk of bank runs is high.

Essentially starting with the Panic of 1907 and carrying through the banking crisis of August 1914, the stock market crash of 1929, and the banking panics of 1930, 1931 and early 1933, what emerged was a complete overhaul of the U.S. financial system. While the Federal Reserve - and its role as the lender of last resort - was created in 1913, the majority of the changes were enacted in 1933 and 1934.[3] These regulatory initiatives were enacted precisely because policymakers recognized that the severity of the banking crisis and the ensuing period, commonly referred to as the Great Depression, were inexorably inter-related.

Specifically, the 1929 stock market crash, the collapse of production and wealth that followed, and the continued volatility of financial markets in the 1930s, led consumers and businesses to dramatically reduce spending, caused extraordinarily high bankruptcy rates among businesses, and brought about the disappearance by failure or acquisition of nearly half of all American financial institutions, often involving classis bank runs triggered by suspected insolvency. These came in the form of three separate waves of banking panics during 1930-33. The economic forces that created and perpetuated the Great Depression have been much discussed and debated, and we will simply note here a general consensus that the contractionary monetary policies that the Federal Reserve Board pursued at the time were a contributory factor in the banking crises and their real-sector consequences (Friedman and Schwartz, 1971). Prices of goods and services fell approximately 25 percent between 1929 and 1933. This in turn led to debt deflation, a phenomenon by which the collateral underlying loans shrinks in value, causing

[3] Friedman and Schwartz (1971) and Meltzer (2004).

the real burden of debt to rise, leading the economy to spiral further downward (Bernanke, 2000).

Policymakers at the time recognized that, even with the liquidity backstop by the government, the problem with the U.S. financial system was that uncertainty about insolvency (i.e., bank capital) could cause a run on the system. The Banking Act of the 1933 solved the uncertainty problem that led to bank runs by providing deposit insurance through the creation of the Federal Deposit Insurance Corporation (FDIC). Depositors no longer had to run on the bank because the government guaranteed deposits, the bulk of bank liabilities. Along with this government backstop came the fact that deposit insurance creates moral hazard – the incentive for banks to undertake greater risk than they would otherwise have taken without deposit insurance. Regulators and policymakers understood that deposit insurance could lead to excessive risk taking, so they set up a number of counteracting barriers.

In particular, banks would have to pay fees to be part of the deposit insurance system. So, at least, on an *ex ante* basis, regulators took into account the cost of the insurance. Deposit insurance was limited in magnitude per account, thus restricting the size of the banks. Most important, there were the so-called Glass-Steagall restrictions: the risk-taking activities of banks were ring-fenced to the extent there was a separation of commercial banking (taking deposits and making commercial loans) from arguably more risky investment banking activities (underwriting and dealing in corporate debt, equity securities and municipal revenue bonds). In addition, there would be enhanced supervision of individual banks, generally in the form of minimum capital requirements, as well as winding-down provisions in the case of failure. Capital requirements

represent protection against the risk-shifting incentive arising from deposit insurance, because the incentive only exists when leverage and/or asset volatility are high.

While there are many reasons for the relative calm of the U.S. financial system for the fifty years after the Great Depression, many analysts point to the financial regulation that was enacted in 1933, complemented by securities and investment legislation enacted in 1933, 1934 and 1940.

But starting in the early 1980s, the U.S. banking system began to show some cracks. Ignoring international shocks such as the emerging market crisis of 1981, the real estate crises in Japan and the Nordic countries in 1991, the Mexican "tequila" crisis of 1994, and the Asian contagion of 1997, it may be surprising to recall that the U.S. suffered a number of events during this time that could have led to financial crises that might have been far more serious than they turned out to be – the failure of Continental Illinois in 1984, the S&L crisis of the 1980s, the stock market crash of 1987, the LTCM crisis in the fall of 1998, and the burst of the dotcom bubble in 2000. So what happened during this period that ultimately made the serenity of the U.S. financial system fade away and ultimately evaporate in the most recent crisis?

B. Bank Competition, Financial Innovation and Risk-Taking in the Last Decades of the 20th Century

There is considerable debate about why the banking system changed so much in the 1980s, but the general consensus is that technology changed the nature of banking and therefore competition in the banking sector (Kroszner (2000) and Kroszner and Strahan (2007)). Some of these technological changes included (i) the development of the automated teller machine (ATM) that reduced geographical ties between banks and depositors, (ii) the proliferation of money

market funds and cash management accounts outside the banking system, and (iii) the increase in the types of communication channels, reducing again the ties between local bankers and depositors. In other words, traditional lines of business of banks no longer enjoyed their privileged status as financial intermediaries.

In an important paper, Keeley (1990) uses the increase in bank competition as an explanation for the Savings and Loan (S&L) crisis of 80's. Prior to the aforementioned changes in financial technology, banks and thrifts enjoyed monopolistic advantages and their charters had significant franchise value. But once this franchise value was diminished, the benefits associated with risk-shifting and exploiting the guarantees of deposit insurance increased. In general, there is convincing evidence of risk-shifting related to deregulation and increased banking competition that was a prime explanation for the S&L crisis (Saunders, Strock and Travlos, 1990, Cordell, MacDonald and Wohar, 1993, Kroszner and Strahan, 1996 and Hovakimian and Kane, 2000).

Around the same time, the institutional side of banking also changed dramatically. For example, there was tremendous growth in the so-called "shadow" banking system, i.e., financial institutions outside the traditional banking system that provide very similar services (Adrian and Shin, 2009, Acharya, Schnabl and Suarez, 2009 and Gorton, 2009). The shadow banking system includes derivatives – futures, options, swaps - as well as repos and money market funds, securitization of loans in the mortgage, corporate, and household sectors, and an increasing importance of public equity and bond markets. As an illustration, the amount of assets of the financial sector held by depository institutions dropped from 60% in 1950 to less than 30% in 2006 (Kroszner and Melick, 2009). In Section III we provide a detailed analysis of this banking model that took hold in the 80's and appeared to flourish thereafter.

Partly because of these dramatic changes in the nature of financial intermediation, there was general recognition that certain provisions of the Banking Act of 1933 – those most commonly referred to as the Glass-Steagall provisions - had become obsolete. This process of erosion of the allowable scope of commercial bank activities started in the mid 1980s with the reinterpretation of Section 20 subsidiaries of banks (which were permitted to carry out Glass-Steagall prohibited activities within certain limits), later with the Riegel-Neal Interstate Banking and Branching Efficiency Act of 1994, and then finally with the formal repeal of Glass-Steagall through the Gramm-Leach-Bliley Financial Services Modernization Act of 1999. The deregulatory environment continued thereafter, with the Commodity Futures Modernization Act of 2000, and in August 2004 with the amendment to the "net capital rule" of the Securities Exchange Act of 1934 allowing investment banks to dramatically increase leverage and put them on equal footing with universal banks under Basel II.

The result of these changes was to leave the financial system for the most part unprotected by the safety infrastructure that had been created in the 1930s, and, in many ways, even weaker in a regulatory sense than at any time since the early 1900s. This is not to argue that the Banking Act of the 1930s should necessarily have remained in place, only that whatever replaced them should have been mindful of the market failures that led to their passage in the first place. One only has to look at two episodes in the 1980s to understand this point.

i. Continental Illinois[4]

In 1982, federal regulators decided to close the Oklahoma-based Penn Square Bank, a $436-million asset bank that specialized in oil and gas sector loans. Penn Square originated large

[4] This account relies heavily on FDIC (1997).

volumes of loans to the historically risky exploration sector of the US energy industry, which began to suffer as energy prices fell after 1981. The seventh largest bank in the U.S., Continental Illinois, had invested aggressively alongside or through Penn Square and held hundreds of millions of dollars of Penn Square's book of loans. Continental had made many other loans to the energy sector and had also expanded its business risk by lending large amounts to developing countries to help them finance external debt incurred in the energy crises of the 1970's. In 1982, Mexico was forced to begin renegotiating its syndicated bank debt, triggering the emerging market debt crisis that was not fully resolved for almost a decade.

While many other US commercial banks followed the same strategy of lending to credit hungry markets in the late 1970s, Continental's credit exposures were compounded by a funding strategy that was unusual at the time. Traditionally, banks fund growth in their lending activities by attracting larger volumes of savings from retail depositors. Continental, however, had a limited retail presence, due in part to federal and local banking regulations. The bank depended heavily on funding from the wholesale money markets. Indeed, by 1981, Continental gained most of its funding through federal funds and by selling short-term certificates of deposit on the wholesale money markets. Only 20% of its funding came from traditional retail deposits.

Continental had pursued an aggressive growth strategy and assumed concentrated risk financed mostly with short-term wholesale debt. When the energy sector turned sour and the developing countries renegotiated their debt, Continental was unusually vulnerable to the views of the wholesale funding markets. In 1984, investors and creditors lost confidence and in a precursor to the crisis of 2007-2008, Continental was quickly shut out of its usual sources of funding in the domestic and Eurodollar interbank markets. In May of 1984, Continental

experienced what the FDIC described as a high-speed electronic bank run. To stem the panic, regulatory agencies and the banking industry arranged massive emergency funding for the bank. The fear was that a failure of Continental would undermine the entire banking system. As a matter of fact, more than 2,300 banks had correspondent accounts with Continental.

In an extremely controversial decision, the Federal Deposit Insurance Corporation tried to stop the bank run by extending a guarantee to uninsured depositors and creditors at the bank. This was arguably the beginning of the notion that some banks should be considered "too big to fail". The emergency help was followed by a package of permanent measures, making Continental the largest bank in the history of US banking ever to be rescued by government agencies. Unable to find a takeover partner, the FDIC ended up owning more than 80% of Continental. Management was fired, the board replaced and the bank was returned to the private sector in an IPO, later to be sold at a significant premium to Bank of America. The FDIC's share of the bill to rescue the bank was later calculated to be $1.1 billion. Although many considered the rescue of Continental under the leadership of Fed Chairman Paul A. Volcker a crisis management *tour de force*, it nevertheless signaled to unsecured creditors that they were likely to be fully protected against losses by the government under systemic risk circumstances. Market discipline was not eroded in the case of shareholders, who were wiped out, but it was eroded in the case of creditors, thereby creating moral hazard for the future.

The Continental story provides a classic example of how a sharp drop in confidence can lead counterparties in the wholesale markets to suddenly withdraw funding from a damaged bank, spinning the institution into a funding liquidity crisis as potentially fatal as any nineteenth-century run on a bank by retail depositors. It should have been a warning call that systemic risk

can build up quickly in a credit expansion cycle – outside of the traditional banking technology (deposits) – and needs to be priced and regulated accordingly. Continental Illinois should have been the canary in the coal mine. It showed that the regulatory system crafted in the 1930's needed serious updating. Instead, the problem was soon forgotten and eventually resurfaced with a vengeance.

ii. The Savings and Loan Crisis

The most serious post-war crisis in US the banking sector was the Savings and Loan (S&L) Crisis of the late 1980's. It is often blamed (with at least some justification) on the more permissive regulatory environment that evolved during the Reagan Administration (White, 1991), and was repeated during the Clinton Administration a decade later. That isn't the entire story however, and it is an episode that contains valuable lessons for the crisis of 2007-2009.

US Savings and Loan institutions, as distinct from commercial banks, were also a product of the Great Depression. They were created to serve the public policy goal of encouraging home ownership. The Federal Home Loan Bank Act of 1932 created the Federal Home Loan Bank System to provide liquidity and low-cost financing for S&Ls. There were 12 regional Home Loan Banks that were owned by their members and were under the supervision of the Federal Home Loan Bank Board (FHLBB). The National Housing Act of 1934 created the Federal Savings and Loan Insurance Corporation (FSLIC) to provide deposit insurance for S&Ls similar to what the FDIC provided for commercial banks. In contrast to the FDIC, which was established as an independent agency, the FSLIC was placed under the authority of the FHLBB.

For decades, the FHLBB's examination, supervision, and regulation capabilities were relatively poorly developed, in part because S&Ls had a narrowly defined role in the

intermediation sector and not much scope for expanding it. S&Ls took in household savings, on which they paid relatively low interest rates, and lent at attractive interest rates on thirty year fixed rate mortgages. This model began to change with the high inflation of the 1970's when interest rates soared in response to accelerating inflation during the Carter Administration. Deposits began to flee the S&Ls in pursuit of higher returns and, even when Congress lifted caps on deposit interest rates, the S&Ls were still being squeezed on the other end by their portfolios of 30-year fixed rate mortgages. They needed to find other sources of income. As described earlier, many economists view this as the period when S&Ls moved more towards a risk-shifting model, exploiting their federal deposit insurance backstop. To accomplish this, the S&Ls needed to circumnavigate or erode existing regulations.

This began with the FHLBB itself loosening regulations covering S&Ls. It allowed the thrifts to begin issuing adjustable rate mortgages. Congress also encouraged S&L diversification, and explicitly authorized consumer lending and investment in commercial real estate. Both federal and state thrift regulators began relaxing restrictions on their asset allocation, relaxing safety and soundness regulation, lowering capital requirements, and changing accounting rules to make it easier for S&Ls to meet their net worth requirements. All of these changes helped the thrift industry to grow rapidly. Between 1980 and 1986, 492 new thrifts were chartered in the United States.

Things began to change when inflation was brought under control in the early 1980s by the Volcker experiment, accompanied by a serious recession. Oil prices fell to a level that made many investments in that sector unprofitable. Tax benefits for real estate investments were eliminated, and that made many projects unprofitable. Much of the financial intermediation

growth between 1983 and 1985 was in commercial real estate lending. By 1985, it became clear that the thrift industry faced serious trouble. Enough S&Ls had folded or were in danger of folding that the FSLIC itself was insolvent. Efforts to recapitalize the FSLIC in 1986 and 1987 were bitterly fought by the industry, which lobbied aggressively with members of Congress. Thrift failures increased during 1987 and into 1988, but the insolvency of the FSLIC meant that rescuing troubled thrifts would cost more than the FSLIC had available in its insurance fund. As a result, the regulators could not intervene in S&Ls that had more liabilities than assets. This meant that several insolvent thrifts remained in business. These "zombies" had incentives to take even more risks in the hope that they could eventually improve their outcomes.

The crisis in the S&L industry was finally acknowledged and resolved after the inauguration of George H.W. Bush in 1989. Congress passed the Financial Institutions Reform Recovery and Enforcement Act (FIRREA) in 1989. FIRREA abolished the FHLBB and shifted regulation of S&Ls to the Office of Thrift Supervision (OTS), transferred the thrifts' deposit insurance function from the FSLIC to the FDIC, and reinstituted many of the regulatory provisions that had been weakened during the previous decade. In addition, FIRREA created the Resolution Trust Corporation (RTC) to liquidate or restructure the insolvent S&Ls.

There are several lessons from the S&L mess. The first is that when regulatory institutions have outlived their usefulness or been rendered obsolete it is not enough to just eliminate the regulatory boundaries without consideration of the risks that are being created. This was the case with the thrift industry, which had been created and developed with specific goals in mind but then morphed into something else entirely. Another lesson is that regulators can easily be captured by the industry they regulate. This was clearly the case with the FHLBB. The S&L

Crisis makes it clear as well that moral hazard is an important issue. It demonstrated how critical it is to promptly close insolvent, insured financial institutions in order to minimize potential losses to the deposit insurance fund and to ensure a more efficient financial marketplace. Finally, resolution of failing financial institutions requires that any deposit insurance fund be strongly capitalized with real reserves based on meaningful risk assessments.

C. Risk-Taking Incentives of Financial Institutions

Given their inherently high leverage and the ease with which the risk profile of financial assets can be altered, banks and financial institutions have incentives to take on excessive risks. Ordinarily, one would expect market mechanisms to price risks correctly and thereby ensure that risk-taking in the economy is at efficient levels. However, there are several factors – some novel and some traditional – that have ruled out such efficient outcomes.

i. The Novel Front

Financial institutions have become large and increasingly complex and opaque in their activities. This has weakened external governance that operates through capital markets (accurate prices), the market for corporate control (takeovers), and the role and functioning of boards of directors. Coincidentally there is the fact that financial risks at these institutions are now increasingly concentrated in the hands of a few "high performance" profit/risk centers. Employees (bankers, traders) engaged in these centers have skills in creating, packaging-and-repackaging, marking to market and hedging financial securities. Since such skills are largely fungible across institutions, such employees have exerted tremendous bargaining power in their

institutions and have succeeded in getting themselves rewarded through highly attractive, short-term compensation packages that provide them lucrative cash bonuses for short-run performance and what has shown itself to be effectively "fake-alpha".[5]

In the period leading up to the recent crisis, bankers were increasingly paid through short-term cash bonuses based on volume and on marked-to-market profits, rather than on the long-term profitability of their "bets."[6] So they had no incentive to discount for liquidity risk, for example, that of asset-backed securities, if their bets went wrong and nobody wanted to buy these securities. Nor was there an incentive to discount for the "maturity mismatch" inherent in special investment vehicles off the banks' balance sheets — which funded long-term assets via short-term debt (asset-backed commercial paper) that had to be rolled over frequently, generally overnight. Nor, apparently, did their managers assess the true skills of those who were generating these large "profits." In effect, regulatory arbitrage – taking on risks and financing structures that were not subject to significant capital requirements – became a primary business of the financial sector because of the short-term profits it was generating.

A case in point.[7] In the summer of 2005, UBS, the Swiss-based LCFI, became a major player in subprime mortgage collateralized debt organizations (CDOs). It purchased pools of subprime mortgages from mortgage originators and sliced and diced them so that the "super

[5] Of course, whether the high level of compensation paid to bankers or traders was a symptom of weak governance or a result of the equilibrium outcome of a competitive labor market remains an open question. Gabaix and Landier (2008), for example, show how the latter mechanism can explain pay scales of such magnitude.

[6] See Rajan (2008) for an early hint of this problem with bankers' pay. Acharya, Pagano and Volpin (2009) and Acharya and Volpin (2010) provide models explaining why pay may have risen in the banking industry, and coincidentally risk management (governance) quality deteriorated, due to greater mobility of risk-takers across financial institutions. Acharya and Richardson (2009) provide a detailed account of such governance failures (see, especially, chs. 7 and 8).

[7] The following account is taken from UBS's "Shareholder Report on UBS's Write Downs," 2008, prepared for the Swiss Federal Banking Commission.

senior" tranches would receive the highest designation from the rating agencies. The resulting AAA securities would then be sold off to investors. UBS was paid handsomely for structuring these deals. This business usually worked as intended -- the credit risk that would normally be held by UBS or other banks or mortgage lenders was transferred to the better-capitalized investment community.

Starting in 2006, however, the CDO group at UBS noticed that their risk-management systems treated the AAA securities as essentially riskless, even though they yielded a premium (the proverbial free lunch). So they decided to hold onto them rather than sell them. After holding less than $5 billion of these securities in February 2006, the CDO desk was warehousing a staggering $50 billion of them by September 2007. Incredibly, this happened even though the housing market had turned south in June 2006; subprime lenders had begun to go belly-up in December 2006; and UBS itself shut down its in-house hedge fund, Dillon Read Capital Management, in May 2007 due to subprime investment losses. None of this mattered to the UBS CDO group. For every $1 of super senior securities held, it booked the premium as immediate profit. And for every dollar of current "profit" booked, the members of the CDO group received correspondingly high bonuses. The members of the group had every incentive to increase the quantity of CDOs on the balance sheet as much as possible, since their own bonuses were tied to instant profits with no recognition of any risk. In a similar fashion, by the late summer of 2007 Citigroup had accumulated over $55 billion of AAA-rated CDOs.

Many analysts have taken stories like UBS, and the fact that many of the shareholders of the failed (or near failed) institutions – Bear Stearns, Fannie Mae, Freddie Mac, Lehman Brothers, A.I.G., Merrill Lynch, Washington Mutual, Wachovia and Citigroup – lost most of their investment in bank stocks in the crisis, as prima facie evidence of massive failure of

corporate governance, i.e., between shareholders and managers. While clearly this view cannot be completely discounted, we believe it is actually secondary in importance compared to the failure of corporate governance at the debt and regulatory level. Put another way, it appears to us that shareholders of LCFIs themselves benefited from the risk-taking option inherent in such CDO bets at the expense of creditors and taxpayers.

ii. The Traditional Front

To understand risk-taking incentives in large and complex financial intermediaries, we need to examine how the claim structure of the LCFIs is different from that of a regular non-financial firm. On the liability side, LCFIs are highly leveraged entities. At least 90% of the claim holders of an LCFI are debt holders (including depositors). Of course, other claimants comprise taxpayers through the numerous government guarantees in the system, most notably (i) deposit insurance, (ii) the implicit guarantee of too-big-to-fail institutions, and (iii) the "subsidies" provided to government-sponsored enterprises like Fannie Mae and Freddie Mac. That is, the vast majority of liabilities in the U.S. financial system were the beneficiaries of some form of safety net (see, for example, Marcus and Shaked, 1984, and Pennacchi, 1987).

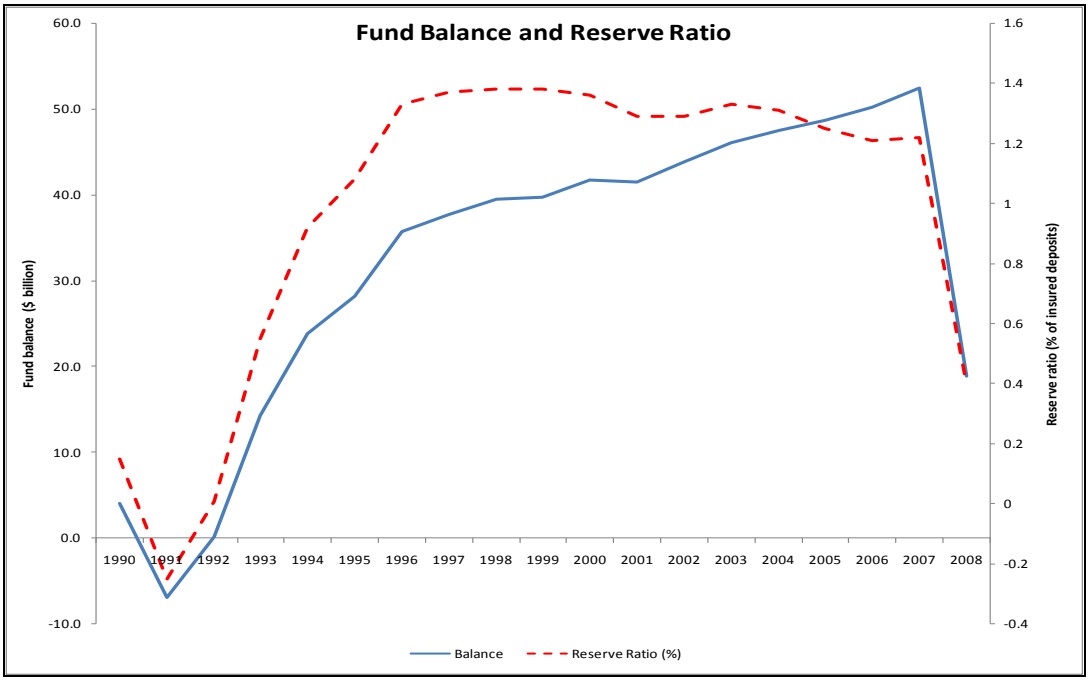
Given this structure of claims, corporate governance mechanisms that align managers with shareholders may deviate significantly from those that maximize firm value. Put differently, corporate governance mechanisms in LCFIs have to be designed so as to align the manager with the interests of the debt holders and the FDIC guarantor, as well as the shareholders. Monitoring by debt holders and the regulator are critically important components of corporate governance in LCFIs (see John and John, 1993, for details) compared to nonfinancial corporations. What kind of monitoring can one expect from debt holders? If the debt holders are depositors, deposit insurance reduces the incentives to monitor virtually to zero.

Of course, the fact that banks are covered by deposit insurance does not in itself necessarily lead to excessive risk-taking on their part. If the franchise value of their enterprise exceeds the benefits due to risk-shifting, then there might be very little effect on risk-taking as a result of deposit insurance. But two sets of consequences arose from competition that eroded the profits underlying the traditional lines of business of banks, described earlier. First, banks moved more and more into businesses focusing on noninterest income, such as trading and fee-based activities (e.g., Stiroh, 2002). Second, and more importantly, the relative value of risk-shifting increased given that value of bank charters had decreased. If the guarantees turned out to be mispriced, then the mispricing effectively removed any market discipline component of governance normally reserved for creditors. And risk-shifting within large financial intermediaries was particularly easy to do.

There is very strong evidence in the literature supporting the existence of mispriced government guarantees and the consequences arising from such guarantees. In terms of the financial crisis of 2007-2009, what was the source of regulatory failure? With respect to deposit insurance, as described earlier, there seems to be a consensus that moral hazard played an important role in both initiating and prolonging the S&L crisis. As a result, there were substantial reforms enacted to address this issue, most notably the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991. One of the major changes in setting FDIC premiums was to make them more risk-based. In theory, the FDIC assesses higher premiums on those institutions that pose greater risks to the insurance fund. In practice, if the deposit insurance fund was well-capitalized (i.e., 1.25% of reserves to total insured deposits), it turned out that no premiums were assessed to those banks. In fact, from 1996 to 2006, more than 90 percent of all banks paid very

little in deposit insurance premiums.[8] Figure 1 effectively illustrates this point by showing a reserve ratio close to 1.25% during this period, combined with a small increase in deposit insurance fund balances.

Figure1: Balances of Deposit Insurance Fund and the Reserve Ratio



Source: Federal Deposit Insurance Corporation

The S&L crisis clearly suggested the need for risk-based insurance premiums to be charged to banks. The market failure was that not only was the risk-based method not applied, but no insurance premiums at all were charged to the majority of banks. This effectively meant that the U.S. had a free deposit insurance system with little or no protection at all in place in

[8] This issue was only partially addressed by the Federal Deposit Insurance Reform Act of 2005 to the extent the range of ratio of reserves to total deposits covered a wider range for which premiums would be collected.

consideration of the repeal of Glass-Steagall and the changing institutional and systemic risk exposures in the financial structure.

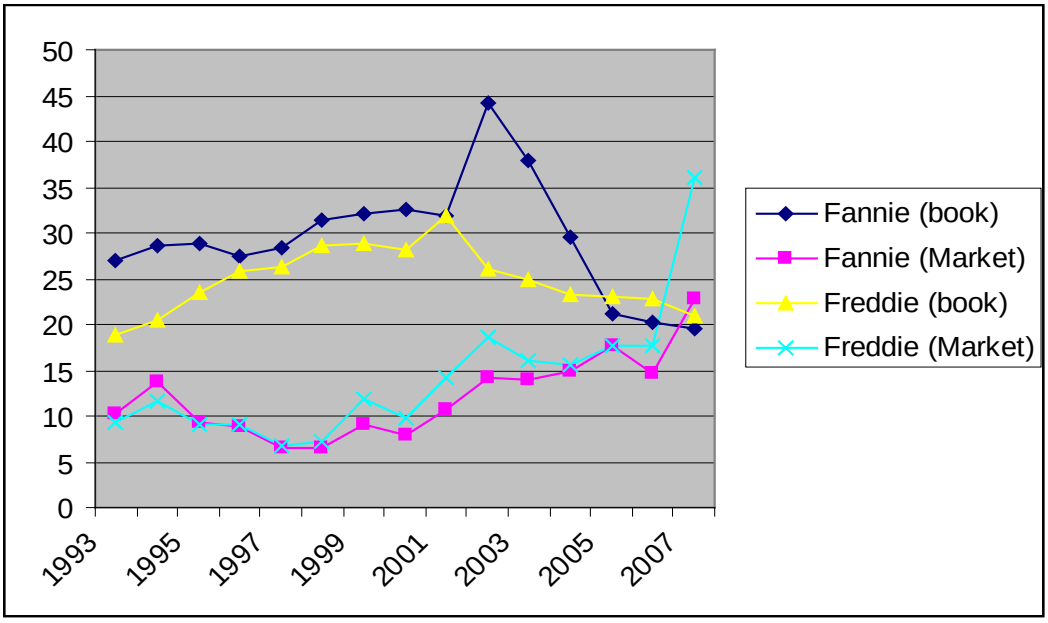
At first glance, the moral hazard inherent in depository institutions was limited in scope, since deposits were only a limited component of the assets (and liabilities) of the U.S. financial system. However, since the majority of assets of the financial sector were held by a small number of LCFIs, the market discipline provided by debtholders was similar to that of depositors due to the too-big-to-fail (TBTF) guarantee. Since the 1984 bailout of Continental Illinois, the issue of TBTF had been much discussed in regulatory and academic circles (see, for example, Stern and Feldman, 2004, and Ennis and Malek, 2005). Even before the financial crisis of 2007-2009 made the TBTF guarantee explicit, there was ample evidence that TBTF was alive and well over the previous two decades, and seriously distorted financial market pricing (see, for example, O'Hara and Shaw, 1990, Penas and Unal, 2004 and Morgan and Stiroh, 2005).

To understand further the importance of moral hazard and the role of government guarantees, consider the case of the government sponsored enterprises (GSEs), Fannie Mae and Freddie Mac. Fannie Mae was founded in 1938 in the wake of the depression to provide liquidity and aid to the mortgage market. It became a government sponsored enterprise in 1968, and shortly after, Freddie Mac was formed to compete with Fannie Mae to create a more efficient secondary market for mortgages. While not explicit, there has always been the presumption that both the guarantor function and debt of these GSEs had full backing of the U.S. government. Indeed, the GSEs' debt generally was priced marginally above the prevailing treasury rate.

Consider the investment function of the GSEs. For every $1 of mortgage-backed securities purchased with equity, there was a large amount of debt issued to purchase additional

mortgage-backed securities. Figure 2 shows the book and market leverage ratios of the GSEs, measured as assets divided by equity, over the period 1993 to 2007. The extraordinary point to note is the access to very high leverage, given that the GSEs were investing in risky, relatively illiquid mortgage-backed securities. This provides an idea of the size of the implicit government guarantee. In fact, the literature has quantified the transfer from taxpayers to the GSEs to be in the billions of dollars even before the crisis ignited (see, for example, Passmore, 2005 and Lucas and McDonald, 2006).

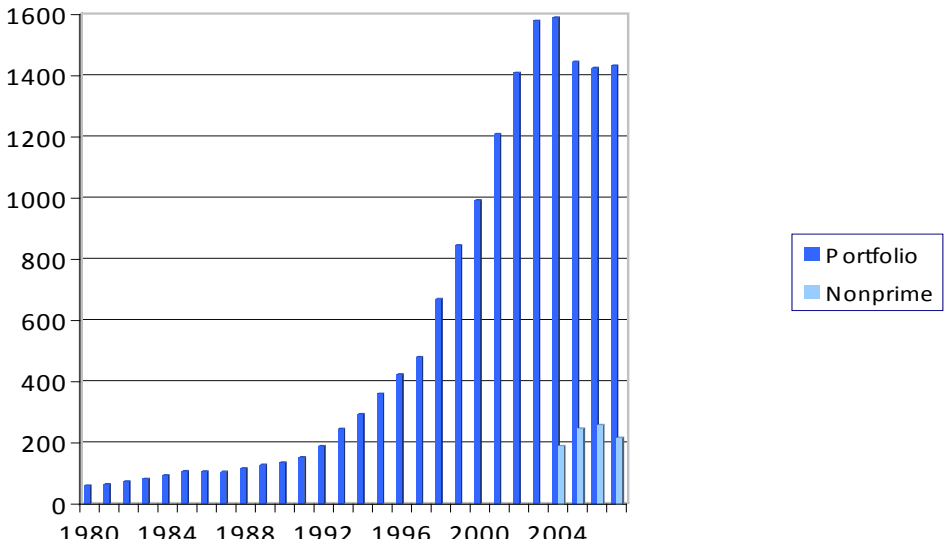
Figure 2: The Leverage Ratio of the GSEs (1993-2007)



The investment portfolio of the GSEs became markedly riskier through time as they began to load up on non-prime mortgages under pressure from Congress and the Clinton Administration. Successive Secretaries of Housing and Urban Development (HUD) mandated that the GSEs increase the share of mortgage loans and guarantees to low-income households to

50% and then 60% of their portfolios. Although some analysts have argued that the GSEs' non-prime bets were much larger (Pinto, 2008), it is clear that by the mid 2000's at least 15% of the GSEs' funds were invested in subprime mortgages. In contrast to prime mortgages, however, these were not hedged using corresponding interest rate swaps. Figure 3 provides the size of the GSE mortgage portfolios, noting the rise in subprime holdings over the later years. Of course, with the lack of market discipline due to the government's guarantee, one would expect that the GSEs would invest in riskier assets to the extent possible. Quite apart from their politicized character, it is therefore not surprising that, as nonprime mortgages took off, the GSEs substituted risk toward these assets. The hybrid nature of the GSEs and the implied sovereign guarantee, in short, underlay a financial disaster waiting to happen.

Figure 3: The size of the GSE retained mortgage portfolio (in billions of $)



To summarize, the traditional role of banks together with the limits imposed on them by Glass-Steagall led to relative calm in the US financial system for fifty or so years after the 1930s.

Once the Glass-Steagall barriers were lifted, the only real protection for the financial system was capital requirements and appropriate pricing of government guarantees covering individual financial institutions. With little or no pricing of government guarantees, the only remaining obstacle to increased risk-taking and systemic exposure was capital requirements. As we argue in Section III, the financial crisis of 2007-2009 is centered on how LCFIs and other Wall Street firms exploited loopholes in regulatory capital requirements to take on an under-capitalized $2-3 trillion highly leveraged, one-way asymmetric bet on the economy, particularly tied to residential real estate but also involving commercial real estate and consumer credit.

III. THE NEW BANKING MODEL OF MANUFACTURING TAIL RISK[9]

Given this background, we discuss the shift in the banking model during 2003-2Q2007 compared to the traditional banking and securitization models.

The simple theory of banking is that banks act as financial intermediaries between depositors and borrowers (Diamond, 1984). Depositors provide funds to make loans, and banks provide expertise in assessing the creditworthiness of borrowers. Historically, then, the asset side of a bank's balance sheet (Figure 4) would consist of loans funded by deposits as well as loans funded by equity (and in general non-deposit debt).

A bank's loans are considered assets because they are owed to the bank by borrowers. Deposits are considered liabilities because, upon demand, they must be returned by the bank to the depositors. In the meantime, however, most deposits have been lent out to borrowers, with the exception of liquidity reserves, and the interest on these loans is the main source of the

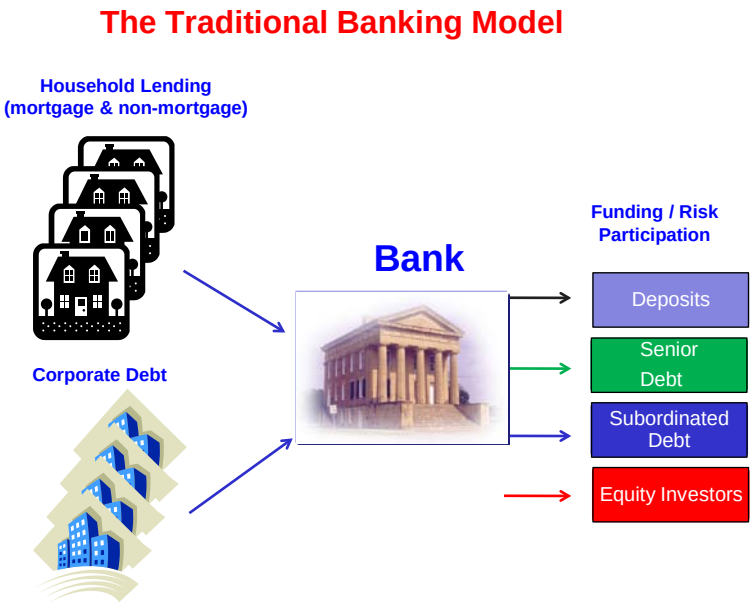
[9] This section draws heavily on the discussion in Acharya and Richardson (2009b).

commercial bank's profits. Most deposits, therefore, are unavailable at any given time to be reclaimed by the depositors.

Figure 4: Traditional Banking[10]

Bank Balance Sheet

Assets	Liabilities
Loans	Deposits
	Capital/Equity



[10] We are grateful to Philipp Schnabl for schema describing traditional bank balance sheet and its modern forms.

To avoid the possibility that all the depositors will demand the return of their deposits at the same time — as occurred during several panics between 1850 and 1914 and during the Great Depression — we have emphasized that deposits are generally insured up to a certain amount by the government. In return for this guarantee and an insurance fee, and to ensure that banks have a stake in the process, banks are required to hold a minimum amount of "capital" as a buffer against losses. Quite apart from simple prudence in management and governance, even in the days of the Medicis in Florence or the Fugger in Frankfurt, banks that wanted to survive kept a sharp eye on capital adequacy. And while there are other complementary explanations of bank-capital regulation, this simple one suffices for exposition of our main point. For these purposes, what constitutes "capital" is defined by regulators. The regulations in place in the run-up to the crisis in most Western countries defined capital in terms of funds obtained either by raising equity (selling stock or certain forms of "hybrid" debt that has equity-like features), or by retaining earnings. We will shortly point out that banks' efforts to circumvent these capital-adequacy requirements caused the financial crisis.

In a world without deposit insurance, capital-adequacy regulations might in fact be unnecessary, as it often was in banking history. The creditors of financial institutions (depositors, uninsured bondholders, and other counterparties) would apply pressure to curb excessive risk taking. Uninsured bondholders and other counterparties could do this by charging higher interest rates to banks that took what seemed to be excessive risks. Similarly, depositors could demand higher interest rates on their deposits in exchange for the higher risk involved in using such banks. And if unanticipated risks seemed to arise in a given bank, they would take their money elsewhere, or under stress conditions participate in bank runs (akin to the run of unsecured creditors on banks during the ongoing crisis). But the creation of deposit insurance created a risk

of moral hazard for traditional banks, and similarly, implicit government bailout guarantees for institutions that are considered too big to fail created moral hazard for today's LCFIs.

The bank-capital regulations of most Western countries follow the terms recommended by the Basel Committee on Banking Supervision (BCBS) of the Bank for International Settlements in Basel, Switzerland. Under the Basel accords, banks must maintain at least an 8 percent capital buffer against a risk-adjusted measure of their assets, although there is considerable national discretion in the actual implementation of the Accord. For instance, in the United States the FDIC has interpreted "at least" 8 percent to mean 10 percent if a bank is to be designated "well capitalized" (a designation that brings certain privileges such as lower deposit insurance premiums).

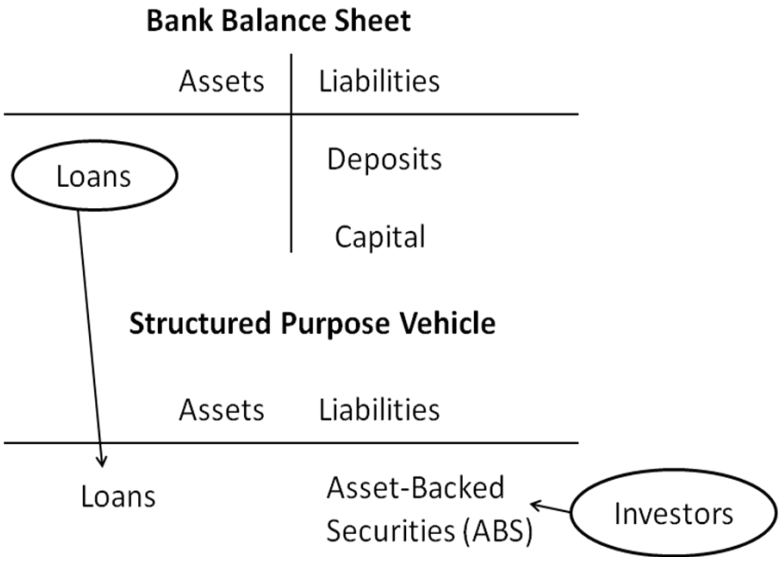
The two main forms of "capital," according to the Basel rules, are equity and retained earnings. Maintaining large capital buffers is costly from an economic standpoint since debt, especially if short-term and demandable, has market discipline role that cannot be served by the relatively passive nature of equity financing (Calomiris and Kahn, 1991, Diamond and Rajan, 2001). However, even maintaining socially efficient levels of capital can seem privately costly to bank management if their attention is focused on short-term accounting measures of performance such as return on equity (ROE). For instance, the capital can be lent out at risk-free interest rate whereas putting it away into illiquid and tail-risky assets can generate a carry over and above the risk-free rate. While the return on both forms of investment should be similar on a risk-adjusted basis, the absence of proper accounting of risks in recording of profits can make reducing capital, that is, increasing leverage, highly attractive from the standpoint of generating greater ROE over the next quarter.

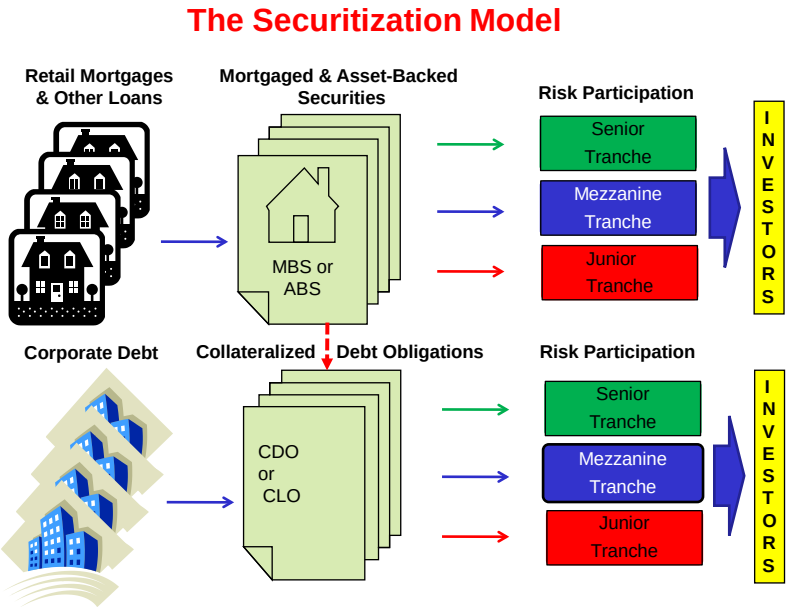
As such, in difficult times, if a bank's capital must be boosted through issuing equity shares, it generally signals to investors the adverse news that retained earnings are unlikely to be sufficient to meet the bank's capital needs (Myers and Majluf, 1984), and the new equity injections will dilute the value of existing shares (Myers, 1977) since the primary benefit of the injections accrues to creditors. It would seem that such costs of capital issuance might discipline banks and induce them to manage capital in a countercyclical manner. However, once decision-making horizons are shortened due to focus on quarterly accounting measures of performance with poor risk-adjustment of recorded profits, such dynamic and long-term incentives are lost.

Regardless of the exact nature of this cost, in order to deal with holding costly capital on balance sheet in originating assets, the model of banking evolved to focus on securitization (Figure 5). This allowed banks to avoid holding costly capital by essentially turning them into underwriters that continued to originate loans but then sell them off to others. Once loans are removed from a bank's balance sheet in this way, the 10-percent capital reserve need not be held.

Securitization explains the fact that there are today far fewer deposits in the modern financial system than there are bank loans. The U.S. banking system currently holds approximately $7 trillion in deposits, but the credit market includes $2.7 trillion in bank and leveraged loans, $3.3 trillion in commercial mortgages, $1.3 trillion in subprime mortgages, $5.8 trillion in non-agency (i.e., non-Fannie Mae or -Freddie Mac) prime residential mortgages, and $2.6 trillion in consumer loans, among others. The riskier credits, such as high-yield corporate loans, nonprime mortgages, commercial mortgages, and consumer credit, are likewise generally securitized.

Figure 5 : Modern Banking – Securitization with risk transfer





With securitization, the original idea of banking is altered. Banks are now intermediaries between borrowers and *investors* (rather than just depositors). To understand how this works, consider the successful model of securitizing prime mortgages. This involves pooling prime mortgages into mortgage-backed securities (MBSs) that pay their owners fractional streams of the interest and principal payments collectively made by the mortgage holders. The principal and interest of these mortgages are guaranteed by Fannie Mae and Freddie Mac. The U.S. residential mortgage market is worth more than $10 trillion. Over 55 percent of it is securitized, and 64 percent of these securities are backed by Fannie and Freddie.

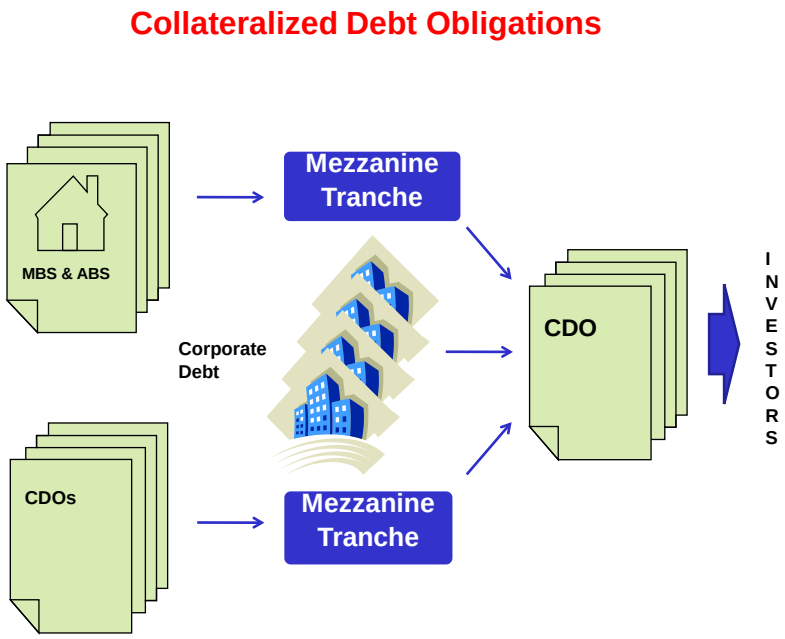
Toward end of 2002, as credit markets began to recover from the recession of 2001, banks extended the prime-mortgage securitization model to other, riskier asset classes. This allowed banks to transfer these risks from their balance sheets to the broader capital market, including pension funds, hedge funds, mutual funds, insurance companies, and foreign-based institutions.

The new asset-backed securities were "structured," meaning that they divided (for example) mortgage pools into "tranches" according to the predicted riskiness of the loans. Holders of shares in the riskier tranches received higher interest payments, but in exchange, they were subject to losses before the holders of shares in the less-risky tranches suffered losses. Thus, the holders of the least-risky tranches, as determined by the three rating agencies — Moody's, Standard and Poor's, and Fitch—got a lower risk-based interest payment, but they would feel any effect of nonperformance in the structured security only after its "subordinated tranches" had stopped performing (through delinquency or default). The relatively low risk level of a AAA-rated tranche, however, did not necessarily mean that it was backed by prime loans. It might only mean that, of the thousands of nonprime loans in a given mortgage-backed security,

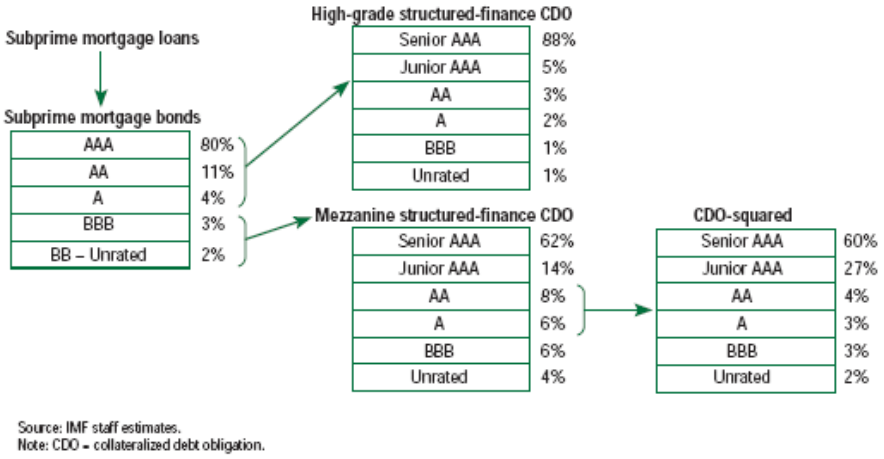
this tranche was designated as the one that would continue to throw off income and principal income from performing debts in the entire security until all the other tranches had stopped performing.

In order to meet the demand for AAA-rated paper beyond that available from the top tranches of asset-backed securities, the mezzanine tranches of those structured could be packaged into collateralized debt obligations, which in turn could be tranched to create more AAA-rated securities, and this could be repeated for the mezzanine tranches of CDOs in the form of CDO-squared issues (Figure 6).

Figure 6 : Manufacturing CDOs and CDO-squareds



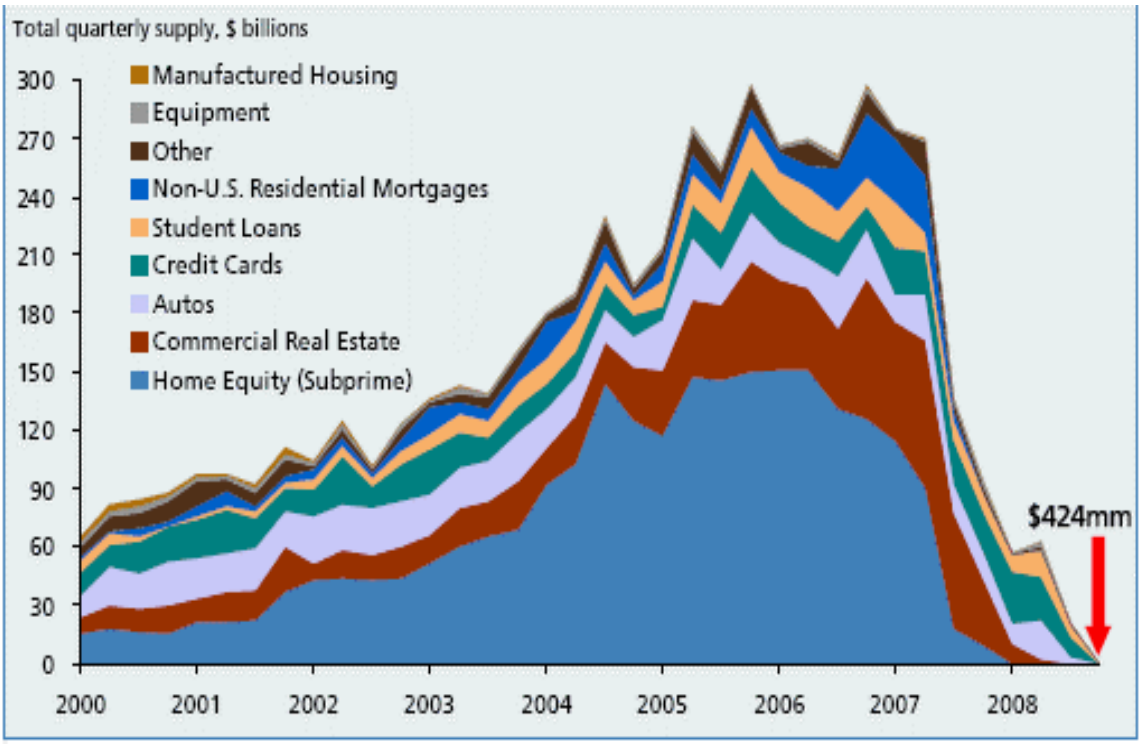
CDO-squared Multi-Layered Structured Credit Instrument



Source: IMF staff estimates.
Note: CDO = collateralized debt obligation.

The growth in structured securities across Wall Street during 2002-2007 was staggering. While residential mortgage-related securities were certainly a large component of the total, so too were securities backed by such assets as commercial mortgages, leveraged loans, corporate bonds, and student loans. Figure 7 graphs the new issuance of various asset-backed securities during this period. Note that there is an almost threefold increase in new issuance from 2002 to 2007. In the aggregate, securitization worldwide went from $767 billion at the end of 2001 to $1.4 trillion in 2004 to $2.7 trillion at the peak of the "bubble," in December of 2006. By late October 2008, the market had effectively collapsed.

Figure 7: Asset-Backed Security Issuance, 2000-2008

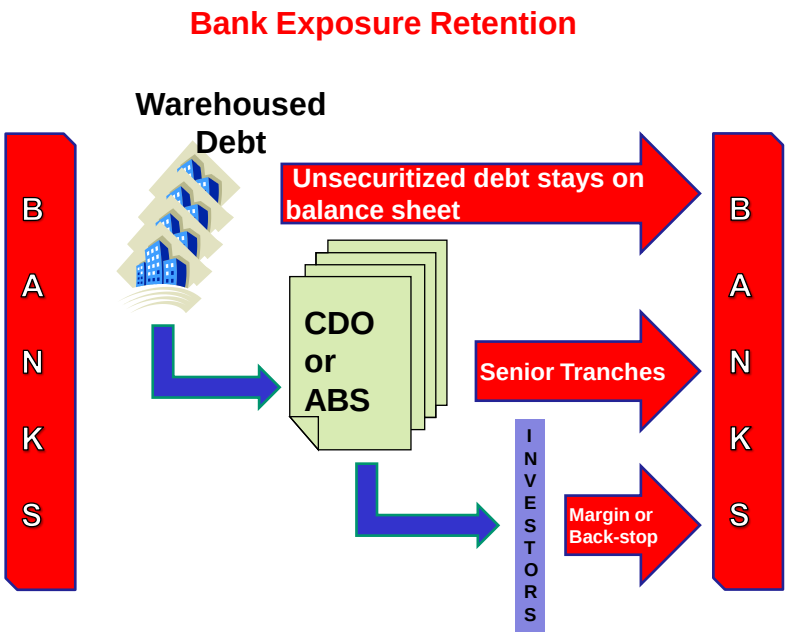


Source: J.P. Morgan Securities Inc. Data as of 10/31/2008.

It is very clear that the strongest demand for these asset-backed financial products came through the creation of "highest quality" – supposed to be essentially riskless – securities, which appealed to a host of potential investors such as pension funds, insurance funds, and money market funds. Interestingly, and crucially for our thesis, however, end investors were not the chief purchasers of these securities, and, in turn, of the underlying risks that were being securitized. In fact, the banks themselves, instead of acting as intermediaries between borrowers and investors by transferring the risk from mortgage lenders to the capital market, became primary investors. In addition to normal "pipeline" exposure to assets in the process of origination, securitization and distribution, they took on "warehousing" exposure by holding onto them (see Figure 8). Since — unlike a typical pension fund, fixed income mutual fund, or

sovereign wealth fund — banks are highly leveraged, this investment strategy was exceedingly risky. The goal, however, was logical - to create return on equity through the carry of asset-backed securities and simultaneously avoid minimum-capital regulations.

Figure 8: Warehousing and Retention of Risks during Asset-Backed Security Issuance

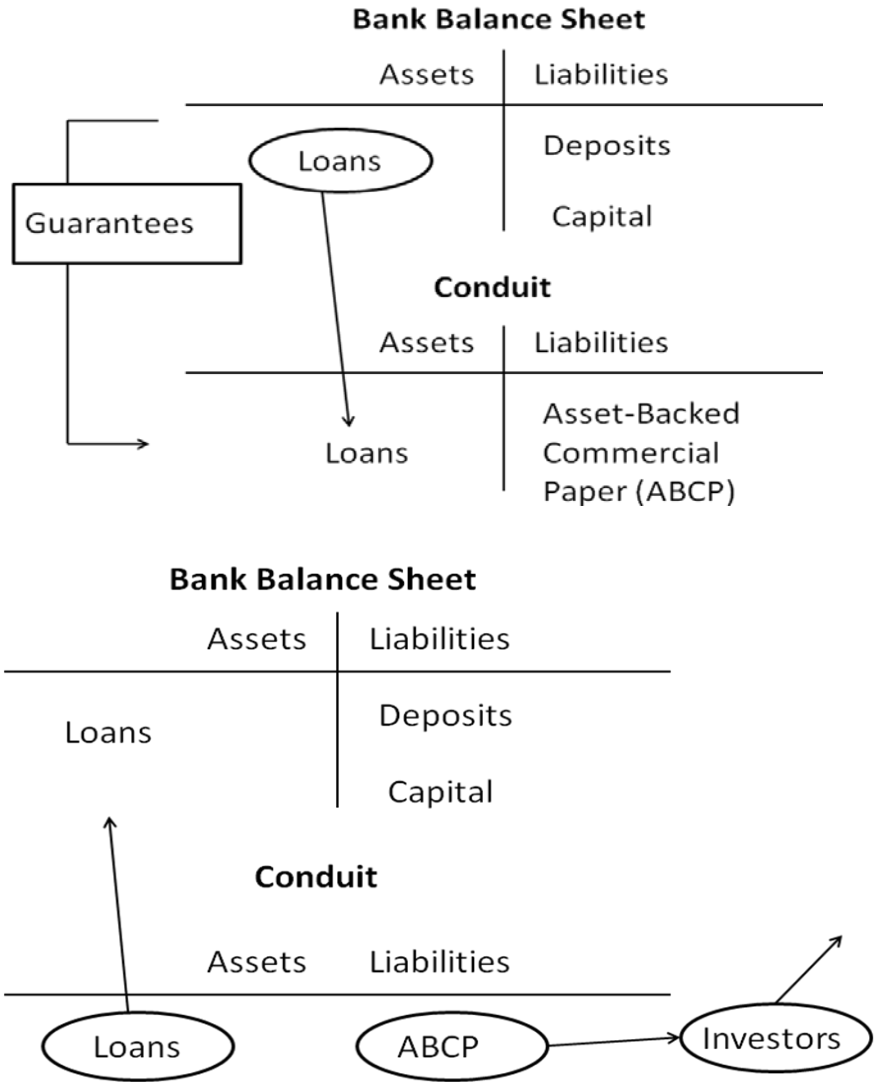


One of the two principal means for this "regulatory arbitrage" was the creation of off-balance-sheet special-purpose vehicles, which held onto many of the asset-backed securities. These vehicles were generically called "conduits." Structured investment vehicles (SIVs), which have received the most public attention, were one type of conduit.

With securitized loans placed in conduits rather than on a bank's balance sheet, the bank did not need to maintain capital against them. However, the conduits funded the asset-backed securities by issuing asset-backed commercial paper (ABCP) — short-term debt instruments sold in the financial markets, notably to investors in money market instruments. To be able to sell the

ABCP, a bank would have to provide the buyers, i.e., the banks' "counterparties," with *guarantees* of the underlying credit— essentially bringing the risk back onto the banks themselves, even though that risk was not shown on their balance sheets (Acharya, Schnabl and Suarez, 2009). This "new" banking model is depicted in Figure 9.

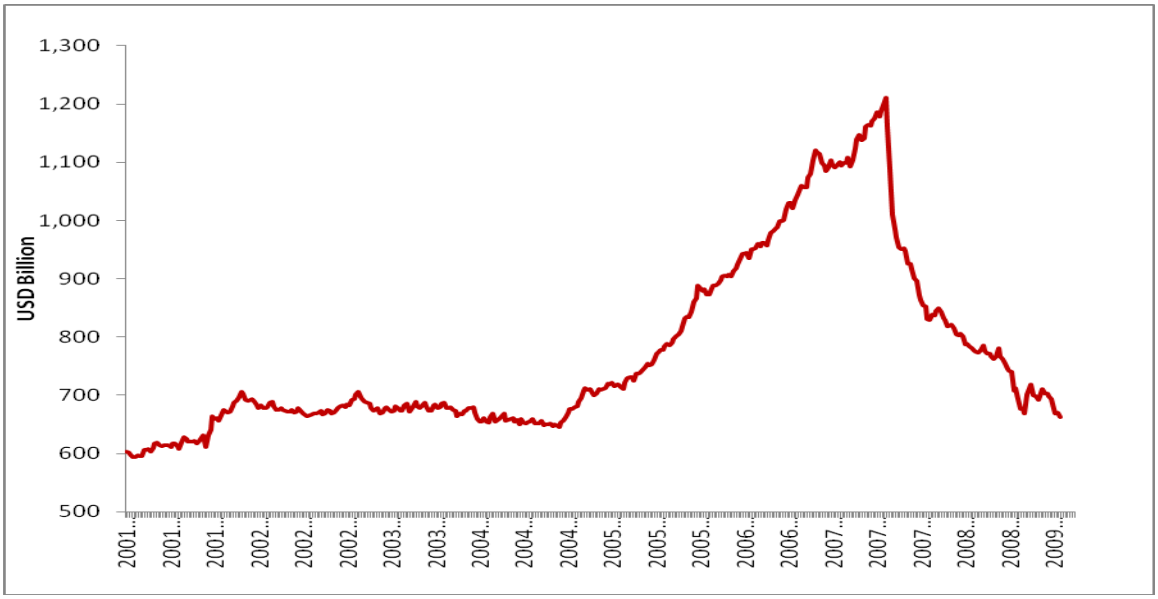
Figure 9: Modern Banking+ : Securitization without risk transfer using ABCP conduits



These guarantees had two important effects. First, guaranteeing the risk to banks' counterparties was essential in moving these assets off the banks' balance sheets. Designing the guarantees as "liquidity enhancements" of less than one year maturity (to be rolled over each year) allowed the banks to exploit a loophole in Basel capital requirements. The design effectively eliminated the "capital charge," so that banks achieved a tenfold increase in leverage for a given pool of loans. Second, the guarantees ensured the highest ratings for the off-balance sheet vehicles from the rating agencies. Indeed, the AAA ratings made it possible for banks to sell ABCP to money-market funds, which are required by law to invest mainly in AAA-rated securities. This allowed banks to fund the ABCP at low interest rates, similar to that paid on deposit accounts.

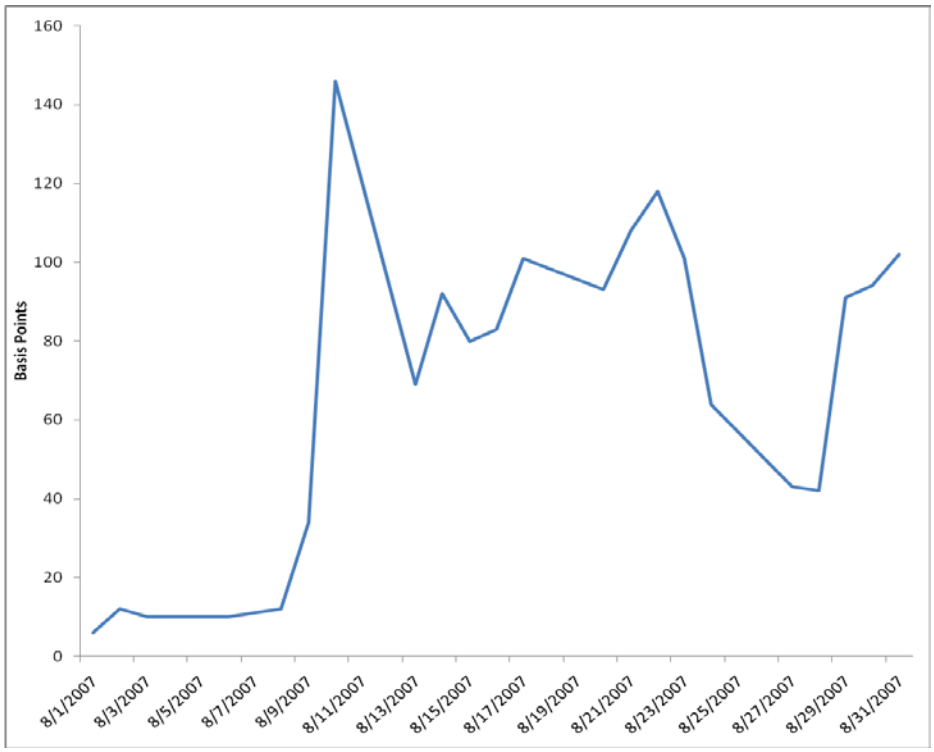
Figure 10 graphs the growth and collapse of the ABCP market over the years 2001 to 2009. ABCP issuance peaked from 2004 until the second quarter of 2007. When the collapse occurred in the next quarter, Figure 11 shows that the cost of issuing ABCP rose from just 15 basis points over the Federal Funds rate to over 100 basis points (at its peak being close to 150 basis points). Consequently the ABCP could no longer be rolled over, and the banks had to return the loans to their balance sheets. Acharya, Schnabl and Suarez (2009) show that when the crisis hit, of the $1.25 trillion in asset-backed securitized vehicles, only 4.3 percent of the loss was structured to remain with investors. The remaining loss wiped out significant portions of bank capital and threatened banks' solvency.

Figure 10: Asset Backed Commercial Paper around the Financial Crisis of 2007-2009



Source: Federal Reserve Board. Data do not include European ABCP.

Figure 11: The behavior of asset-backed commercial paper (ABCP) spread over the Federal funds rate during 2007 (Source: Federal Reserve Board)



Not all banks followed the conduit model, which financed off-balance-sheet assets through the sales of ABCP. Some chose an alternative route that had a similar effect. A bank would still make loans and move them from its balance sheet by securitizing them. But as Shin (2009) explains, the bank then turned around and reinvested in AAA-rated tranches of the same securitized products they (or other banks) had created (Figure 12). Because of their AAA ratings, these securities had a significantly lower capital requirement under Basel 2 arrangement. For commercial banks, the Basel accord weighted the risk of AAA-rated securities at half the risk of ordinary commercial or mortgage loans, and thus required an even lower capital reserve for them (20% risk weight compared to 50% for mortgages and 100% for corporate bonds). In 2004, the Securities Exchange Commission (SEC) granted stand-alone American investment banks the ability to employ internal models to assess credit risk and the corresponding capital charge. This allowed them even higher leverage than commercial banks, which duly skyrocketed from 22:1 debt to equity ratio to 33:1 within just three years.

As Table 1 shows, banks, GSEs (Fannie and Freddie), and broker/dealers in 2007 held $789 billion of the AAA-rated CDO tranches that were backed by nonprime loans, or approximately 50 percent of the volume outstanding at the time. Moreover, the majority of the subordinated tranches of the CDOs was also held by banks, broker/dealers, and monoline insurers (which insure only one type of bond —e.g., municipal bonds). They collectively held $320 billion of the $476 billion total outstanding.

Figure 12: Modern Banking+ : Originate, Distribute and Buy Back

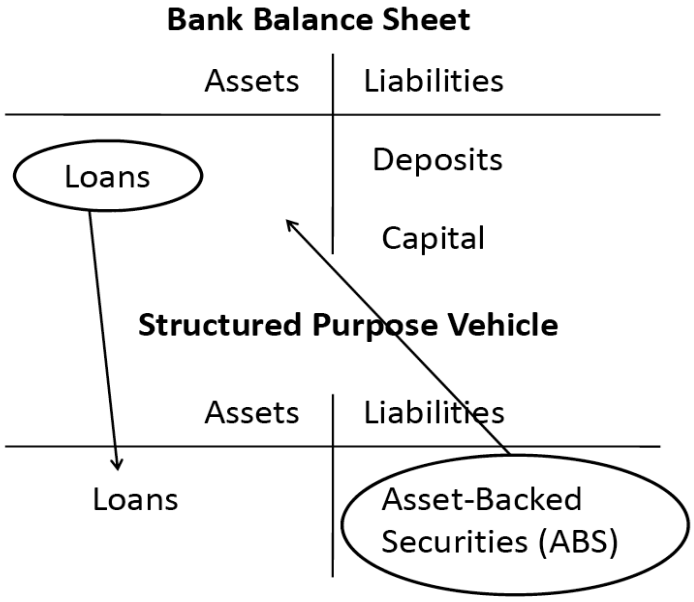


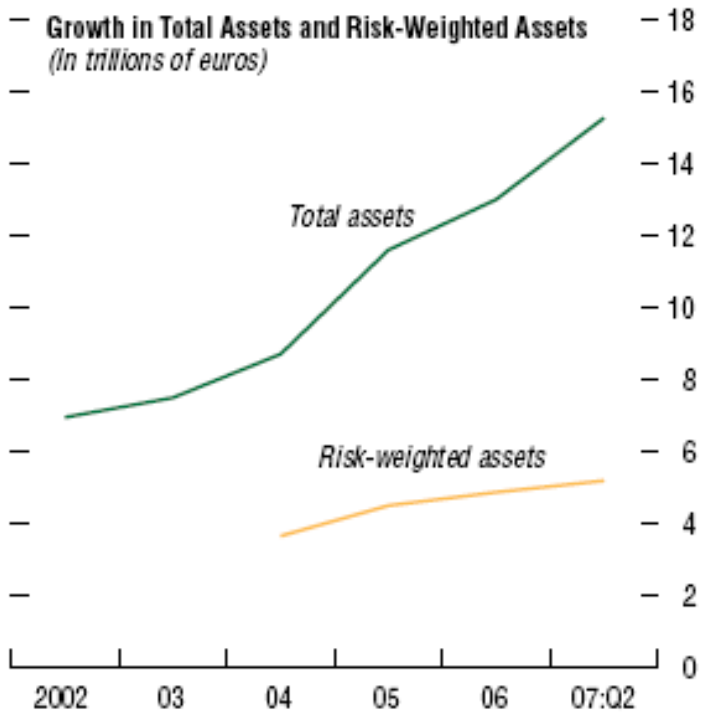
Table 1: Holdings of Mortgage-related Debt by Financial Institutions (2007)

Type of financial institutions	Loans	HELOC*	Agency MBS	Non-Agency AAA	CDO subord.	Non-CDO subord.	Total	Percentage of outstanding volume
Banks & Thrifts	2,020	869	852	**383**	90		4,212	39%
GSEs & FHLB	444		741	**308**			1,493	14%
Brokers/dealers			49	**100**	130	24	303	3%
Financial Guarantors		62			100		162	2%
Insurance Companies			856	**125**	65	24	1,070	10%
Overseas			689	**413**	45	24	1,172	11%
Other	461	185	1,175	**307**	46	49	2,268	21%
Total	2,925	1,116	4,362	**1,636**	476	121	10,680	
	27%	10%	41%	**15%**	4%	1%		

Source: Krishnamurthy (2008)

To recap - while the assets on banks' balance sheets doubled between 2004 and the middle of 2007, the regulatory assessment of the risk of these assets grew at a far slower pace. As a result, banks were considered by the regulators to have been investing in relatively safe assets over this period because the assets were rated AAA. This enabled banks to double their leverage, and hence the quantity of profitable loans they could make. Figure 13 shows this trend in the quantity of total assets of top ten publicly traded banks relative to the trend in the quantity of their *risk-weighted* assets.

Figure 13: Trends in bank assets, nature of assets and leverage



Source: International Monetary Fund Global Financial Stability Report, April 2008

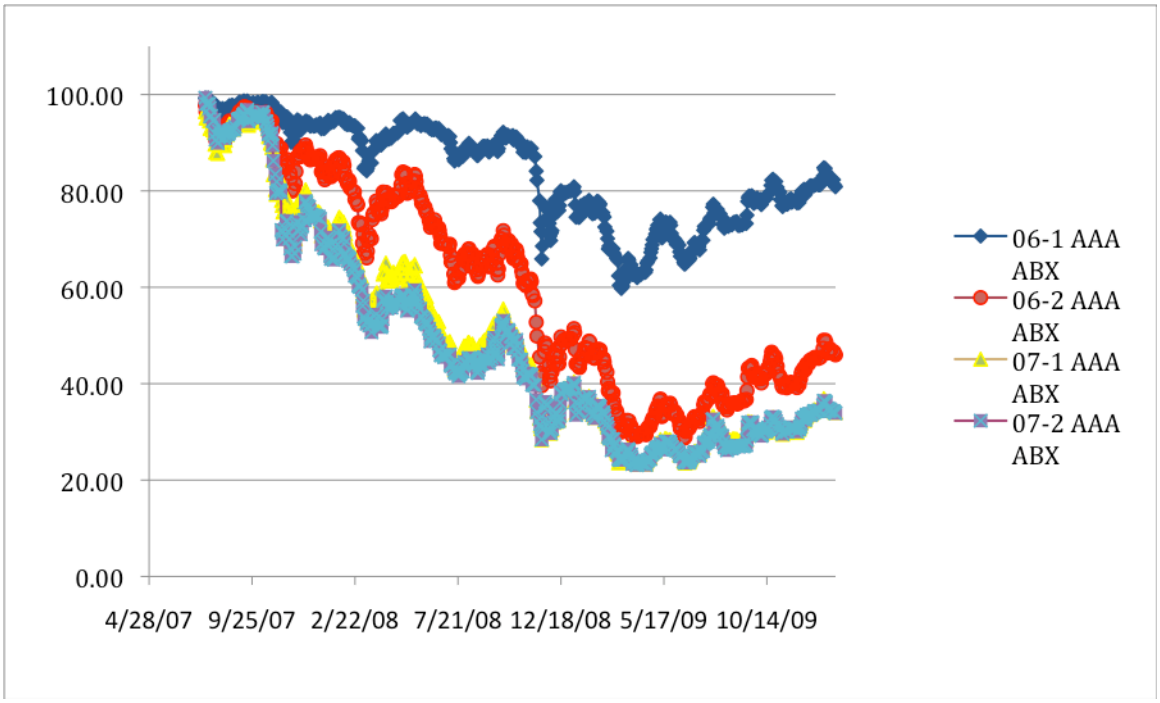
Why did the banks create, securitize and then retain the risks associated with highly systematic and long-term assets such as subprime mortgages?

Take the AAA-rated tranches of subprime CDOs. True, they were risky. But banks that held these tranches had it both ways: On the up side, they reduced their capital requirements, and they (or other investors) earned the higher premium commanded by the risky nature of subprime loans. For example, at the peak of the housing bubble, in June 2006, even the relatively low-yield AAA-rated tranches of subprime CDOs offered twice the premium of the typical AAA credit-default swap of a corporation. On the down side, losses would only occur if a large number of subprime mortgages got hit at once, in which case even the AAA tranche of a CDO got hit. If such a rare event actually occurred, however, it would almost surely result from an economic catastrophe – a systemic shock affecting all markets at the same time.[11] The banks were betting their futures that this would not happen, or that the decision makers' time horizons were too short for them to care if it did happen. Of course, bad things do happen.

To get some understanding of how hard the systemic shock hit the AAA tranches, of asset backed securities and their derivatives, Figure 14 graphs the various AAA-rated ABX index series from their initiation until the end of 2008 – an index of 20 representative CDOs of subprime mortgages. Such indices are initially priced at par, and one can see that the 2006 series stayed around that level until late July 2007, when the crisis got underway. Depending on the series, the AAA tranches were selling from 20 cents to 80 cents on the dollar as of May 2009. Putting aside issues specific to the pricing of the ABX, at the borrowing costs shown in Figure 11 and given the aforementioned $789 billion of exposure, losses to the financial sector at the time ranged from $158 to $473 billion on their holdings of the AAA-tranches of mortgage-backed securities alone.

[11] Coval, Jurek and Stafford (2008), therefore, call these kinds of tranche products "economic catastrophe bonds".

Figure 14: Subprime Mortgage AAA-Tranche Pricing (2007-Jan 2010) (source: Markit)



Source: Markit. The Figure tracks the prices, from January 1, 2007 to February 17, 2010 of the ABX index of AAA tranches of mortgage-backed securities issued in the first and second halves of 2006 and 2007. The ABX index is an index of 20 representative collateralized debt obligations (CDOs) of subprime mortgages. The AAA tranche index represents an initial equally-weighted portfolio of the AAA tranches of each CDO.

Similarly, the financial firms that used off-balance-sheet conduits had, through the guarantees they issued on the ABCP, written huge quantities of insurance against a systemic decline in the overall economy, especially in the housing market. In the case of both AAA tranches and conduits, the guarantees were often provided by third-party insurers such as monolines and other insurers. Most prominently AIG, which also tried to have it both ways - they collected insurance premia when times were good, and would have to honor their promises only when there was a systemic decline of markets and the economy.

Effectively, the entire financial sector was riding a massive one-way bet on the economy. Commercial banks, through ABCP guarantees, and investment banks and insurance companies, through AAA-rated tranches and insurance on the tranches, had set up a way to (1) sell deep out-of-the-money (OTM) options, (2) with sector concentrations primarily on housing – a highly systematically risky and long-term asset, and (3) funded with short-term debt finance such as ABCP in case of conduits set up by commercial banks and unsecured commercial paper in case of investment banks. This intricate structure ensured that banks had a "carry" – both due to term premium in funding long-term assets with short-term debt and as a result of the systematic risk imbedded in the underlying mortgages. This carry can be alternately viewed as the price obtained by selling OTM options. And in this case, the options were structured with the aid of securitization in a way so as to arbitrage or optimize regulatory capital requirements. In aggregate, banks were not holding sufficient capital against the contingency that the tail systemic risk would materialize. The aggregate systemic exposure was hair-raising. During the period 2003-07, banks used an accounting-based notion of profits that did not suitably correct for the long-run risk and return involved in selling OTM options. Consequently, they seemed enormously profitable. Regulatory capital levels seemed remarkably healthy. And there was little information on the exact nature of bets taken. Few asked the key question, "why are we so lucky?"

They soon found out with a vengeance when housing prices collapsed in 2007, the over-leveraged financial sector experienced a large solvency shock, and the real economy experienced the most severe financial crisis since the Great Depression. Specifically, the collapse of the ABCP market in the third quarter of 2007 forced commercial banks to bring the assets held in their conduits back onto their balance sheets or otherwise support them. This hit banks like

Citigroup particularly hard and consumed Royal Bank of Scotland (which inherited the legacy of ABN Amro's conduits). Investment banks, which were not subject to the same capital requirements, held their CDOs on their books - but since investment banks, too, were typically funded overnight, they suffered the same maturity mismatch as did the commercial banks' off-balance-sheet conduits. By September 2008, investment-banking operations that had loaded up on AAA tranches of subprime mortgage-backed securities and their derivatives had effectively brought down UBS, Bear Stearns, and Lehman Brothers and threatened Merrill Lynch and Morgan Stanley.

While the post-Lehman phase has been the most difficult period of the crisis so far, in fact the first signs of the impending crisis can be traced nearly two years prior, with the bankruptcy of Ownit Solutions, a nonbank specialist in subprime and Alt-A (not-quite-prime) mortgages. From that point onward, there was a slow run on other non-bank non-prime mortgage lenders. Most of their loans were hybrid "2/28" or "3/27" adjustable-rate mortgages. These loans offered a fixed "teaser" rate for the first two or three years, and then adjustable rates for the remaining maturity of the mortgage. After the first two or three years, the adjustment of rates would be substantial enough to be unaffordable for subprime borrowers, so from the begining the mortgages were designed to be refinanced. But for the most part, this would be possible for subprime borrowers only if the collateral on the loan (i.e., the price of the house) had increased in value. Otherwise, they would be forced into default.

Because most of these mortgages were all originated around the same time, mortgage brokers and lenders had inadvertently created an environment that could lead to a systemic wave of defaults if the price of housing declined two or three years later, when the mortgages were scheduled to reset (Ashcraft and Schuermann, 2008; Gorton, 2008). Once the failure of lenders

like Ownit Solutions (and major banks with US sub-prime businesses like HSBC) signaled that this had begun to happen, the short-term finance available to nonprime lenders dried up, and hundreds of specialists failed. The next wave of the crisis began on August 9, 2007, when three investment funds that were part of BNP Paribas, the French LCFI, could not determine the mark-to-market values of their securitized investments backed by subprime mortgages. This led to a suspension of redemptions by BNP Paribas, which in turn caused the asset-backed commercial paper market for conduits to "freeze-up." Purchasers of ABCP suddenly realized that assets backing the conduits were of such dubious quality that they might have little or no resale value, especially if they were all hit simultaneously with delinquencies and defaults (Acharya, Gale and Yorulmazer, 2008).

A year later, most of the assets funded by banks through securitized markets were hit by the same doubts, which ultimately brought down the investment banks that repackaged and warehoused subprime and other mortgages – as well as corporate, auto, and other loans—into structured securities. The failure of the likes of Bear Stearns and Lehman Brothers, which invested heavily in the securities created from of these mortgages, led to severe counterparty risk concerns that paralyzed capital markets (and even interbank lending markets) and thus caused the worldwide recession. Standing behind the mortally wounded wholesale banks was the systemic failure of securitization market, triggered by the popping of the overall housing bubble. And this in turn had been fueled by the ability of these firms, as well as commercial banks, to finance so much housing stock in the first place. The severity of the resulting recession and its worldwide scope has been magnified by the massive decline in lending by commercial banks, including most of the major names such as BNP Paribas, Citigroup, Royal Bank of Scotland, and UBS, as well as Bank of America, JPMorgan, and others, such as Wachovia, that no longer exist.

Contrary to the originate-and-distribute model, it was these same banks that turned out to be the main credit destinations for the mortgages originated by subprime lenders.

To summarize the genesis of it all, the root cause of the crisis was the desire of highly leveraged LCFIs to take even greater risks, generating even higher short-term "profits" than those associated with their role as financial intermediaries. They managed to do so by financing long-term, systematically risky assets such as mortgages using short-term, often overnight, debt. They further enhanced the "carry" by repackaging the risk in such a way as to get around the capital requirements imposed by regulators. This was the "new model" of LCFIs during 2003-07 – to manufacture and take on systemic risk or write deep out-of-the-money options, but do so with little capital on the balance-sheet – which ultimately led to the financial crisis of 2007-09.

IV. ALTERNATIVE EXPLANATIONS OF THE FINANCIAL CRISIS

There is no shortage of proximate causes of the financial crisis. We consider each of these in turn, and explain why most of them do not suffice to explain the spectrum of evidence available on what caused the financial crisis.

1. *Moral hazard in the originate-and-distribute model:* A commonly mentioned cause of the crisis has been that the originate-and-distribute model of banking – the securitization model – destroyed incentives of loan originators, which led to the origination and distribution of poor quality mortgages. The conceptual point goes back at least to the work of Stiglitz (1992). For instance, in the buildup to the most recent crisis, there were mortgages granted to people with little ability to pay them back, and mortgages designed to systemically default or refinance in just a few years, depending on the path of house prices. There was the securitization of these

mortgages, which allowed credit markets to grow rapidly, but at the cost of some lenders having little "skin in the game" and in turn contributing to the deterioration in loan quality (Dell'Ariccia, Igan and Laeven, 2008; Mian and Sufi, 2008; Berndt and Gupta 2008; Keys, Mukherjee, Seru and Vig, 2008). Finally, opaquely structured securitized mortgages were classified AAA by rating agencies prone to modeling failures and possible conflicts of interest between thorough risk assessment and generating fee income from security issuers.

Perhaps surprisingly, these are not the ultimate reasons for the near-collapse of the financial system. If bad mortgages sold to investors hoodwinked by AAA ratings were all there was to it, those investors would have absorbed their losses and the financial system would have moved forward. Although numerous investors would have been burned, the crash would have been no different, in principle, than the bursting of the tech bubble in 2000. In other words, the failure of the originate-and-distribute model might help explain why we saw poor quality mortgages, but it fails to explain why the mortgage risk ultimately did not leave the financial intermediaries responsible for originating and distributing them.

Since the AAA ratings indicated to investors that these tranches of "asset-backed" investments — collateralized debt obligations (CDOs) and collateralized loan obligations (CLOs) — were as safe as the safest possible non-sovereign debt instruments, the role of the rating agencies in this process should not be underestimated (White, 2006). Nevertheless, we believe that the rating agencies' role *in marketing asset-backed securities to investors* can be overstressed as a factor in the crisis because, in fact, investors were not the chief purchasers of these securities – the financial intermediaries or banks themselves were, as shown convincingly in Table 1. To repeat, instead of acting as intermediaries between borrowers and investors by transferring the risk from mortgage lenders to the capital market, the banks themselves became

primary investors, and so it was not a true originate-and-distribute model that was at work but rather the new banking model of "originate-distribute-and-hold," incurring massive systemic tail-risks that ultimately brought the financial sector down.

2. *Good securitization or bad securitization?* Gorton (2008, 2009) provides an explanation of the financial crisis based on the idea that financial intermediation is intrinsically about financial institutions selling risk-free instruments that are essentially informationally insensitive to investors. However, adverse risks can materialize in the future which may make these instruments sensitive to information relating to the underlying assets, in which case investors "run" in order to enhance their redemption priority before other investors put in their claims and before there is a further deterioration of assets. This is the view that securitization growth during 2003-07 was inherently of the "good" type and therefore economically beneficial. For instance, the creation of AAA-rated tranches could be characterized as supplying investors with informationally insensitive securities. The growth in the wholesale credit market – the "repo" transactions in which banks borrow from each other against treasuries or relatively high quality assets, often on overnight basis – could also be viewed similarly in terms of creating liquidity flows that provide plumbing for securitized intermediation in the economy.

Gorton (2008, 2009) thus attributes the panic of 2007-09 as essentially a run on securitized banking - for instance, on the repo markets - due to the increase in risk in the underlying assets and counterparty risk among the financial intermediaries themselves. To Gorton's phraseology, these intermediaries were "slapped" by the invisible hands of the market suddenly recognizing that securities and transactions hitherto informationally insensitive had now turned informationally sensitive. As shown in Figure 10, the introduction of ABX indices

tied to the quality of securities backed by US subprime assets deteriorated steadily during the Summer of 2007 and ignited fatal runs on securitized banking.

We do not contest the view that securitization can in principle be economically beneficial. Indeed, it seemed to have worked remarkably well until the most recent crisis erupted. We also do not dispute the view that a part of the financial crisis was a run on securitized banking. However, we have two fundamental points of departure from Gorton's "good securitization" view.

First, exposures of the financial sector to 50% of all AAA-rated sub-prime tranches, as shown in Table 1, is hard to square with the "good securitization" view. Securitization's purpose is to spread risks to end investors and away from the financial sector, rather than create "hot potatoes" (Shin, 2009) for circulation within the financial sector. Indeed, the classical theory of securitization (for example, Gorton and Pennacchi, 1990) argues that intermediaries should sell most or all of the "risk-free" tranches and hold back the information-sensitive first-loss tranches, which is what often happened as the securitized sector developed. This is in striking contrast to the securitization model financial intermediaries adopted during 2003-07, since they themselves held AAA-rated tranches. In terms used in international trade, they increased their focus on activities where they had a comparative disadvantage as against the informationally-sensitive activities where they had a comparative advantage, which makes no sense.

Second, the structure of ABCP conduits can be viewed as potentially consistent with the traditional view of securitization. In this view, banks sell guarantees to conduits in order to issue highly rated, short-term ABCP. However, as explained earlier, the guarantees were in fact 100% and were un-priced. That is, what happened was "securitization without risk transfer" (Acharya,

Schnabl and Suarez, 2009) and guarantees were structured in a way that reduced and effectively eliminated regulatory capital requirements.

Contrary to this explanation of the crisis, our view is that the growth in securitization during 2003-07 was primarily of the "bad" type, in that it was directly contrary to the risk-transfer objective underlying traditional forms of securitization, and allowed banks to synthesize systemic tail risk without holding much capital against it.

3. *Global imbalances:* Many analysts of the financial crisis have singled out huge global imbalances as a primary cause of the crisis. Bernanke (2005) argued in a speech that the "savings glut" in Asia, most notably in China, and several European countries with current account surpluses such as Germany, had created severe and persistent global imbalances. These imbalances by and large found their way through capital flows into the US economy (Caballero, Farhi and Gourinchas, 2008). Importantly, unlike capital flows to emerging markets, a large share of these flows were subsequently invested in effectively risk-free assets such as US treasuries, US agency debt, and money market fund shares. Some observers (for example, Caballero and Krishnamurthy, 2009) have additionally argued that the appetite of surplus countries for risk-free assets left the US economy fragile by concentrating the real risks in its financial sector. Portes (2009), for example, recently wrote: "I maintain that global macroeconomic imbalances are the underlying cause of the crisis… The underlying problem in international finance over the past decade has been global imbalances, not greed, poor incentive structures, or weak financial regulation, however egregious and important these may be." Combined, these observations form the global imbalance explanation of the financial crisis of 2007-09.

It is certainly true that much capital has flowed to the United States. The reasons are many: a) The U.S. dollar's status as the reserve currency; b) The depth, liquidity and relative safety of U.S. financial markets; c) Relative demographics; d) Good institutions. The U.S. current account has been in deficit for twenty years and the size of the deficit has averaged more than 4% of GDP for at least ten years. But, it is very difficult to make a causal connection between capital flows and the financial crisis that is void of reliance on seeking of tail risks by LCFI's. The financial crisis seems to have arisen primarily due to this seeking of tail risks with capital flows linked to global imbalances having fueled that fire.

In particular, while global imbalances are clearly central to understanding the capital flows into the US economy, they fall short in explaining the financial crisis on two different dimensions. First, they fail to explain why the risk-free assets -- for example, the AAA-rated securities -- found their way into the balance-sheets of the US financial institutions (as shown in Table 1) rather than simply ending up in the asset holdings of surplus countries.

Second, Acharya and Schnabl (2009) explain that the global imbalances hypothesis does not coincide with the geography of the financial crisis -- in particular, why the crisis took such a global form right from its inception. Clearly financial institutions in the U.K. and the U.S., both deficit countries were the hardest hit in the crisis. But, financial institutions in Switzerland (UBS), the Netherlands (ABN Amro), and Germany (West LB, Deutsch Bank), all surplus countries were among the hardest hit. UBS was effectively a hedge fund that lost most of its capital in exposure to AAA-rated tranches of the US subprime assets; ABN AMRO was one of the largest creators of off-balance sheet conduits with liquidity guarantee provisions backed by little capital. And indeed, the first banks to collapse in the crisis due to exposure to ABCP

markets were in Germany, a surplus nation. In August 2007, IKB and Sachsen Bank had to be bailed out. These banks had experimented investing in subprime assets in search of a new model following the withdrawal (forced by the European Union competition authorities) of the state guarantees on their liabilities. Thus, simply relying on global imbalances to explain failures in the financial sector proves to be grossly inadequate.

Further, many countries with large deficits as a percentage of GDP, such as Australia, Spain, Italy, were unscathed. What was the difference between countries that were hit hard and those that were not? The difference appears to be in the choices the banks and LCFIs made about what to take onto their balances sheets and the regulatory systems in place. Acharya and Schnabl (2009) explain for example that in spite of the housing price crash, banks in Spain have been reasonably well-buffered due to the prudent capital charge applied to off-balance sheet conduits that have recourse to bank balance-sheets and reserves-averaging in good times based on past asset growth (that served to restrict asset growth as well as create adequate capital buffers for a downturn affecting the quality of assets).

Figures 15-16 and Table 2 help illustrate these points. Table 2 in particular shows banks with the top-ten exposures to ABCP conduits, relative to their equity capitalizations, as of January 2007. This can be viewed as the extent of poorly capitalized off-balance sheet assets that banks took on.

Figure 15: ABCP and global imbalances, weighted by GDP
(Source: Acharya and Schnabl, 2009)

This figure shows the correlation between global imbalances, measured as the Current Account Deficit in 2006, and off-balance sheet activity, measured as ABCP as of 1/1/2007 relative to country GDP in 2006. The current account deficit data is from the OECD Economic Outlook. The GDP country data is from the OECD Statistical Database measured at prices and exchange rates of 2000. The ABCP data is based on Moody's data and only includes ABCP sponsored by commercial banks.

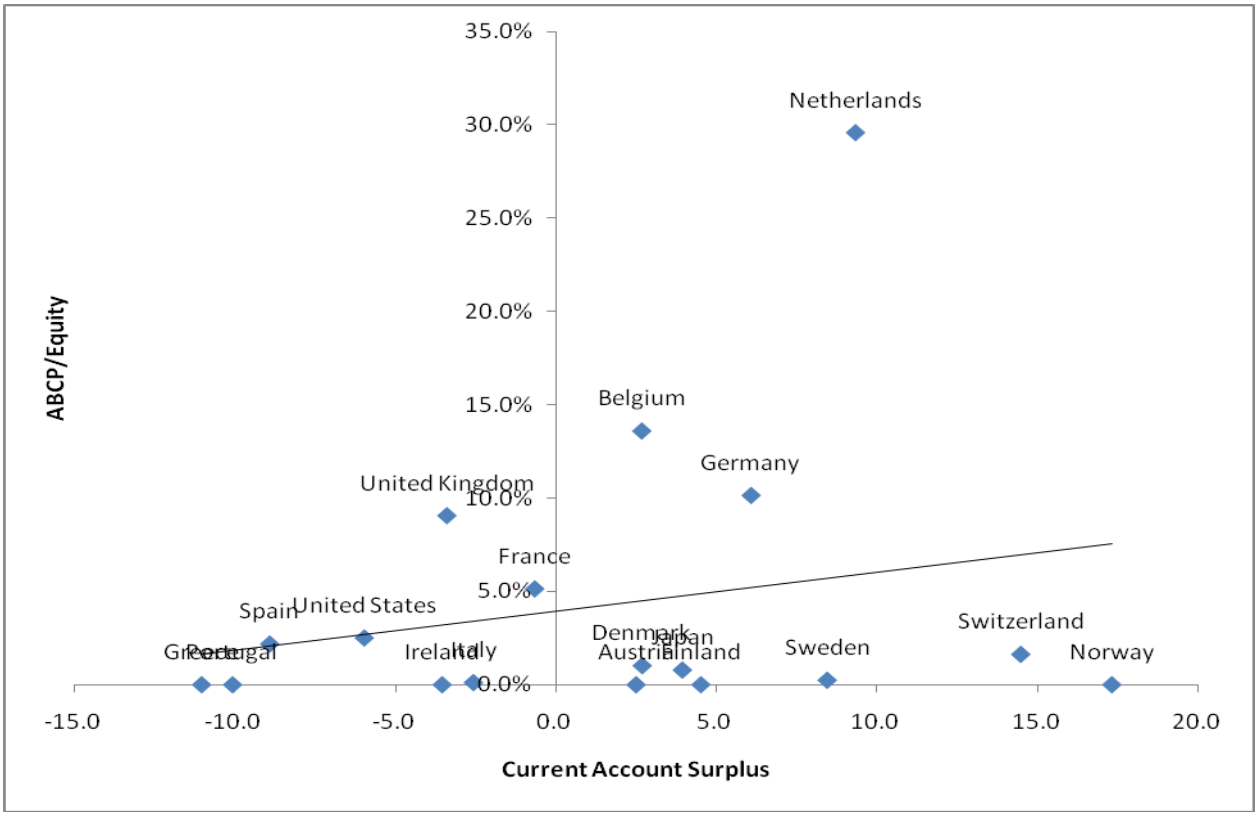
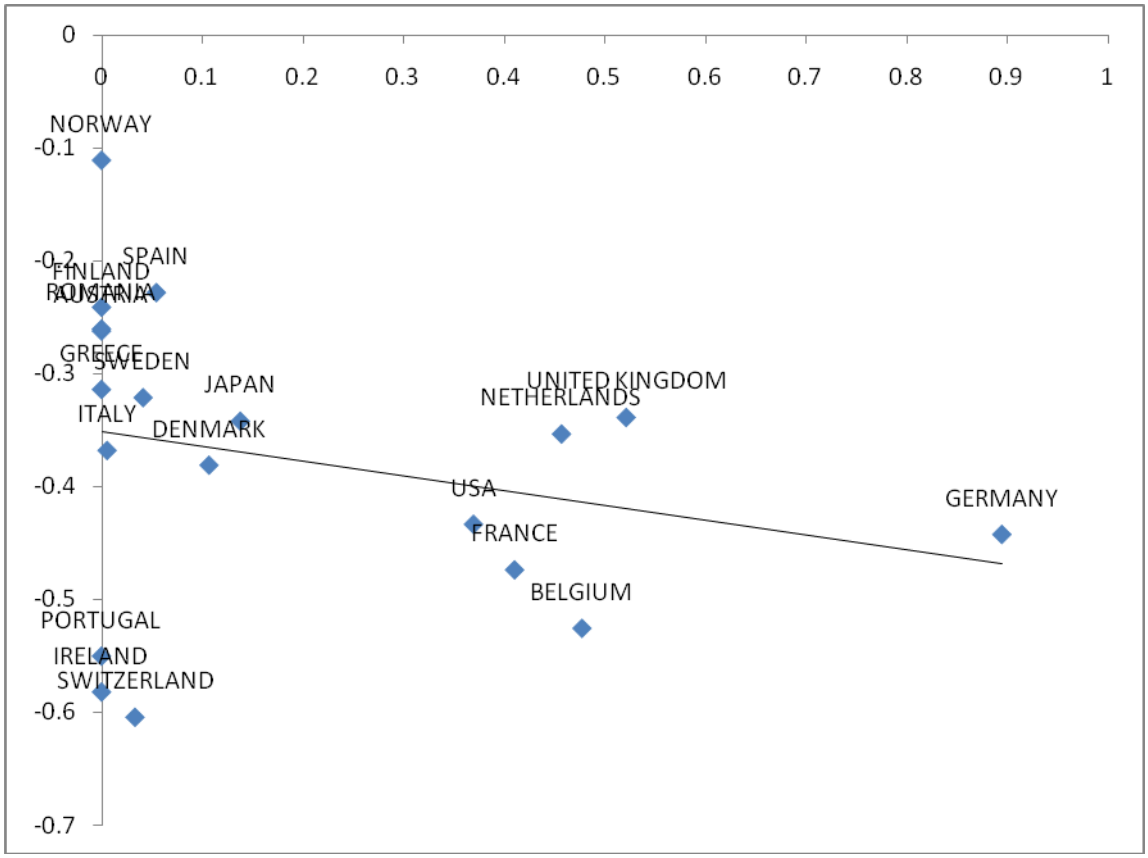


Figure 16: Stock Returns and ABCP from July 2007 to July 2008, by country (Source: Acharya and Schnabl, 2009)

This figure shows the correlation between global imbalances, measured as the Current Account Deficit in 2006, and off-balance sheet activity, measured as the asseet-weighted ABCP as of 1/1/2007 relative to equity per country. The current account deficit data is from the OECD Economic Outlook. The GDP country data is from the OECD Statistical Database measured at prices and exchange rates of 2000. The ABCP data is based on Moody's data and only includes ABCP sponsored by commercial banks.



	ABCP (bn)	Assets (bn)	Equity (bn)	ABCP/Equity
Citibank	93	1,884	120	77.4%
ABN Amro	69	1,301	34	201.1%
Bank of America	46	1,464	136	33.7%
HBOS	44	1,160	42	105.6%
JPMorgan Chase	42	1,352	116	36.1%
HSBC	39	1,861	123	32.1%
Societe Generale	39	1,260	44	87.2%
Deutsche Bank	38	1,483	44	87.8%
Barclays	33	1,957	54	61.5%
WestLB	30	376	9	336.6%

Table 2: Ten Largest ABCP sponsors and their off-balance sheet leverage relative to equity
Source: Acharya, Schnabl and Suarez (2009)

Table 2 shows that, of the top six banks, three were in surplus countries (WestLB and Deutsche Bank in Germany, ABN Amro in the Netherlands) and three were in deficit countries (HBOS in the UK, Société Générale in France and Citibank in the United States), with the top two among these banks being WestLB and HBOS. Figure 15 shows that, indeed, the average measure of ABCP exposure to equity for countries is unrelated to whether they were surplus or deficit nations, and if anything the relationship is positive. Germany, Belgium and Netherlands had the highest ABCP to equity exposure for banks in the period leading up to the crisis. Confirming this, Figure 16 shows that when the ABCP crisis broke out in August 2007, the average performance of banks at the country-level was again as bad for surplus nations as for deficit nations.

In short, the financial crisis may have been largely based on dubious quality of assets in the deficit countries, but there was a great deal of direct exposure to ABCP guarantees sold to these assets among banks in surplus countries as well. Any explanation of the financial crisis must come to grips with the propensity of the banks in surplus countries to manufacture tail risk in this manner. Global imbalances help in understanding the flow of capital across countries, but in a

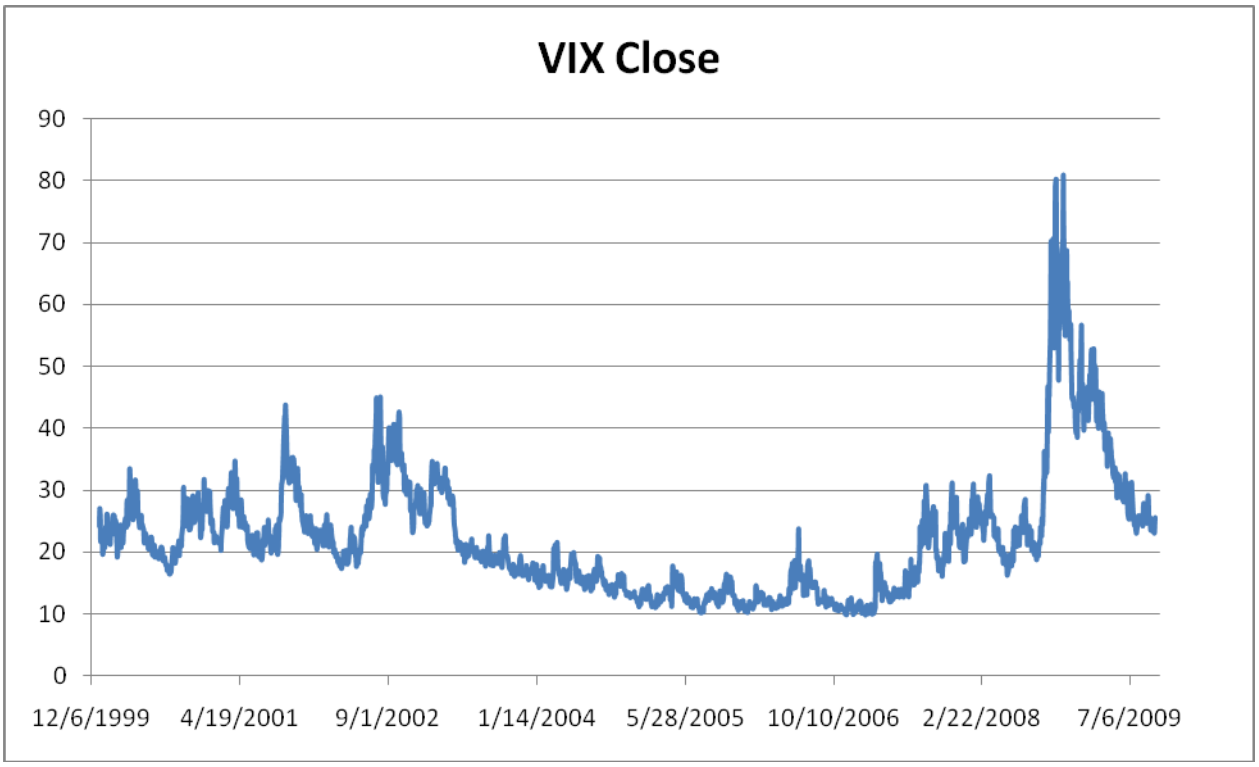
world of integrated financial sectors, global banks of surplus countries can themselves be exposed if they are poorly regulated and have incentives to take on assets of poor quality (being financed elsewhere by the imbalances).

Obstfeld and Rogoff (2009) present a more nuanced view that both the perpetuation of global imbalances and the occurrence of the financial crisis has common roots in loose monetary policies in the United States (and China's ability to maintain an underpriced currency), as discussed below. Note, however, that this common explanation – the loose monetary policy in the US – fails in explaining the geography of the financial crisis, as outlined in Figures 15-16 and Table 2.

4. *Mis-pricing of risk: The "false" belief in the Great Moderation and the "animal spirits":*

Akerlof and Shiller (2009) present perhaps the most authoritative endorsement of the view that there were strong psychological forces that led to the current financial crisis. They attribute the crisis both to the blind faith in ever-rising house prices and correspondingly plummeting faith in capital markets once the house prices crashed. There was certainly a widely shared view among macroeconomists in the decade prior to the crisis that a so-called "Great Moderation" had become established, a period with a genuine fall in macroeconomic volatility due to development of global capital markets and the risk-sharing that it provided (Stock and Watson, 2002). This was reflected in a downward revision of asset price volatility as shown in Figure 17 for levels of VIX, a measure of market volatility implied from short-term (30-day) option prices on the S&P 500 stock index. VIX typically ranged above 20% per annum prior to 2003, but almost always remained between 10% and 20% until the Summer of 2007. Within two years, it had jumped to an unprecedented level of 80%.

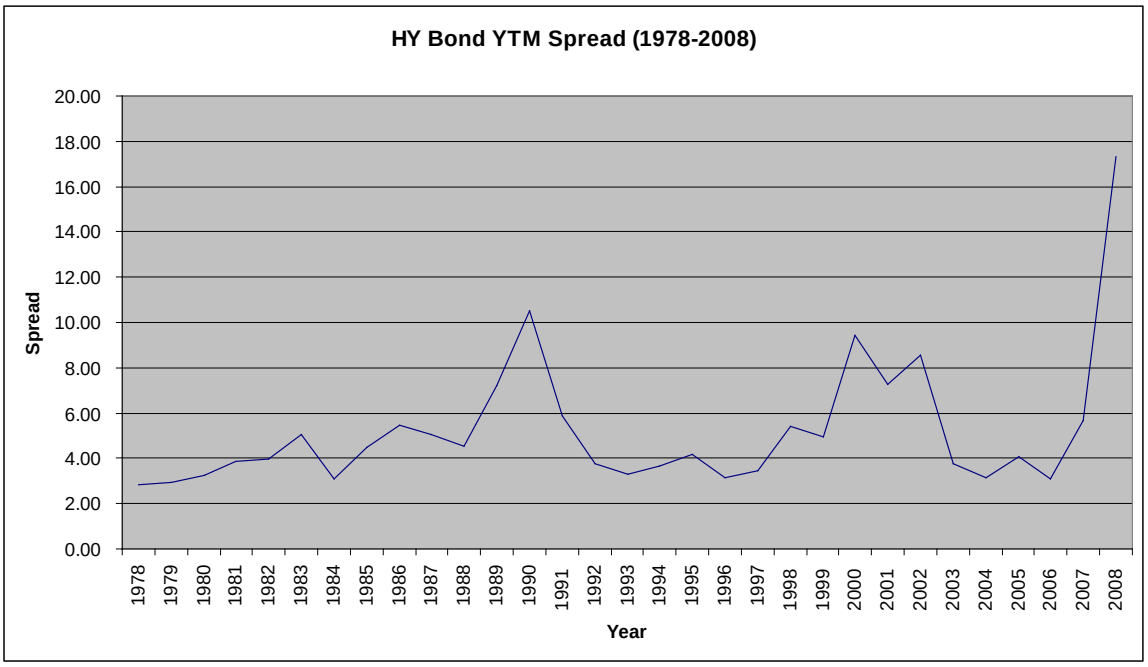
Figure 17: Behavior of VIX, the option-implied measure of volatility during 2000-2009 (Source: Chicago Board Options Exchange)



Akerlof and Shiller (2009) and other proponents of behavioral explanations of the financial crisis attribute the housing and the credit market boom to a misplaced faith in a permanent downward shift in volatility, or to markets in general being excessively euphoric in good times and failing to impose sufficient discipline on risk takers. In other words, the behavioral view of the financial crisis is simply that risks were mispriced and markets ignored early-warning signals that the housing market and the economy were overheated, fueling the boom instead through extraordinary valuations attached to both credit and equity instruments.

Such a view is not entirely unwarranted. Figure 18, for instance, graphs the high yield bond spread over Treasuries on an annual basis over the period 1978 to 2008. The lowest point in the graph, from June 1, 2006 onwards (not visible due to the annual nature of the data), is 260 basis points on June 12th 2007. This is remarkably close to the start of the crisis, indeed, just a few of weeks before Bear Stearns' hedge funds that invested in sub-prime securities ran into problems. As the graph shows, the high yield bond spread was essentially hovering around its historical lows for most of 2004-07, when the risks were in fact rising in the financial sector of the economy. Again, within two years, this spread jumped to the historic high of 1800 basis points.

Figure 18: Historical High Yield Bond Spreads (1978-2008)
Source: Salomon Center, Stern School of Business, NYU



So why does the behavioral explanation fall short in explaining this particular episode? Note that housing assets cannot be easily short-sold. That is, a speculator wanting to express a

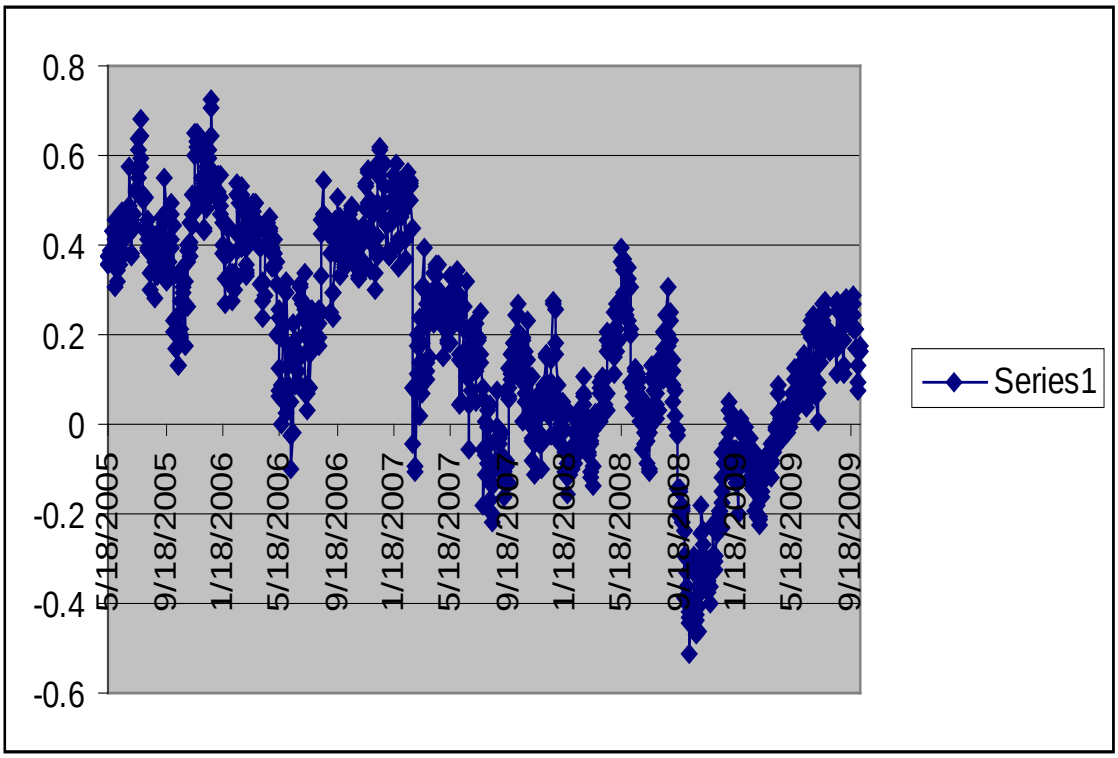
negative view on the housing market cannot do so easily. Indeed, this became possible only a year prior to the crisis through development of trading in protection products on (ABX) indices linked to prices of asset-backed securities. Consequently, housing booms and busts are by and large a function of availability of credit in the economy. When there is a credit boom, housing prices rise substantially; and when there is a credit contraction, housing prices decline. It is imperative for the behavioral explanation to come to terms with reasons for and consequences of the credit boom and bust.

As explained in Section III, the financial sector had undertaken highly sophisticated structures in order to buy mortgages from originators, securitize them, partly sell them and hold the rest. If their own access to credit was very inexpensive or if they simply mispriced the risk of a housing crash, there would have been no need to increase their own leverage in funding the tremendous creation of housing finance that occurred. The financial sector had to simply expand its asset-base, and capital was readily available to do so (at abnormally low costs under the null of the behavioral hypothesis). But asset expansion was not simply a scaling-up of balance sheets. Instead, the asset-expansion was associated with a rise in the leverage of financial institutions, in particular through design of clever guarantees sold to ABCP conduits and slicing and dicing of risks to create AAA-rated tranches, which in turn helped reduce capital requirements. Consequently, the picture that emerges from the evidence in Section III is one of a financial sector eager to take on excessive leverage even in a world where equity capital was easily available. Furthermore, there is something internally inconsistent about bankers getting it all wrong as far as price of risk is concerned and yet getting it all right as far as reduction of capital requirements is concerned.

Finally, the leverage undertaken by the financial sector was essentially reflective of a severe short-term bias. Again, as explained in Section III, the leverage was constructed primarily through issuance of short-term asset-backed commercial paper (for commercial banks) or unsecured commercial paper (for investment banks). Since investors in such paper have the right to "run" on the issuing conduits or investment banks, the pricing of such debt is naturally dependent on short-term measures of volatility. Banks sponsoring conduits or holding the underlying long-term assets are however subject to short-term volatility. In particular, if risk rises, the short-term paper may not be rolled-over and the shortfall would have to be met by bank capital. Since the risk-taking model of modern banking during 2004-07 was built around constructing short-term carry and paying it out as profits, the long-run risks were ultimately ignored also by bank managers and their boards.

Figure 19 shows that the ratio of 2-year implied volatility from S&P 500 option prices was on average 30-40% higher than the short-term 1-month volatility over the period 2Q 2005-2Q 07. This upward sloping term-structure of volatility is typical during boom periods, when short-term volatility is low and long-term volatility is high, and inverts itself during stress times (as can be seen in the figure after the onset of the crisis). As noted by Engle (2009), long-run volatility should incorporate the possibility that the level of risk may change over time -- that is, rise from the current levels in boom times. This was indeed the case with market-observed long-term volatility. Hence, it is more likely that the financial sector at large ignored the long-term risks because it had incentives to do so, as discussed below.

Figure 19: Ratio of 2-yr at-the-money (ATM) S&P 500 implied volatility to 1-mth ATM volatility, i.e.,$\sigma_{2yr}/\sigma_{1mth} - 1$ (Source: Bloomberg)



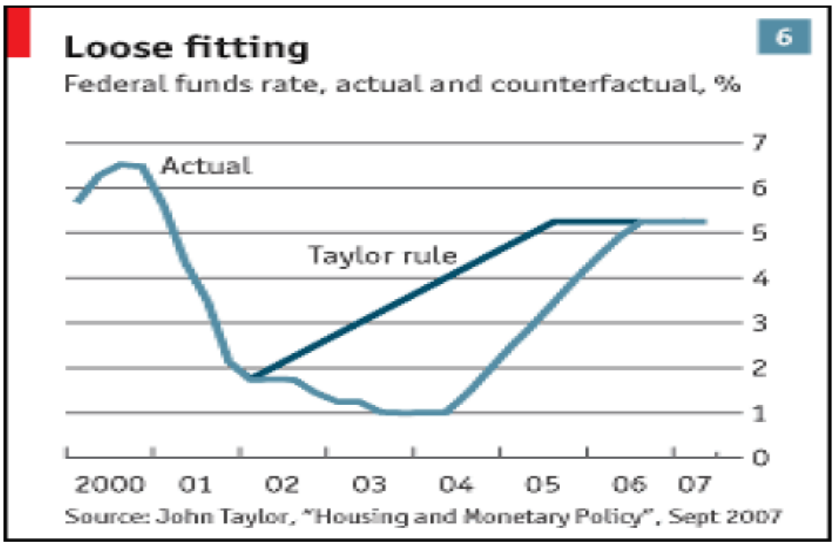
All of this still begs the question why there were such abrupt shifts in the market price of risk when the crisis took hold in August 2007. We conjecture that since most risks undertaken by the banking sector were through opaque over-the-counter and off-balance sheet positions, investors did not have the relevant information that disclosed regulatory capital levels of banks did not mean what they implied. When its hedge funds invested in sub-prime assets had to be bailed out by Bear Stearns, and BNP Paribas' hedge funds suspended redemptions on August 8 2007, the absence of a market for selling sub-prime asset-backed securities made it clear to investors that the entire financial sector had taken a one-way bet on the economy. Since that day, markets have in fact been right about most failures (of the shadow banking world, leveraged hedge funds, Bear Stearns, Lehman Brothers, Wachovia, Washington Mutual, etc.) with the

exception of A.I.G., whose collapse and rescue in September 2008 was a surprise to most observers. We conjecture that market's failure in picking up AIG's woes was most likely due to opacity arising from the completely over-the-counter (and thus, largely unregulated and often undisclosed) nature of its credit default swap positions. Regulatory arbitrage exposes markets to unexpected outcomes, and most likely played a destabilizing role during 2004-09. It ultimately compromised market discipline in good times (2004-2Q 07) producing low cost of credit, so that the correction that took hold on the release of hidden information (3Q 2007-09) had to be larger and more severe.

5. *The Greenspan "put":* An important reason why asset-pricing bubbles may arise (even in the absence of "animal spirits") is due to the risk-shifting problem of leveraged households and financial institutions, coupled with the so-called "Greenspan put" - that when asset prices (such as house prices) decline, interest rates will be lowered by the central bank. An expected future reduction of interest rates will tend to raise asset prices, exacerbating the risk-shifting problem associated with the limited liability option in leveraged financing of assets. Allen and Gale (2000) explain in a simple model that if borrowing costs are insensitive to risks (e.g., due to government guarantees or opacity), then asset-pricing bubbles arising due to loose monetary policy can, in the limit, be explosive in nature. Taylor (2009) argues that the counter-factual interest rates based on the "Taylor rule" during the period 2002-05 far exceeded the low interest rates adopted by the US Federal Reserve after the recession of 2001-02 (see Figure 20). Taylor also shows that under this counterfactual, the housing price boom and bust that developed would probably not have materialized --"no boom, no bust". Obstfeld and Rogoff (2009) couple the loose monetary policy argument with global imbalances, implying that low interest rates in the

United States allowed it to continue with its foreign borrowing at low rates to maintain its macroeconomic imbalances and avoid tough policy decisions concerning the fiscal deficit.

Figure 20: Loose monetary policy of the United States (*The Economist,* 18 October 2007)



By and large, the role played by loose monetary policy in fueling the housing price bubble is hard to dispute. Indeed, US monetary policy kept borrowing rates low not just for the households but also for the financial sector. Importantly, it made it attractive for banks from outside of the United States to borrow in US dollars and fund asset purchases in the US (Acharya and Schnabl, 2009). This does not necessarily explain why we ended up with a full-blown banking crisis, however. As we have stressed earlier, had the banks and LCFIs transferred the assets they created by lending down the quality curve – mainly sub-prime mortgages – on to end-investors, even the large negative shock arising due to popping of the housing bubble would not have resulted in a significant financial crisis. Consequently, we view loose monetary policy during 2002-05 as a primary candidate for sowing seeds of the economic crisis in the United

States, whereas the tail risk-seeking, regulatory arbitrage motives of the LCFIs as the primary explanation for the financial crisis.

6. *Liquidity crisis or solvency crisis?* Finally, we consider the classic debate whether financial crises occur due to liquidity or solvency problems, in the context of this crisis. Allen and Gale (2007) build a series of economic models of financial crises in which depositors run on banks following the arrival of some adverse news about bank asset quality. The inability of banks to liquidate long-term assets at their fair values plays a crucial role in precipitating the crisis. Specifically, if the market among buyers of assets is segmented, or if there is not sufficient arbitrage capital set aside for asset purchases, then liquidation values reflect available cash in the market -- Allen and Gale call this "cash-in-the-market" pricing -- rather than fundamental values. In turn, the likelihood of such liquidations causes all depositors to run at once, since there will not be much long-run value in assets left post-liquidations. In other words, liquidity problems in the market for assets exacerbate the problem caused by adverse news about those assets.

Figure 21 shows that the market indeed had adverse information about asset quality. The figure graphs the de-meaned value of the ratio of the Office of Federal Housing Enterprise Oversight (OFHEO) repeat-sale house price index to the Bureau of Labor Statistics (BLS) shelter index (i.e., gross rent plus utilities components of the CPI). Because of de-meaning, the average value of this ratio is zero. As is clear that the peak is reached in 2006 at a value of 0.3 but thereafter the ratio declines sharply. Thus, prior to outbreak of the crisis in Summer of 2007, there was certainly credible adverse evidence about the value of the underlying housing assets (see also Figure 14 on the time-series of ABX indices).

Figure 21: House Price to Rent Ratio (1975-2008)
Source: Own calculations, OFHEO, BLS

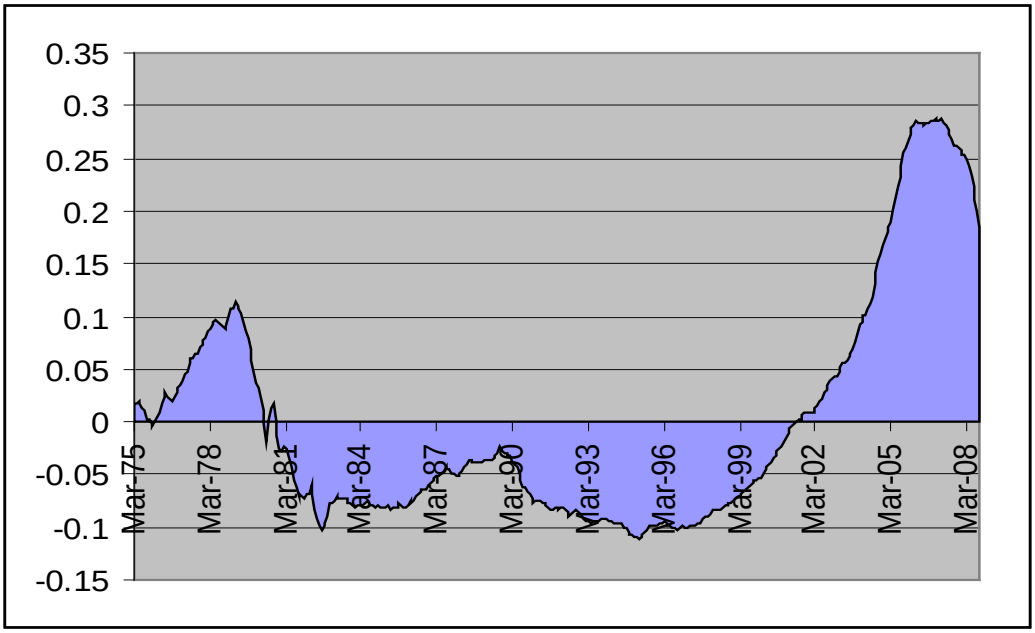
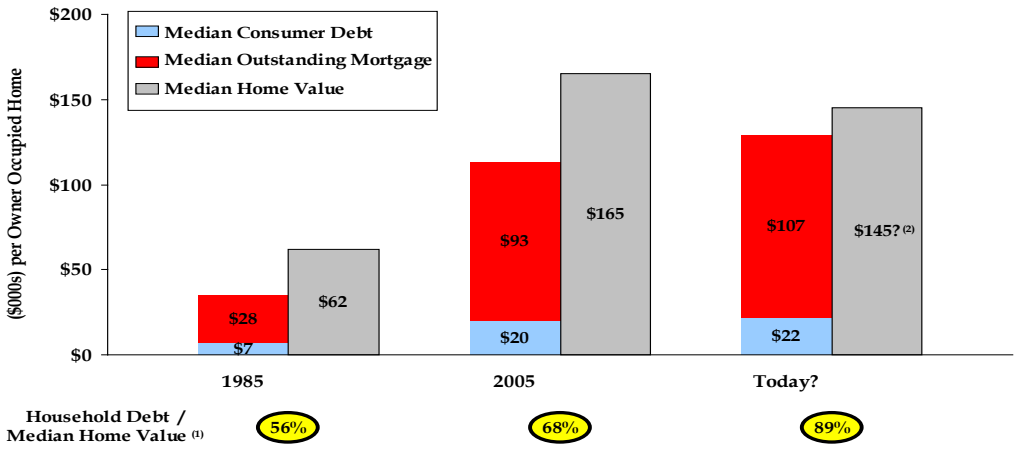


Figure 22: Household Debt/Home Values (1985, 2005, 2008)
Source: U.S. Census Bureau, Federal Reserve Flow of Funds, S&P Case-Shiller Index.



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What made the housing price shock primarily a solvency issue was the high leverage in both the household sector and the financial sector. Figure 22 graphs estimates of household debt over home values of the median household. The median value of outstanding mortgage principal amount of owner-occupied units and the consumer credit per household was derived from the U.S. Census Bureau and Federal Reserve Flow of Funds, and the 2008 median home value was adjusted from the 2005 fourth quarter value using the Case-Shiller National Home Price Index. The ratio of household debt to home values stood at a remarkable 89% in 2008 compared to just 68% in 2005, and 56% twenty years earlier, in 1985. Similarly, Table 1 showed that the financial sector was likewise significantly exposed to housing values.

So right from its inception, the financial crisis of 2007-09 appears to have been a crisis of solvency not just for the household sector but also for the financial sector. It is indeed the case that when a large number of economic agents de-lever at once, market prices will reflect liquidity discounts (Allen and Gale, 2007) and short-term creditors will "run" as debt capacity of assets deteriorates due to the market-driven discounts (Acharya, Gale and Yorulmazer, 2008). Nevertheless, the primary cause of both of these problems is the need to de-lever and the fact that the leveraged agents are all on the same side of the trade. We therefore believe that the "liquidity problems" witnessed in this crisis, while clearly a symptom of some market segmentation and mark-to-market treatment in regulatory capital buffers of banks, they ultimately were connected to at least some solvency problems.

The root cause of the crisis as a solvency problem of households and the financial sector is perhaps one explanation for why the highly innovative liquidity injection facilities created by the Federal Reserve (and other Central Banks) in its lender-of-last-resort function did not

ultimately succeed in stemming the crisis. Between Fall 2007 and Dec 2008, the Federal Reserve effectively created backstop facilities for most kinds of assets that experienced stress in the crisis; it provided longer-term lending facilities against the highest-quality collateral, extended discount window to securities firms and investment banks, lent against high-quality illiquid asset-backed securities, lent for purchases of ABCP and unsecured CP, provided liquidity to money market funds, and purchased assets of the GSE's. These were liquidity-targeted measures, and were unlikely to save the day if the underlying problem was insolvency. Indeed, any balance-sheet restructuring or solvency stress tests occurred only after 14 months into the crisis, following the failure of Lehman Brothers in mid-September 2008. At that stage the crisis had already taken fully systemic proportions.

In fact, some of the markets the central banks attempted to restore through liquidity injections – such as illiquid mortgage-backed securities – continue to remain moribund over two years after the onset of the crisis due to the substantial overhang of debt and poor quality assets on the financial sector's balance-sheets. As an illustration of this point, consider Figure 14 again which shows the price behavior of ABX of AAA-rated subprime tranches issued in first and second halves of 2006 and 2007. The plot shows that in spite of the significant economic and financial stimulus, and government backing to support leveraged purchases of these assets, the tranches have recovered little as of February 2010, especially the tranches based on 2007 assets. From their lows of 20-30 cents on a dollar, these tranches have only recovered about 10 cents, highlighting that even fifteen months after bank recapitalizations these assets' prices remain depressed relative to par. This is strongly suggestive of poor cash flow realizations and quality of underlying mortgages rather than of a persistent liquidity discount.

Some of the worst assets, originated in 2006 and 2007, were taken over by regulators (explicitly or through government back-stops) while rescuing Bear Stearns and Citigroup, and are generating losses even to date on the regulators' books. Financial Times, February 16 2010 ("Bear property losses weigh on Fed") reports that the US Federal Reserve is sitting on significant paper losses on the real estate assets in its Maiden Lane I portfolio acquired in the Bear Stearns rescue in March 2008, with much of the red ink coming from debt used to back some of the most high-profile buyout deals of the bubble years (e.g., Hilton Hotels which is being restructured and Extended Stay which is in bankruptcy). The assets – all of which came from Bear's mortgage desk – were originally valued at $30bln and at the end of 2009, they were said to be worth $27.1bln, about 10% loss, in spite of the economic stimulus and recovery. Commercial real estate holdings fell from $7.7bln valuation to $4bln. "It was the scrapings off the slaughterhouse floor. It started with the things that were not good enough to get securitized". While the Fed Chairman Ben Bernanke insists that they will ultimately not make losses on these portfolios, the temporary valuations of these assets have not yet rebounded, suggesting that the worst assets might be sitting in regulatory balance-sheets, masking the true profitability of the banking sector portfolio from pre-Lehman days.

V. CONCLUSION

We have argued in this essay that there was a fundamental shift in the business model of large, complex financial institutions during the period of 2003-2Q2007. This new business model led to their "manufacturing" tail risks that were systemic in nature. This involved, inter alia, selling deep out-of-the-money guarantees to off-balance sheet vehicles and holding little capital against

them, or warehousing AAA-rated tranches of subprime mortgage-backed assets and financing their purchase with deposits and short-term commercial paper. They did this without sufficient capital to back the associated market, credit and liquidity risk exposures. We conclude that the propensity of LCFIs to take on these risk exposures reflected an overriding risk-shifting incentive. The specific forms of this involved the use of complex innovations to arbitrage regulatory capital requirements.

While conclusive empirical evidence explaining the cause of such a shift in the banking model is worth pursuing, the history of bank regulation and the dynamics of the financial intermediation business itself suggest that there are several contributing factors. These include (a) increased competition which has eroded the profit margins in the traditional banking model and thus the "franchise value" of banks, (b) explicit or implicit provision of government guarantees without appropriate charges or fees for the insurance cover implied and without ring-fencing of guarantees for the originally intended purposes, and (c) a passive regulatory stance towards the arbitrage of capital requirements on the part of the financial intermediaries themselves. The erosion of franchise values made it attractive for LCFIs to increase leverage. Mis-priced government guarantees and lack of ring-fencing meant that tail risks could be manufactured without affecting the cost of funding. The lax enforcement of capital requirements allowed these tail risks to be retained on- or off-their balance sheets. Macroeconomic factors such as low interest rates in the US and large capital flows into trade-deficit countries such as the US and the UK undoubtedly amplified the inherent propensity for seeking tail-risk in the financial sector.

Our recommendations in Acharya, Cooley, Richardson and Walter (2010a, b) for reforming financial sector regulation directly address some of these underlying drivers. Below we provide a brief summary of our proposals:

First, systemic financial intermediaries like LCFIs must be charged fees (effectively insurance premiums) commensurate with the explicit or implicit government insurance they enjoy on a continuous basis, and not just when resolution funds have been depleted in crisis situations. These insurance premiums would be explicitly linked to their overall risk profiles and insured deposit base -- as well as to their total leverage given the likelihood of ex-post forbearance when large players fail.

Second, there should be an additional fee or premium that is tied specifically to the systemic risk of banks and other LCFIs given the reality that systemic failures are associated not just with ex-post forbearance but also with significant negative externalities bearing on the rest of the financial sector and the real economy. While systemic risk is difficult to quantify, a start needs to be made in this direction.

Third, it must be recognized that charging of such fees or insurance premiums depends inherently on the regulatory assessment of risk. Even with market-based data and good supervisory intelligence, macro-prudential risk assessment might well be imperfect, since there are always internal issues related to capital and risk allocations whose consequences are not fully reflected or visible, even at the level of their own boards and much less to outside stakeholders. To this end, some discipline that is based on realized outcomes is necessary. This might be some type of "contingent capital" that could for example take the form of debt that automatically converts into equity when bad firm-level or systemic states materialize. There are plenty of alternatives of this nature that could be helpful.

Finally, it is worth considering -- whether by regulatory fiat or through appropriate capital charges -- if a form of functional separation or carve-outs needs to be enforced, as is being advocated, by Paul Volcker, Mervyn King, and others who are deeply skeptical about the efficacy of finely-tuned regulation of financial firms that have time and again proven their skill at regulatory avoidance and arbitrage. This separation would carve out the traditional banking and intermediation activities of lending and underwriting from the more risk-prone activity of proprietary trading or effectively running an in-house hedge fund, which are the likely "manufacturing" centers for tail risk and systemic instability. Enforcing or inducing a separation of this type might well erode some economies of scope between hedging and trading activities at banks and other LCFIs. In return, it could render more tractable the immense moral hazard problem arising from accordance of government guarantees and the inevitable opacity and complexity associated with financial innovations aimed at exploiting loopholes and undermining systemic safety and soundness. Functional separation may well be a small price to pay for enhanced robustness of the financial system.

Appendix: Tail Risk in the Rest of the World

Over the years there has been a great deal of debate about the relative properties of alternative financial systems around the world: How do they differ from one another, and how do they compare in achieving what financial systems are supposed to achieve in terms of the public interest – an optimum combination of efficiency, innovation and global competitiveness, balanced against stability and robustness? Financial systems do indeed differ widely among national financial systems in terms of the role of universal banks and financial conglomerates,

specialized financial intermediaries of various kinds, government-owned and hybrid financial services providers, financial cooperatives and the like. The financial crisis of 2007-09 provides an unusual opportunity to perform a robustness check into the resilience of financial systems in terms of their inherent fragility, propagation of financial shocks and their transmission to the real sector of the economies.

The available date on write-downs of impaired assets that are at the center of the crisis suggest that non-US financial intermediaries were as involved as their US competitors in taking losses (Exhibit 1). By the end of 2006 and the onset of the crisis, a small number of non-US banks had pushed into the upper brackets of the fixed-income origination league tables – notably Deutsche Bank AG, UBS AG and Credit Suisse. As the volume of fixed-income originations shifted to asset-backed securities (ABS) and mortgage-backed securities (MBS) as well as collateralized debt obligations (CDOs) and related instruments, one would expect these firms to have also taken on "pipeline" exposures to these instruments comparable to American firms like Merrill Lynch and Citigroup. The incentive for these non-US wholesale intermediaries – all of whom are universal banks or financial conglomerates – to invest in these securities and assume warehouse risk exposures would have been the same as for the US firms. In fact, in some cases such as UBS the incentive could have been even greater due to the abnormally low cost of funds attributable to the large private banking divisions. Consequently, as confirmed by Exhibit 1, in the losses taken by the big wholesale financial intermediaries as of late-2009 the major European players featured no less than their American rivals.

Beyond the key originators and intermediaries were the banks that engaged minimally in the intermediation process but principally took on the role of investors in what ultimately became damaged assets. Again, Exhibit 1 shows that over half of the top-50 losers were non-US banks.

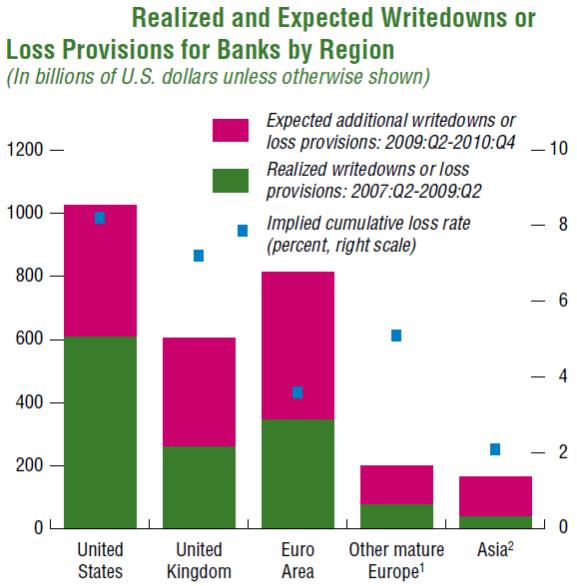
A number of these (most notably, ABN AMRO, HBOS and IKB) had set up off balance sheet vehicles (conduits and SIVs) to avoid the capital requirements associated with this exposure. Northern Rock that collapsed in September 2008 in the UK was also heavily reliant on wholesale asset-backed paper and had grown its mortgage book multi-fold with little growth in retail deposit base. When the crisis hit, these banks took large losses (in some cases arguably larger than indicated due to less conservative marks as to their value) and could not roll over their leverage as they had arranged little capital buffer to guard against the underlying credit and rollover risks. Exhibit 2 shows the IMF's estimates of the magnitude of those losses realized as of 2009 (Q2) and the expected write-downs through the end of 2010, showing European losses to be far higher than American losses.

The losses booked so far and the apparent difference in marked asset valuations between the US and Europe suggests further pain for the surviving institutions. Exhibit 3 estimates the additional capital that would have to be raised by individual European banks to reach 4% and 5%, respectively, of risk-weighted assets under the Basle 2 standards. This assessment is broadened in Exhibit 4 to banks home-based in specific European countries, according to IMF estimates in October 2009. It is clear from this last exhibit that if the US marks prove to be more accurate than the continental European marks, then the European banks will have a great deal of capital raising to do given the significant tail risk of real estate and the global economy at large to which they built exposures leading up to the crisis.

Exhibit 1
Exposure Write-Downs and Capital Raised (in billion dollars) as of October 2009
Source: Bloomberg

Firm	Loss	Capital
Wachovia Corporation	101.9	11
Citigroup Inc.	88.3	109.3
Merrill Lynch & Co	55.9	29.9
UBS AG	50.6	32.9
Washington Mutual Inc.	45.3	12.1
Bank of America Corp.	42.7	78.5
HSBC Holdings Plc	42.2	23.5
JPMorgan Chase & Co	33.3	44.7
HBOS Plc	25.7	22.4
National City Corp.	25.2	8.9
Wells Fargo & Company	23.4	41.8
Morgan Stanley	21.5	24.6
Royal Bank of Scotland	20.7	48.5
Deutsche Bank AG	16.4	5.9
Lehman Brothers Holdings	16.2	13.9
Bayerische Landesbank	16.1	20
Credit Suisse Group AG	15.8	11.9
Barclays Plc	14.2	26.8
ING Groep N.V.	14	19.4
IKB Deutsche Industries	13.9	11.4
Societe Generale	8.9	11.1
Fortis	8.9	21.7
Credit Agricole S.A.	7.7	12
Natixis	7.7	7.8
BNP Paribas	7.6	3.4
Mizuho Financial Group	7.5	8.2
Canadian Imperial Bank	7.3	2.5
PNC Financial Service	7.2	8.1
Goldman Sachs Group	7.1	20.5
DZ Bank AG	7	0
Dexia SA	6.2	8.6
KBC Groep NV	6.2	7.4
SunTrust Banks Inc	6.1	4.9
UniCredit SpA	6	10.1
Bank of China Ltd	5.9	0
Other Asian Banks	5.5	16.9
Other European Banks	5.5	4.5
Hypo Real Estate Holdings	5.4	0
Indymac Bancorp	5.2	0

Exhibit 2



Source: IMF staff estimates.
[1]Includes Denmark, Iceland, Norway, Sweden, and Switzerland.
[2]Includes Australia, Hong Kong SAR, Japan, New Zealand, and Singapore.

Exhibit 3 (Source: International Monetary Fund, Global Financial Stability Report, April 2009)

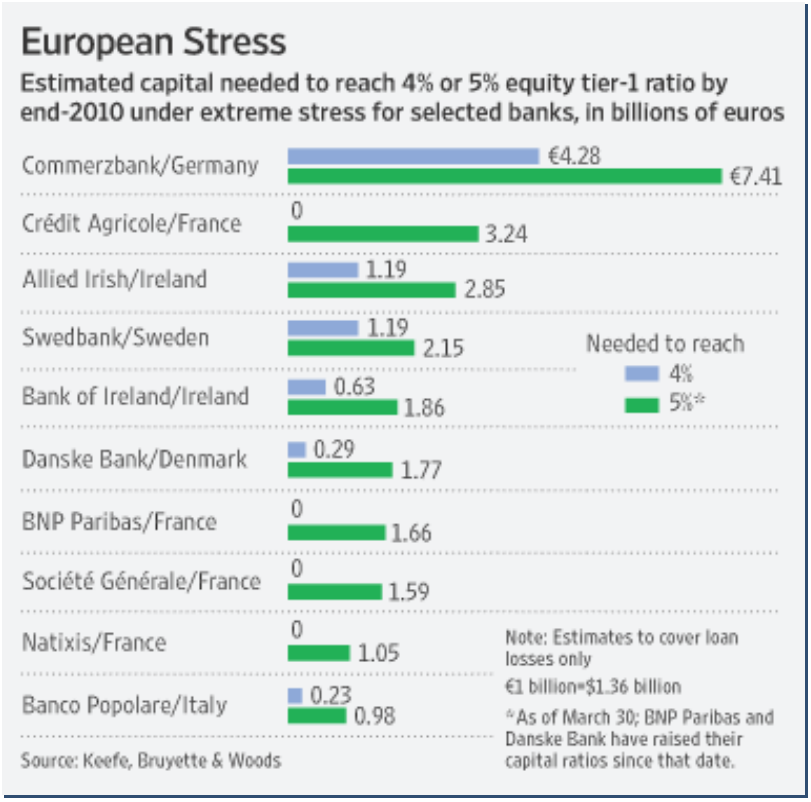


Exhibit 4
Estimates Additional Capital Raising Needed to Reach Specific Targets

Source: IMF staff estimates.

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- Stern, Gary and Ron Feldman, 2004, *Too Big to Fail: The Hazards of Bank Bailouts*, Brookings Institution Press, Washington D.C.

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- Stock, James H. and M. W. Watson, 2002, “Has the Business Cycle Changed and Why?”, *NBER Macroeconomics Annual*, 159–218.

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Professor of Finance (2008-), Faculty Council Member (2009-), Research Appointments Task Force (2010-)
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General Indian, Born on 1st March 1974, Married

Education

Ph.D. Finance, Stern School of Business, New York University, 1996 – 2001
- Dissertation - "Essays in Banking and Financial Institutions"

Ph.D. Computer Science (Incomplete), New York University, 1995 – 1996
B. Tech. in Computer Science and Engineering, IIT Bombay, 1991 – 1995
- President of India Gold Medalist for the highest GPA among 350 students.
- President of India Gold Medalist for the best academic and overall proficiency.
- Ranked 5th all over India at IIT Joint Entrance Exam, 1991.

Academic Appointments

Initiative on Global Markets (IGM) Visitor (May 2009), University of Chicago, Booth School
Professor of Finance (2007-2009), London Business School
Visiting Professor of Finance (Winter 2007), Graduate School of Business, Stanford University
Associate Professor of Finance with tenure (2005-2006), London Business School
Assistant Professor of Finance (2001-2005), London Business School

Other Positions

- Research Associate, National Bureau of Economic Research (NBER) in Corporate Finance, 2009-
- Research Affiliate, Center for Economic Policy Research (CEPR), 2002-
- Research Associate, European Corporate Governance Institute (ECGI), 2009-
- Member of the Research Advisory Board of the British Private Equity and Venture Capital Association, Fall 2008-
- Academic Advisor to the Federal Reserve Bank of New York and Member of the Liquidity Working Group (Jan 2009-), Philadelphia (Jan 2009-), Cleveland (May 2009-), Board of Governors (Fall 2010-)
- Academic Panel Member, the International Centre for Financial Regulation, 2010-
- Academic Director, Coller Institute of Private Equity at London Business School, 2007-09
- Senior Houblon Norman Fellow at the Bank of England (July-August 2008)
- Academic Advisor to the Bank of England (Dec 2004-June 2008)
- Visiting Scholar, International Monetary Fund, August 2006
- Member – American Finance Association, Western Finance Association, European Finance Association, Financial Intermediation Research Society, European Corporate Governance Institute, Society of Financial Econometrics (SoFiE), Volatility Institute

Awards

- Excellence in Refereeing Award, *American Economic Review*, 2009.
- Finalist/Honorable mention for *Restoring Financial Stability: How to Repair a Failed System* (co-edited with Matt Richardson), John Wiley & Sons, at the PSP/PROSE 2009 awards of the Association of American Publishers in Business, Finance and Management
- L. Glucksman Institute (NYU Stern) Best Paper Award for 2009-10 – "Rollover Risk and Market Freezes"
- Best Paper Award (Viz Risk Management Prize on Energy Markets, Securities, and Prices) at the European Finance Association Meetings, 2009 – "Limits to Arbitrage and Hedging: Evidence from Commodity Markets"
- Distinguished Referee Award from the Review of Financial Studies, 2009
- III Jaime Fernandez de Araoz Corporate Finance Award, 2009 – "The Internal Governance of Firms"
- Best Paper on Corporate Governance awarded by the European Corporate Governance Institute, 2008 – "Corporate Governance Externalities"

- Journal of Financial Economics Best Paper in Capital Markets and Asset Pricing, Second (Fama/DFA) Prize, 2007 – "Does Industry-wide Distress Affect Defaulted Firms? – Evidence from Creditor Recoveries"
- The "Rising Star in Finance" Award at the Inaugural Rising Stars Conference in Albany organized by Rennslear Polytechnic Institute (RPI), 2008.
- Citibank Best Paper Award at the Summer Research Conference of the Center for Analytical Finance (CAF) at Indian Business School, 2007 – "Bankruptcy Codes and Innovation"
- Second Runner-up Award for the Best Paper at the 13th Mitsui Life Symposium on "Value Creation: Financing and Organizing the Firm" at the University of Michigan, 2007 – "Bankruptcy Codes and Innovation"
- Journal of Financial Economics Best Paper for Capital Markets and Asset Pricing, First (Fama/DFA) Prize, 2005 – "Asset Pricing with Liquidity Risk"
- First recipient of the Lawrence G. Goldberg Prize for the Best Ph.D. in Financial Intermediation, 2005
- Outstanding Referee Award for the Review of Financial Studies, 2003
- NYSE Award for Best Paper on Equity Trading, WFA Meetings, 2003 - "Asset Pricing with Liquidity Risk."
- Best Student Paper Award at FMA European Conference, 2001 - "Is the International Convergence of Capital Adequacy Regulation Desirable?"
- Journal of Financial Economics Best Paper for Corporate Finance and Organizations, First (Jensen) Prize, 2000 - "On the Optimality of Resetting Executive Options."
- Lehman Brothers Fellowship for Excellence in Finance Research - First Prize, 2000 (Awarded to a graduating student across MIT, Harvard, NYU, Columbia, Wharton, and Chicago) - "A Theory of Systemic Risk and Design of Prudential Bank Regulation."
- L. Glucksman Institute Research Awards, NYU Stern - First Prize (2002-2003, 1998-1999), Second Prize (2000-2001), and CDC Working Paper Awards, NYU Stern - First Prize, 2003, 2000, 1999
- Harold W. MacDowell Award for Outstanding Achievement in Doctoral Program, Stern School of Business, NYU, 2001

Research

Areas of Interest

- Banking – Liquidity, Crises, Systemic Risk, Regulation, Diversification of Loan Portfolios.
- Corporate Finance – Cash Management, Incentive Compensation, Bankruptcy Systems, Private Equity and Corporate Governance.
- Asset Pricing – Causes and Effects of Liquidity Risk, Disclosure and Insider Trading.
- Valuation and Hedging of Corporate Debt and Credit Derivatives.
- International Finance – Law, Innovation, Growth and Crises.
- General Equilibrium – Agency and Default.

Publications

- "Creditor Rights and Corporate Risk-taking" with Yakov Amihud and Lubomir Litov, *forthcoming, Journal of Financial Economics.*
- "Leverage, Moral Hazard and Liquidity" with S. Viswanathan, *forthcoming, Journal of Finance.*
- "Crisis Resolution and Bank Liquidity" with Hyun-Song Shin and Tanju Yorulmazer, *forthcoming, Review of Financial Studies.*
- "Do Global Banks Spread Global Imbalances? The Case of Asset-Backed Commercial Paper during the Financial Crisis of 2007-09" with Philipp Schnabl, *forthcoming, IMF Economic Review.*
- "Causes of the Financial Crisis" with Matthew Richardson, 2009, *Critical Review,* 21(2–3): 195–210.
  - Reprinted as Chapter 7. "How Securitization Concentrated Risk in the Financial Sector." In Jeffrey Friedman, ed., *The Causes of the Financial Crisis,* University of Pennsylvania Press, 2010.
- "Systemic Risk and Deposit Insurance Premiums" with Joao Santos and Tanju Yorulmazer, *forthcoming, Economic Policy Review, Federal Reserve Bank of New York.*
- "Finance and Efficiency: Do Bank Branching Regulations Matter?" with Jean Imbs and Jason Sturgess, *forthcoming, Review of Finance.*

- "More Insiders, More Insider Trading: Evidence from Private Equity Buyouts" with Timothy Johnson, *forthcoming, Journal of Financial Economics.*
- "Cross-country Variations in Capital Structures: The Role of Bankruptcy Codes," with Kose John and Rangarajan K. Sundaram, *forthcoming, Journal of Financial Intermediation.*
- "Corporate Governance Externalities" with Paolo Volpin, *Review of Finance*, 14(1), 2010, 1-33 (lead article).
- "A Theory of Systemic Risk and Design of Prudential Bank Regulation", *Journal of Financial Stability*, 5(3), 2009, 224-255.
- "Bankruptcy Codes and Innovation" with Krishnamurthy Subramanian, 2009, *Review of Financial Studies*, 22(12), 4949-4988.
    - "Bankruptcy Codes and Innovation: A Model" with Krishnamurthy Subramanian, theoretical appendix to the above paper, online at *Review of Financial Studies*.
- "Managerial Hedging, Equity Ownership, and Firm Value" with Alberto Bisin, *Rand Journal of Economics*, 40(1), 2009, 47-77.
- "Private Equity versus Plc Boards in the U.K.: A Comparison of Practices and Effectiveness" with Conor Kehoe and Michael Reyner, *Journal of Applied Corporate Finance*, 21(1), 2009, 45-56.
- "Cash-in-the-Market Pricing and Optimal Resolution of Bank Failures," with Tanju Yorulmazer, *Review of Financial Studies*, 21, 2008, 2705-2742.
    - Reprinted in *Handbook on Liquidity and Crises*, Franklin Allen, Elena Carletti, Jan-Pieter Krahnen and Marcell Tyrell, eds., Oxford University Press, forthcoming.
- "Information Contagion and Bank Herding" with Tanju Yorulmazer, *Journal of Money, Credit and Banking*, 40(1), 2008, 215-31.
    - Reprinted in *Handbook on Liquidity and Crises*, Franklin Allen, Elena Carletti, Jan-Pieter Krahnen and Marcell Tyrell, eds., Oxford University Press, forthcoming.
- "Is Cash Negative Debt? – A Hedging Perspective on Corporate Financial Policies" with Heitor Almeida and Murillo Campello, *Journal of Financial Intermediation*, 16(4), 2007, 515-554.
- "Does Industry-wide Distress Affect Defaulted Firms? - Evidence from Creditor Recoveries," with Sreedhar Bharath and Anand Srinivasan, *Journal of Financial Economics*, 85(3), 2007, 787-821.
- "Too-Many-To-Fail – An Analysis of Time-inconsistency in Bank Closure Policies," with Tanju Yorulmazer, *Journal of Financial Intermediation*, 16(1), 2007, 1-31 (lead article).
- "Insider Trading in Credit Derivatives," with Timothy Johnson, *Journal of Financial Economics*, 84(1), 2007, 110-141.
- "Private Equity: Boom and Bust?" with Julian Franks and Henri Servaes, *Journal of Applied Corporate Finance*, 19(4), Fall 2007, 44-53.
- "When Does Strategic Debt-Service Affect Debt Spreads?" with Jing-zhi Huang, Marti G. Subrahmanyam, and Rangarajan K. Sundaram, *Economic Theory*, Feb 2006, 1–16.
- "Should Banks Be Diversified? Evidence from Individual Bank Loan Portfolios," with Anthony Saunders and Iftekhar Hasan, *Journal of Business*, May 2006, 79(3), 1355-1412.
- "Optimal Financial-Market Integration and Security Design," with Alberto Bisin, *Journal of Business*, 78(6), 2006, 2397-2433.
- "Asset Pricing with Liquidity Risk," with Lasse Pedersen, *Journal of Financial Economics*, 77(2), 2005, 375-410.
- "Is the International Convergence of Capital Adequacy Regulation Desirable?" *Journal of Finance*, 58(6), 2003, 2745-2781.
- "Corporate Bond Valuation and Hedging with Stochastic Interest Rates and Endogenous Bankruptcy," *Review of Financial Studies*, 15(5), 2002, 1355-1383 with Jennifer N. Carpenter.
- "Pricing Credit Derivatives with Rating Transitions," *Financial Analysts Journal*, 58(3), 2002, 28-44, with Sanjiv R. Das and Rangarajan K. Sundaram.
- "On the Optimality of Resetting Executive Stock Options," *Journal of Financial Economics*, 57(1), 2000, 65-101, with Kose John and Rangarajan K. Sundaram.

Papers under revision

- "The Internal Governance of Firms" with Stewart Myers and Raghuram Rajan *(being revised for resubmission, Journal of Finance)*.

- "Rollover Risk and Market Freezes" with Douglas Gale and Tanju Yorulmazer *(being revised for resubmission, Journal of Finance)*.
- "A Theory of Slow-Moving Capital and Contagion" with Hyun-Song Shin and Tanju Yorulmazer *(being revised for resubmission, Review of Economic Studies)*.
- "Corporate Governance and Value Creation: Evidence from Private Equity" with Moritz Hahn and Conor Kehoe *(resubmitted, Review of Financial Studies)*.
- "Endogenous Information Flows and the Clustering of Announcements" with Peter DeMarzo and Ilan Kremer *(being revised for resubmission, American Economic Review).*
- "Imperfect Competition in the Inter-Bank Market for Liquidity as a Rationale for Central Banking" with Denis Gromb and Tanju Yorulmazer *(being revised for resubmission, American Economic Journal - Macroeconomics).*

Submitted papers

- "Securitization Without Risk Transfer" with Philipp Schnabl and Gustavo Suarez.
- "Limits to Arbitrage and Hedging: Evidence from Commodity Markets" with Lars Lochstoer and Tarun Ramadorai.
- "Wrongful Discharge Laws and Innovation" with Ramin Baghai and Krishnamurthy Subramanian.
- "Labor Laws and Innovation" with Ramin Baghai and Krishnamurthy Subramanian.
- "Fire-sale FDI" with Hyun-Song Shin and Tanju Yorulmazer.

Working papers

- "Caught Between Scylla and Charybdis? Regulating Bank Leverage When There is Rent-Seeking and Risk-Shifting" with Hamid Mehran and Anjan Thakor.
- "Measuring Systemic Risk" with Lasse Pedersen, Thomas Philippon and Matthew Richardson.
- "Centralized versus Over-the-counter Markets" with Alberto Bisin.
- "The Seeds of a Crisis: A Theory of Bank Liquidity and Risk Taking over the Business Cycle" with Hassan Naqvi.
- "Competition for Managers, Corporate Governance and Incentive Compensation" with Marc Gabarro and Paolo Volpin.
- "Aggregate Risk and the Choice between Cash and Lines of Credit" with Heitor Almeida and Murillo Campello.
- "Precautionary Hoarding of Liquidity and Inter-Bank Markets: Evidence from the Sub-prime Crisis" with Ouarda Merrouche.
- "Liquidity Risk and Correlation Risk: A Clinical Study of the General Motors and Ford Downgrade of 2005" with Stephen Schaefer and Yili Zhang.
- "Cash Holdings and Credit Risk" with Sergei Davydenko and Ilya Strebulaev.

Work in progress

- "Liquidity Risk of Corporate Bond Returns" with Yakov Amihud and Sreedhar Bharath.
- "Seeking Alpha: Excess Risk Taking and Competition for Managerial Talent" with Marco Pagano and Paolo Volpin.
- "The Dark Side of Liquidity Creation: Leverage and Systemic Risk" with Anjan Thakor.
- "Anatomy of Trading and Liquidity in the Credit Default Swaps Market" with Rob Engle.
- "Counterparty Risk in the Credit Default Swaps Market" with Rob Engle.
- "Innovation, Risk-sharing and Financial Fragility" with Rangarajan K. Sundaram.
- "Reciprocity in a Model of Informal Finance" with Raghuram Rajan.
- "Dividend Externalities in the Presence of Leverage" with Hanh Le and Hyun Song Shin.

Books, Monographs and Short Articles on the Crisis of 2007-09

- *"Manufacturing Tail Risk: A Perspective on the Financial Crisis of 2007-09"* with Thomas Cooley, Matthew Richardson and Ingo Walter, *Foundations and Trends® in Finance*, Vol. 4: No. 4, 247-325 (2010).
- *"Rewriting Financial Regulation: Evaluating the Congressional Proposals", e-book published on www.voxeu.org, December 2009,* an assessment from NYU Stern of HR 4173 bill, the Wall Street Reform and Consumer Protection Act of 2009, passed by the U.S. House of Representatives and the U.S. Senate's Restoring American Financial Stability Act.

- *"Restoring Financial Stability: How to Repair a Failed System" – An Independent View from New York University Stern School of Business, Viral V. Acharya and Matthew Richardson, editors, (c) John Wiley & Sons, March 2009.* Some of my articles featured in the book:
    - "Prologue: A Bird's Eye View – The Financial Crisis of 2007-09: Causes and Remedies", with Thomas Philippon, Matthew Richardson and Nouriel Roubini.
    - "How Banks Played the Leverage *Game*" with Philipp Schnabl.
    - "Centralized Clearing for Credit Derivatives" with Robert Engle, Stephen Figlewski, Anthony Lynch and Marti Subrahmanyam.
    - "Regulating Systemic Risk" with Lasse Pedersen, Thomas Philippon and Matthew Richardson.
    - "Private Lessons for Public Banking: The Case for Conditionality in LOLR Facilities" with David Backus.
    - "The Financial Sector *Bailout*: Sowing the Seeds of the Next Crisis?" with Raghu Sundaram.
- *"The Financial Crisis of 2007-09: Causes and Remedies", Viral V. Acharya and Matthew Richardson, editors, New York University Salomon Center Series on Financial Markets, Institutions and Instruments, (c) Blackwell, March 2009*
    - Overview and Executive Summaries of articles in the book *"Restoring Financial Stability: How to Repair a Failed System"*
- "State of Corporate Finance: It's Not Over Yet" with Matthew Richardson, 2009, *Financial Executive*, September 2009, 38-42.
- "Government Guarantees: Why We Need to Put the Genie Back in the Bottle" with Matthew Richardson, *The Economists' Voice*, October 2009.
- "Market Failures and Regulatory Failures: Lessons from Past and Present Crises" with Thomas Cooley, Matthew Richardson and Ingo Walter, *forthcoming in "Financial Sector Regulation and Reforms in Emerging Markets"* edited by Masahiro Kawai and Eswar Prasad, Brookings Institution Press (Washington, DC), 2010.
- "A Tax on Systemic Risk" with Lasse Pedersen, Thomas Philippon and Matthew Richardson, 2010, *forthcoming, NBER publication on Quantifying Systemic Risk,* ed. By Joseph Haubrich and Andrew Lo.
- "Dividends and Bank Capital in the Financial Crisis of 2007-09" with Irvind Gujral and Hyun-Song Shin, *forthcoming, Journal of Applied Corporate Finance*.
- "Capital Budgeting at Banks: The Role of Government Guarantees", with Julian Franks, prepared for Knight Vinke Asset Management, published in various versions in *The Banker (February 2009), QFinance, voxeu.org, Agenda - Advancing Economics in Business, London Business School's Business Strategy Review and Alumni magazine.*
- "What If a Large, Complex Financial Institution Fails?" with Matthew Richardson and Nouriel Roubini, June 2009, mimeo.
- "On the Financial Regulation of Insurance Companies" with John Biggs, Matthew Richardson and Stephen Ryan, September 2009, mimeo.

Invited Articles, Overviews and Presentations

- "Measuring and Taxing Systemic Risk", Keynote Presentation at the Fields Institute in Toronto, May 2010; Keynote Presentation at the Korea Development Institute in Seoul, May 2010.
- "How Banks Play the Leverage Game and What To Do About It", Congressional Hearing to the Financial Services Oversight and Investigations Subcommittee, May 2010.
- "Board of Directors and Experience: A Lesson from Private Equity" (with Conor Kehoe), *McKinsey on Finance*, Number 35, Spring 2010, pp 18-19.
- "Roundtable on a Financial Levy", Panelist at the Korea Economic Institute and the Ministry of Strategy and Finance, April 2010.
- "The Future of Financial Reforms", Keynote speech at the 2010 MARC conference at Villanova University, March 2010; Panelist at the Federal Reserve Bank of Chicago Conference on Bank Structure and Competition, May 2010.
- "Systemic Risk, Stronger Regulation and Liquidity Management: Changes for Which Risk Management Should Be Prepared", Webinar, PRMIA, February 2010.
- "Dynamics of Aggregate Liquidity Shocks", presentation at the BCBS-CFGS roundtable on Systemic Liquidity Risk, organized by the New York Federal Reserve and Bank for International Settlements, November 2009; Banque de France, December 2009.

- "Causes of the Financial Crisis", presentation at a conference at Yale University on the *Future of Globalization*, November 2009.
- "Too big to fail, too big to manage, or just too big?" Central Banking Seminar at the New York Federal Reserve, October 2009; Daiwa Securities Research conference, Tokyo, October 2009.
- "Fixing the OTC Market: Centralized Counterparty and Transparency", European Commission Conference, September 2009; NYU-Stern Derivatives Research Retreat, November 2009.
- "Regulation of Derivatives in India: Too Much or Too Little?", NIPFP (Delhi), September 2009.
- "Regulating Systemic Risk", Presentations at the Federal Reserve Bank of New York and Federal Reserve Bank of Cleveland, March-August 2009.
- "Dividends and Bank Capital in the Financial Crisis of 2007-2009", Presentation to Liquidity Working Group of the Federal Reserve Bank of New York, April 2009.
- "Restoring Financial Stability: How to Repair a Failed System", Presentations in 2009 at Baruch College, NYU-Stern, Bank of England, Banque de France, International Monetary Fund, Growth Commission Workshop at Harvard, World Bank, Journal of Financial Intermediation Conference on the Financial Crisis in Barcelona, the CFA Society of the UK, Bank of Finland, Helsinki School of Economics, Bank for International Settlements, London School of Economics, Indian School of Business, Bombay (Mumbai) Stock Exchange, ICRIER (Delhi), Bank of Canada, Moody's KMV, Nykredit Symposium in Copenhagen, Universitat van Amsterdam Center for Corporate Governance, Swiss Finance Institute Meeting 2009, NYU-Law Conference on Rethinking the Taxation of the Financial Sector.
- "Credit Derivatives: Some Puzzling Facts", BNP Paribas Center, HEC Paris, March 2009.
- "The Voice of Experience: Public versus Private Equity", with Conor Kehoe and Michael Reyner, in *The McKinsey Quarterly*, Spring 2009.
- "Corporate Governance and Value Creation: Evidence from Private Equity", Presentation to the HM Treasury Group and Regulators for Pensions and Financial Reporting, November 2007, November 2008.
- "Private Equity and Hedge Funds: The Changing Face of Corporate Governance", Presentation to the HM Treasury Group and London Business School Governance Center, October 2006, to Freshfields Private Equity Group, December 2006.
- "Liquidity, Liquidity Risk and Credit Spreads: Some Open Questions," for The Third Annual Credit Risk Conference organized by Moody's and Stern School of Business, New York University, May 16-17, 2006.
- "Understanding and Managing Correlation Risk and Liquidity Risk," with Stephen Schaefer, *International Financial Risk Institute (IFRI) Roundtable*, 29-30 Sep 2005, *CREDIT Conference in Venice*, Sep 2006, *RISK Magazine's Credit Risk Summit (Europe)*, 2-3 Oct 2006.
- "Should Banks Be Diversified? Evidence from Individual Bank Loan Portfolios," *Proceedings of the Federal Reserve Bank of Chicago Conference on Bank Structure and Competition*, 2002, with Anthony Saunders and Iftekhar Hasan.
- "Competition amongst Banks, Capital Requirements, and International Spillovers," *Economic Notes*, 30(3), 2001, 337-358.

Teaching

- Credit Risk: Executive Education (S&P), NYU-Stern's AIF program, Integrated Risk Mgt
  Spring 2010, 2009 – Teaching rating: 6.0/7.0 (S&P), 4.3/5.0 (AIF), 5.73/7.0 (Risk Mgt)
- Credit Risk, Full-time MBA and Langone (Part-time MBA) elective, NYU Stern.
  Spring 2010, 2009 – Teaching rating: 6.0/7.0
- Credit Risk, MBA/Masters in Finance Elective, LBS (with Stephen Schaefer).
  Summer 2008 – Teaching rating: 4.66/5.00, Summer 2007 – Teaching rating: 4.39/5.00
- Corporate Finance and Valuation, Masters in Finance Core, LBS.
  Fall 2006, 2005, 2004, 2003, 2002, Average teaching rating: 4.20/5.00
  Summer 2004 [Indian School of Business], Teaching rating: 6.28/7.00
- Options and Futures, MBA/Masters in Finance Elective, LBS.
  Fall 2006, 2005, 2004, Spring 2004, 2003, 2002, Average teaching rating: 4.13/5.00
  Fall 2003 [Indian School of Business], Teaching rating: 6.65/7.00

Teaching Awards

- Runner-up for Best Teacher in Masters in Finance at London Business School, 2006-07.

Grants

- BNP Paribas Hedge Fund Center, 2009; Q-group, 2009; Europlace de Finance, 2008; BSI Gamma Foundation, 2008; Global Association of Risk Professionals (GARP), 2008; Senior Houblon Norman Fellowship at the Bank of England, July-August 2008; INQUIRE Europe, 2007-08; Leverhulme Trust Fellowship, 2007-08; Fondation Banque de France, 2008, 2005, 2004; Research & Materials Development, London Business School, 2008, 2007, 2006, 2005, 2003, 2001; INQUIRE, UK, 2002.

Editorship

- Editor – Journal of Financial Intermediation (2009-)
- Associate Editor – Management Science (2009-), Review of Finance (2006-), Review of Financial Studies (2005-2008), Journal of Financial Intermediation (2005-2008), International Journal of Central Banking (2004-2006), Journal of Financial Stability (2004-), Journal of Financial Services Research (2007-)

Refereeing

- Econometrica, American Economic Review, Journal of Political Economy, Review of Economic Studies, Quarterly Journal of Economics, Rand Journal of Economics, Journal of Economic Theory, International Economic Review, Journal of Law, Economics and Organization, Journal of Finance, Journal of Financial Economics, Review of Financial Studies, Management Science, Journal of Financial and Quantitative Analysis, Journal of Banking and Finance, Journal of Financial Intermediation, Review of Finance, Journal of Money, Credit and Banking, International Journal of Central Banking, Journal of Financial Stability, Journal of International Economics, The B.E. Journals in Theoretical Economics, Review of Derivatives Research, Mathematical Finance, Journal of Derivatives, Journal of Financial Services Research, Bank of England Working Papers, Economic Theory, European Economic Review, Journal of the European Economic Association, Economic Notes.
- Expert Panelist for European Research Council (ERC)'s Advanced Grant Evaluation, 2010, 2008, 2009 (remote); Reviews of NSF, ESRC and Candian Research Council Grant Proposals.
- Jury member for Jaime Fernandez de Araoz Corporate Finance Award, 2010.
- Book review of "Credit Risk – Pricing, Measurement, and Management" by Darrell Duffie and Kenneth J. Singleton, for Economica, 2004.
- Co-organizer of the Second Theory Workshop on Corporate Finance and Financial Markets at NYU-Stern, May 2010.
- Scientific Committee –Annual Credit Risk Conference organized by Moody's and London Business School, 2010 (co-chair), 2008, 2005, CREDIT Conference (Venice), 2009, 2008, 2006.
- Program Committee – AFA, 2011, 2008, WFA, 2006-2010, EFA, 2002-2009, 2010 (Track Chair: Financial Crises and Regulation), Financial Intermediation Research Society – 2004-2010, Corporate Finance of Financial Intermediaries (Wharton) – 2006, FMA – 2010, 2008, Indian School of Business Summer Conference, 2007-10, UniCredit Conference on Risk Transfer, 2009, JFI/BIS conferences on financial intermediation, 2008-10, Private Equity conferences at ESSEC, 2008-09, Emerging Markets Conference in Beijing, 2010, Entrepreneurial Finance and Innovation Conference, 2010, CEPR-EIEF Workshop on Disclosure and Market Discipline, 2010, International Risk Management Conference, 2010, NYU Salomon Center and NY Fed Conference on Financial Intermediation, 2010, Washington University Corporate Finance Conference, 2010.

Discussions

- NBER Conference on Risk of Financial Institutions – June 2010, Economics of Payments IV conference at the Federal Reserve Bank of New York – 2010, Carnegie-Rochester Public Policy Conference, April 2009; Econometric Society – 2010, 2009, 2006, AEA – 2010, 2009, AFA – 2010, 2009, 2008, 2007, 2003, WFA – 2009, 2008, 2005, 1999-2002, EFA – 1999-2003; NBER Summer Institute for Corporate Finance, 2008, 2006, 2002; NBER Corporate Finance – 2002; NYU-Penn Conference on "Law and Finance", February 2006; Liquidity Conference at Federal Reserve Bank of New York, October 2005; Financial Intermediation Research Society Meetings – May 2004, Capri; Conference on "Liquidity Concepts and Financial Instabilities," June 2003, Eltville.

Presentations (2009-)

- Sixth Annual Credit Risk Conference organized by Moody's and NYU-Stern, Conference on Contingent Capital at the Federal Reserve Bank of New York, Maryland Macro/Finance workshop, NBER Corporate Finance, NBER Securitization, Volatility and Systemic Risk conference of the Society of Financial Econometrics (SoFiE), Federal Reserve Bank of New York, International Research Forum on Monetary Policy at the Board of Governors, Federal Reserve Board of Governors, NBER Law and Economics, NYU-Stern, Kansas City Fed, De Paul University, Cleveland Fed, AFA (2010), AEA (2010), ES (2010), Europlace de Finance conference (Paris), UniCredit conference (Rome), UNC, UCLA, USC, European Central Bank, Swiss Finance Institute, Theory workshop at MIT, NY Fed and BIS conference on Systemic Liquidity Risk, Philadelphia Fed, NBER Asset Pricing, Globalization conference at Yale, Derivatives Research Retreat at NYU-Stern, Universitat van Amsterdam, Goethe University, Nykredit Symposium of Copenhagen Business School, Daiwa Institute of Research, Moody's KMV, McGill, Bank of Canada, U. Waterloo, Wharton, European Commission Derivatives Conference, NIPFP (India), ICRIER (India), UIUC, Washington University at St Louis, Federal Reserve Bank of Minneapolis conference at the New York Fed, Bombay (Mumbai) Stock Exchange, Indian School of Business, Federal Reserve Bank of Cleveland, Organizer and presenter at the "Short-term Debt and Asset Prices" session at Gerzensee (2009), NBER Market Institutions and Financial Market Risk, London School of Economics, Western Finance Association Meetings 2009, Bank for International Settlements (Basel), Bank of Finland, Helsinki School of Economics, Euronext Conference in Amsterdam, CFA Society of the UK, University of Binghamton, Tuck Business School, JFI Conference on the Financial Crisis, World Bank, Growth Commission Workshop, International Monetary Fund, Bank of England, Banque de France, Federal Reserve Bank of Philadelphia, NYU-Economics, Baruch College, NYU Law and Finance Symposium, Federal Reserve Bank of New York Conference on Liquidity.

Press Coverage

- Opeds, interviews and opinions on the financial crisis of 2007-09: Financial Times Market Insight, *Why Bankers Must Bear the Risk of "Too Safe to Fail" Assets* (with Arvind Krishnamurthy), 17 March 2010; News and Analysis (tax notes), *The Volcker Rule: Getting Serious About Bank Regulation? (extended coverage in article by Lee Sheppard),* 15 February 2010; Financial Times, *Volcker has the measure of the banks (mention in column by John Gapper),* 27 January 2010*;* www.voxeu.org, *Making sense of Obama's bank plans,* 24 January 2010; FT.com, *Obama's bank plan is a start,* 22 January 2010; Forbes, *A Price Tag For Systemic Risk,* 30 December 2009; Financial Times, *Plan to end Fed supervisory role draws fire, 10 November 2009*; http://causesofthecrisis.blogspot.com/, *Regulation, Not Markets, Let Us Down, 4 November 2009;* Financial Times, *Scope Remains to Circumvent Derivatives Bill, 21 October 2009;* Financial Express, *Why Investment Banks were Fated to be Roadkill,* 21 October 2009; www.voxeu.org, *Systemic risk and deposit insurance premiums,* 4 September 2009; Riformista (Italy), *A year after Lehman Brothers failed,* 4 September 2009; Financial Express (India), *Handful in the Entire Banking System Led to the Crisis*, Aug 24 2009; Lombard Street/FinReg21.com, *Big Financial Firms Should be Taxed for Implicit Government Guarantees,* August 2009; Bloomberg, *Systemic Risk Rankings,* 24 August 2009, Bloomberg, *Has the Bailout Worked?* 6 August 2009; Lombard Street, *How to Charge for Deposit Insurance*, August 2009; WSJ.com, *Cracking the Code: Ranking Wall Street's Systemic Risk*, 27 July 2009; Newsweek, *Do Bankers Deserve Bonuses?* 17 July 2009; QFinance, *Regulation after the Crash* (with Julian Franks), May 2009; Wall Street Journal, *Derivatives Trades Should All Be Transparent* (with Robert Engle), 15 May 2009; Huffington Post, *Stress Tests: It Might Have Been Different if Fed had Restricted Dividends,* 8 May 2009; CNBC.com, *What will the Stress Tests tell us?* (with Matt Richardson and Nouriel Roubini), 7 May 2009; FT, *Concorde's Fate Offers a Lesson for Finance*, 15 April 2009; Financial Week, *Is Obama Just Bluffing on Banks?*, 2 March 2009; www.voxeu.org, *Amidst Crisis, Banks Are Still Paying Dividends,* March 2009 (with Irvind Gujral and Hyun Shin); www.voxeu.org and US Exchequer, *Repairing a Failed System*, February-March 2009 (with Matt Richardson); Financial Week, *The Real Reason Investors Dislike TARP 2.0*, 12 February 2009; Forbes.com, *Expect More Shadow Banking Losses,* 3 February 2009 (with Philipp Schnabl); The Banker, *Why Government Guarantees are a Double-edged Sword,*

February 2009 (with Julian Franks); Finance Asia, *HSBC's woes mount*, 20 January 2009; FT.com (The Economists' Forum), *Government money should have strings attached* (with Dave Backus and Raghu Sundaram), 6 January 2009; Bloomberg, *Fed Pledges Exceed $7.4 Trillion to Ease Frozen Company Credit*, 24 November 2008; Forbes.com, *Time to lift the veil: A clearinghouse for credit derivatives trading* (with Marti Subrahmanyam), 12 November 2008; www.voxeu.org, *The other part of the bailout: Pricing and evaluating the US and the UK loan guarantees* (with Raghu Sundaram), 26 Oct 2008; *FT*.com (The Economists' Forum), *Getting healthy banks to acquire troubled ones*, 13 Oct 2008; London Business School's *Business Strategy Review*, Autumn 2008 – *Risky Business;* London Business School's *Insight* magazine, Spring 2008 – *The Sub-prime Smoke Shield*; Herald Tribune, 31 January 2008, *Changes for banks? U.K. overhaul aimed at curbing runs;* FEM Business on the current financial crisis which ran in August; Quoted in *"Rate cut calls miss the point after prolonged market change"* in Financial Times, 27 August 2007**.**

- On private equity: Retail Banking Insider, September 2009, *FDIC Opens Door to Private Equity;* Spectator Business, 1 January 2009, *Capital Breakdown;* The Times, 28 October 2008, *Management Briefing: Private Equity;* Retail Banking Insider, August 2008, *Private Equity Poised to Swoop on Banks;* Harvard Political Review, Spring 2008, *Golden Geese: Sovereign Wealth Funds and Private Equity are here to stay*; Financial News, 23 June 2008, *Operating Partners Brought in to Boost Performance;* Private Equity News, 23 June 2008, *Operating Partners Earn Their Stripe.*
- On insider trading: Wall Street Journal, 22 January 2008, *The M&A Boom: The Biggest for Insider Trading?;* Washington Post, 17 January 2008, *Throw Out the Inside Traders;* CFA Society of the UK, June 2008, Interview with Bloomberg TV, featured in *Special on Insider Trading*, July 2007; Articles in International Herald Tribune and L'Agefi on default credit swaps which ran in May 2007, Bloomberg, 17 October 2006, *Credit-Default Swaps Raise Insider Trading Concerns*, Wall Street Journal, 31 August 2006, *Can anyone police the swaps?*, FT.com, 29 May 2005, *Banks scrutinised in credit default swaps market*, Financial Times, Front Page – First Section, 30 May 2005, *Insider trade fears in swaps market*, and in IDD, IFR, Dow Jones UK Wire.
- Miscellaneous: Credit Slips: A Discussion on Credit and Bankruptcy, *The Path to Economic Growth: Bankruptcy* by Elizabeth Warren, 21 August 2009, "*Credtior Rights and Corporate Risk-taking";* Sloan Management Review, 15 March 2009, *"Labor Laws and Innovation"*; Financial Times – Mastering Financial Management, June 2006, *Managing the Risks of Liquidity and Correlation* (with Stephen Schaefer), Economic and Political Weekly, India, January 2006, *Liquidity Risk: Causes, Consequences and Implications for Risk Management.*

Consulting

- Charles River Associates, 2010; Global Association of Risk Professionals – Financial Risk Management (FRM) Exam, 2009-2010; Pershing Square Capital Management, 2009; Knight Vinke Asset Management, 2008-09.
- International Financial Risk Institute – Research paper on "Changing Correlations and Liquidity: Causes and Implications for Financial Institutions", September 2005.
- Industrial Credit and Investment Corporation of India (ICICI Bank) - Credit Risk, 2002-3.
- Institute for Financial Management and Research/Academy for Management Excellence (IFMR/ACME), India - Design of Post-Graduate Program in Quantitative Finance, 2003-4.
- J. P. Morgan Equity Derivatives Research, New York, Summer 1997 - Developed a Monte Carlo valuation of complex derivative products, based on quasi-random sequences and Brownian Bridge technique, documented in technical mimeo "Hybrid Quasi-Monte Carlo Methods for Valuation," with Julia Chislenko, Jonathan Goodman and Arnon Levy.

Hobbies

- Singing and composing (Indian semi-classical), Poetry, Cricket, Running, Traveling.
- Founding Member and Chairman (2003-2007) of PrathamUK, the UK chapter of Pratham, an Indian NGO providing pre-primary and primary education to underprivileged children in India (www.pratham.org). Chapters raised over £2mln; Founding Member and President of PrathamUSA, the NY/NJ chapter of Pratham, 1998-2001.
- Boardmember, GIVE (Giving Impetus to Voluntary Effort) – UK, 2003-2008.

Non-academic Awards

- Asian Achievers' Award for Community Service, 2006, awarded by Asian Voice and Gujarat Samachar in UK.
- Short-listed in the final seven for the "Young Philanthropist" Award of Beacon Fellowships in the UK, 2004-05, 2005-06.

References

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