



# A Review of the Academic Literature on the Causes and Evolution of the Credit Crisis

**Christopher L. Culp**



**KSP Books**



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The Johns Hopkins University, USA

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Author: **Christopher L. Culp** (The Johns Hopkins University, USA)

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# Foreword

A huge literature has emerged analyzing the causes and evolution of the credit crisis that began in 2007. Several literature surveys have also been written on the causes of the crisis, but most such surveys have discussed the crisis literature in the abstract. This paper provides a current review of the causes of the credit crisis and the timing and evolution of the crisis, thereby putting the various causes and proposed explanations into proper context. The vast majority of the literature supports the notions that the fundamental causes of the crisis were loose monetary policies, significant imbalances across global current accounts, underpriced credit and liquidity risk in certain structured products (as well as some other fixed-income products), disclosed and known declines in mortgage underwriting standards, and the downturn in house price appreciation (and eventually the downturn in housing prices). Although significant attention has been paid to fraud and undisclosed declines in mortgage underwriting standards, the empirical support for the idea that these declines in and of themselves were a significant cause of the credit crisis is limited (albeit not non-existent).



# 1

## Introduction

A vast literature (including several surveys) has emerged analyzing the causes and evolution of the credit crisis that began in 2007. Most surveys of the causes of the crisis literature, however, have discussed the literature in the abstract. This paper provides a current review of the causes of the credit crisis and the timing and evolution of the crisis, thereby putting the various causes and proposed explanations into proper context.

The vast majority of the literature supports the notions that the fundamental causes of the crisis were loose monetary policies, significant imbalances across global current accounts, underpriced credit and liquidity risk in certain structured products (as well as some other fixed-income products), disclosed and known declines in mortgage underwriting standards, and the downturn in house price appreciation (and eventually the downturn in housing prices). Although significant attention has been paid to fraud and undisclosed declines in mortgage underwriting standards, the empirical support for the idea that these declines in and of

themselves were a significant cause of the credit crisis is limited (albeit not non-existent).

Section 2 of this article presents a background discussion on U.S. housing and housing finance markets that serves as a conceptual foundation for the later analyses and discussions in the report. In Section 3, I summarize the broad foundations of the credit crisis, including the macroeconomic and public policy factors that contributed to the crisis. Sections 4, 5, and 6 discuss crisis Phases I, II, and III, respectively (along with the causes of each phase of the crisis). Section 7 then explores the evolution of the crisis in two markets unrelated to U.S. mortgage lending – i.e., the international real estate market and the leveraged commercial and industrial loan market. Section 8 presents a brief summary and a concluding section.

# 2

## Background on U.S. Housing Financial Markets

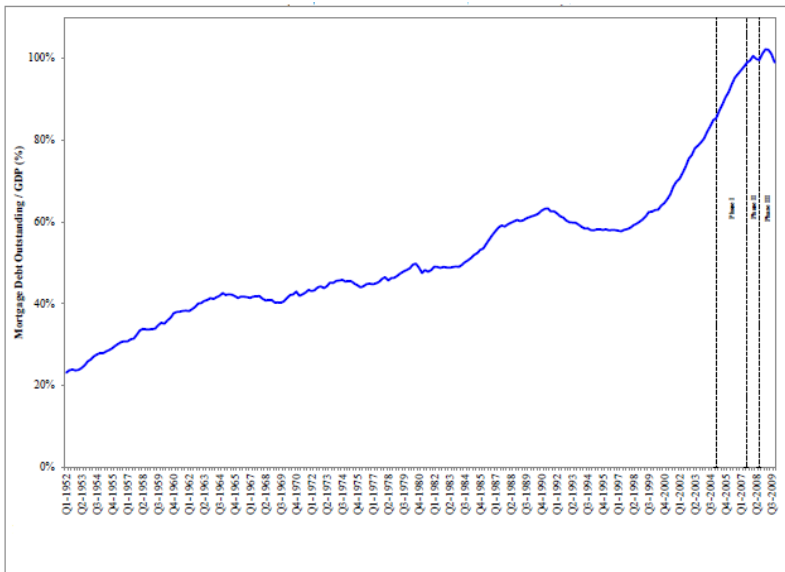
In 1940, about 44 percent of Americans owned their own homes. That percentage increased to 68.4 percent by 2007.<sup>1</sup> Underlying that increase in home ownership was an increase in mortgage lending. Exhibit 1 shows total U.S. mortgage debt outstanding as a percentage of gross domestic product (“GDP”). From 1952 to about 1990, total U.S. mortgage debt outstanding rose from around 23 percent to just over 60 percent of GDP.

Residential mortgage loans are designed to finance private real estate transactions and are secured by the value of the underlying real estate. A bank or other financial institution that advances funds to the current or prospective homeowner through a mortgage loan is known as the mortgage originator.<sup>2</sup>

<sup>1</sup> United States Census Bureau, [[Retrieved from](#)]. (last visited on August 14, 2014) and [[Retrieved from](#)]. (Table 14. Quarterly Homeownership Rates for the U.S. and Regions: 1965 to Present) (last visited on August 14, 2014).

<sup>2</sup> Note that the lender may collect mortgage payments over time and monitor the performance of the borrower on the loan or, alternatively, this service may be performed by a mortgage loan servicing agent.

Residential mortgage loans can be distinguished along a variety of dimensions, including the term of the loan, its interest rate basis (e.g., fixed, adjustable, floating), amortization type (e.g., fixed amortization schedule, bullet principal repayment, etc.), prepayment penalties, lien status (i.e., first- or second-lien), loan balances relative to collateral value (e.g., loan-to-value (“LTV”) and combined loan-to-value (“CLTV”) ratios for first- and second-lien loans on the same collateral), and the credit quality of the borrower (e.g., as measured by the borrower’s Fair Isaac Co. or “FICO” score).



**Exhibit 1:** U.S. Mortgage Debt Outstanding (% of GDP), 1952 – 2009

**Notes:** Vertical lines reference: Q1-2005 - beginning of Phase I; Q3-2007 - end of Phase I, beginning of Phase II; Q3-2008 - end of Phase II, beginning of Phase III.

**Sources:** U.S. Department of Commerce: Bureau of Economic Analysis, Federal Reserve Board.

Residential mortgage loans are often classified as being “prime,” “subprime,” or “Alt-A.” No industry standard definitions of these terms exist,<sup>3</sup> but prime loans are typically

<sup>3</sup> These definitions have changed somewhat since the adoption of the Dodd-Frank Wall Street Reform and Consumer Protection Act (“Dodd-Frank”)



viewed as the least risky. Subprime loans, by contrast, are generally regarded as the riskiest either because the borrower has a relatively low credit quality, the characteristics of the loan itself are relatively risky (e.g., LTV or CLTV ratios of 100 percent or more), or both. Alt-A loans fall in between the prime and subprime extremes and can encompass a wide range of borrower credit qualities and loan risks.

## Originate-and-Hold Mortgage Banking and the Housing Finance Agencies

Originate-and-Hold Mortgage Banking and the Housing Finance Agencies Following Depression-Era stresses on the U.S. mortgage market, the Federal Housing Administration (“FHA”) was created in 1936 to provide insurance to purchasers of certain qualifying mortgage loans – i.e., purchasers of those mortgages would continue to receive interest and principal even if the borrower defaulted. In 1938, the Federal National Mortgage Association (“FNMA”) was established and charged with encouraging the development of a secondary market for FHA-insured mortgages. FNMA accomplished this in part by issuing par bonds based on those mortgages to investors. That enabled mortgage bankers to extend mortgage credit without being exposed to significant interest rate risk (which was instead borne by investors in the mortgage securities) ([Green & Watcher, 2005](#)).

In 1968, FNMA was reorganized and split into two entities: the Government National Mortgage Association (“GNMA” or “Ginnie Mae”) was responsible for guaranteeing FHA- insured mortgages; and a new FNMA (“Fannie Mae”) was charged with purchasing and guaranteeing non-government-insured mortgages. In 1970 Congress created the Federal Home Loan Mortgage Corporation (“FHLMC” or “Freddie Mac”) that was tasked with creating a secondary market for mortgages issued by savings and loan institutions (“S&Ls”) ([Green & Watcher, 2005](#)). Ginnie Mae, Fannie Mae, and Freddie Mac are known

in 2010. (See, e.g., [Siebert, 2013](#)). Regardless, significant disagreement persists even today as to classification categories for mortgages by risk.

as the housing finance government-sponsored enterprises (“GSEs”) or “Agencies.”<sup>4</sup>

Until the 1970s, mortgage loans in the United States were provided largely by commercial banks and S&Ls that originated their own loans, financed long-term fixed-rate mortgages primarily with short-term liabilities (e.g., deposits), and held most of those mortgage loans on their balance sheets. In this “originate and hold” (“O&H”) mortgage banking model, two factors constrained the total availability of mortgage financing. First, mortgage lenders were limited in the amount of mortgage credit they could extend by their own access to retail and wholesale sources of funds. In order to raise the cash to advance to mortgage borrowers, banks relied on both retail and wholesale liabilities such as demand and time deposits and interbank borrowings, as well as by issuing debt and equity securities. Balance sheet and asset/liability management concerns restricted banks’ abilities to increase leverage and issue new stock to finance new mortgage loans.

In addition, banks must maintain adequate regulatory capital to absorb potential losses arising from losses on credit-sensitive assets. So, whereas a bank’s funding profile affected its ability to raise the cash needed to fund mortgages, its regulatory capital requirements defined the leverage and capital-to-asset ratios required to support a given amount of mortgage assets on the bank’s balance sheet.<sup>5</sup> A bank’s ability and willingness to raise equity capital (the preferred source of regulatory capital) thus also constrained its mortgage lending.

## Mortgage-Backed Securities

Since the late 1970s, most mortgage bankers have relied more on the capital markets than on direct borrowings as a

<sup>4</sup> Ginnie Mae was a governmental organization, whereas Fannie Mae and Freddie Mac were set up as private but government-sponsored entities.

<sup>5</sup> Prior to 1981, bank capital requirements in the U.S. were discretionary, but beginning that year banking regulators began to impose numerical minimum capital-to-assets and/or leverage ratio requirements. (See, e.g., Burhouse, *et al.*, (2003). International standards for minimum bank capital were harmonized and formalized with the adoption of the Basel Accord in 1988. (See [Basel Committee on Banking Supervision, 1988](#)).

source of funds for their mortgage originations.<sup>6</sup> Through the process known as securitization, mortgage bankers bundle loans they have originated into portfolios and sell those loan portfolios to investors through the issuance of new securities whose cash flows are collateralized by the underlying loan pool (Kravitt, 1997, 1995; Culp, 2002). The cash proceeds received by originators through securitizations are used to finance the ongoing production of new loans.

The securitization process ushered in a new era of mortgage banking in which originators moved away from the O&H business model toward a new “originate-and-distribute” (“O&D”) model (FCIC, 2020). In the O&D model, originators needed to depend less on retail depository liabilities and interbank borrowings to finance their mortgage loans because the loans could instead be sold in a securitization. O&D mortgage banking also provided balance sheet and regulatory capital relief for banks by allowing them to diversify and securitize their loan exposures, thereby enabling banks to comply more easily with extant regulatory capital requirements.<sup>7</sup>

Mortgage originators did not, however, completely eliminate their ongoing credit exposure to borrowers through securitization. Through their retentions of mortgage servicing rights and the residual interests in mortgage securitizations, originators remained exposed to the risk of poor performance on the mortgage loans they originated. Even after securitizing a loan portfolio, originators thus generally had incentives for the underlying loans to perform well (See e.g., DeMarzo, 2005; Demiroğlu & James, 2012; Erel, Nadauld, & Stulz, 2014; Willen, 2014).

Residential mortgage securitizations can be used by originators to raise medium- or long- term funds, as well as short-term funds. The former are generally used by

<sup>6</sup> See, e.g., Financial Crisis Inquiry Commission, (2010) (hereinafter “FCIC (Securitization)”), p.3; Adrian & Shin, (2009; 2010).

<sup>7</sup> By giving banks access to a new source of funding and enabling them to manage their regulatory capital and credit risks more effectively, securitization promoted additional extensions of mortgage credit that might otherwise not have been possible. See, e.g., Loutskina, (2011).

originators to facilitate new loan originations, whereas short-term mortgage-related securitizations are primarily used by originators to finance their mortgage warehouses – i.e., mortgages that have been originated and funded but that have not yet been sold through a long-term securitization. I discuss mortgage securitizations used by originators to transfer credit risk and raise medium- or long-term funds in this section, and I discuss short-term mortgage-related securitizations in Section 2.3.

The new securities issued in a medium- or long-term securitization of residential mortgage loans are known as mortgage-related asset-backed securities (“ABS”) or MBS.<sup>8 9</sup> Particularly popular through mid-2007 were subprime-backed MBS, as well as MBS based on home equity loans (“HELs”) backed both by first- and second-lien HELs and home equity lines of credit (“HELOCs”). Loans backing subprime and HEL/HELOC MBS were made to borrowers across a range of credit qualities (Hayre, 2001).

MBS are classified as either “Agency” or “private-label” based on whether the interest and principal payments to MBS investors are guaranteed by a GSE.

### Agency MBS

In typical Agency securitizations,<sup>10</sup> a mortgage banker sells a portfolio of “conforming” loans to a GSE, which then creates MBS based on the acquired loan portfolio. In an Agency

<sup>8</sup> ABS can also be backed by non-mortgage collateral, including student loans, auto loans, and credit card receivables. See, e.g., Culp & Forrester, (2013).

<sup>9</sup> In some contexts, MBS and mortgage-related ABS are distinct products. For example, securitized products based on first-lien, fixed-rate 30-year mortgages to prime borrowers are typically called MBS, whereas securities collateralized by subprime or home equity loans are generally classified as ABS. These are all issues of terminology, however, and not economics. For expositional simplicity, I henceforth refer to both MBS and mortgage-related ABS simply as MBS.

<sup>10</sup> Beginning in 2013, Agency securitizations have started to change. See, e.g., Goodman, Yang, & Landy, (2013). These very recent structures are not relevant to the issues explored in this report and are not discussed further herein.

securitization, the GSE also provides a guarantee to investors that it will cover any principal and/or interest shortfalls arising from defaults by the underlying mortgage borrowers. As a result, the primary risks to which investors in Agency MBS are exposed are interest rate and prepayment risks but not borrower default risks (which are borne by the housing GSE).

## Private-Label MBS

In a private-label MBS, a mortgage originator sells a loan portfolio to a special purpose entity (“SPE”) instead of a GSE. An SPE is a private special-purpose trust or company set up for the sole purpose of facilitating the securitization. The SPE raises the cash needed to purchase the loan portfolio by issuing new securities collateralized by the loan portfolio. Principal and interest received by the SPE on the loans finance principal and interest payments due to investors in the newly issued MBS.

Unlike Agency securitizations, private-label structures do not include a GSE guarantee to cover any principal or interest shortfalls arising from borrower defaults. As a result, investors in private-label MBS are subject to the credit risk of the underlying loan portfolio, and they demand higher promised yields to compensate them for bearing that risk.

Virtually all private-label MBS involve the issuance of multiple classes of securities with claims of differing priorities on the same underlying loan portfolio. Known as “tranches,” these different security classes are exposed to varying degrees of credit risk based on the depth of subordination of the security in the SPE’s capital structure. Holders of more junior tranches bear the impact of defaults or declines in value in the underlying mortgages before investors in more senior tranches.

Private-label MBS generally also include a variety of “credit enhancements” designed to provide further protections to investors in relatively more senior MBS tranches from losses on the underlying mortgage collateral (Adelson & Bartlett, 2004; Culp, 2006; Gorton, 2010; Fabozzi, Bhattacharya, &

[Berliner, 2007](#)). One such credit enhancement (especially popular in subprime-backed MBS) is “over-collateralization,” or a cushion between the value of the loan portfolio and the value of the MBS tranches. Over-collateralization can be created at the inception of the deal or built up over time by diverting “excess spread” (i.e., surplus income earned on the mortgages after paying senior expenses and interest to senior tranche holders) into a reserve account.

The impact of credit enhancements on the distribution of the risk of a loan portfolio across subordinated (e.g., mezzanine) and senior MBS tranches can be significant.<sup>11</sup> For example, the credit rating agency Moody’s Investors Service (“Moody’s”) estimated in March 2007 that a loss of 26 to 30 percent in a representative subprime mortgage pool would not cause the Aaa-rated tranche of a subprime MBS to default. As a result of credit enhancements, even the relatively subordinated Baa-rated mezzanine tranche could withstand 10 to 11 percent losses in the mortgage portfolio before defaulting ([Moody’s Investors Service, 2007](#)).

## Mortgage-Related ABCP Conduits

Mortgage originators also rely on securitization to raise short-term funds, usually to finance their mortgage “warehouses” – i.e., inventories of mortgages that have been originated and funded and are eligible for sale to a GSE or SPE but that have not yet been securitized. Originators accomplish this by sponsoring asset-backed commercial paper (“ABCP”) conduits.

ABCP is a type of commercial paper (“CP”), which is a relatively short-term promissory note that can be issued in maturities of up to 270 days but with an average maturity of about 30 days. As such, CP is used by financial institutions and non-financial corporations primarily as a source of short-term liquidity (FED, [[Retrieved from](#)]; Kacperczyk and Schnabl, 2010). Aggregate CP outstanding on June 22, 2007,

<sup>11</sup> In general, MBS backed by relatively riskier loan pools are characterized by more diverse and complex credit enhancements. See, e.g., [Fabozzi, Bhattacharya, & Berliner, 2007](#); and [Gorton, 2010](#).

was \$2.1 trillion. At that time, about 46 percent of outstanding CP (\$960 million in June 2007) was unsecured and represented borrowings by firms backed by their general net cash flows and not by any specific assets pledged as collateral. The remaining 54 percent of the CP market (\$1.14 trillion in June 2007) was secured (i.e., ABCP) (Standart & Poor's, 2007; Moody's Investors Services, 2007).

In a typical ABCP conduit, an SPE issues CP to finance the acquisition of credit-sensitive assets from one or more originators or lenders. The primary purchasers of ABCP are Money market funds and mutual funds (Kacperczyk & Schnabl, 2010). The assets conveyed to the SPE are usually transferred as sales by the originator and thus no longer appear on the originator's balance sheet. Nevertheless, originators often provide various guarantees to investors in ABCP that create significant ongoing exposures for originators to the performance of the collateral backing the ABCP (Acharya, Schnabl, & Suarez, 2013).

Banks may sell whole mortgage loans or other credit-sensitive assets into different types of ABCP conduits (Fitch Ratings, 2007). A "single-seller conduit" is sponsored by a sole financial institution, and its CP is backed exclusively by credits originated by the sponsor. In a "multi-seller conduit," by contrast, multiple institutions sell loans and other assets to the SPE, which issues ABCP collateralized by the collective pool of assets purchased from all the participating institutions.

When the outstanding CP issued by an ABCP conduit matures, the conduit usually "rolls over" the maturing CP – i.e., the balance due on maturing CP is financed with the issuance of new ABCP. To manage the risk of cash flow shortfalls that may occur if maturing CP cannot be rolled over, bank-sponsored ABCP conduits have historically relied on various sources of bank- provided or third-party liquidity support (Kavanagh, Boemio & Edwards, 1992; S&P, 2007; Acharya, Schnabl, & Suarez, 2013). Some ABCP conduits – especially single-seller conduits designed to finance mortgage warehouses – issue "Extendible ABCP," which is CP with a maturity date that can be deferred if the conduit experiences a

cash shortfall on the original stated maturity date. If such an extension occurs, the conduit administrator must raise the cash needed to redeem the Extendible ABCP by its deferred maturity date. To accomplish this, conduit administrators either divert principal and interest received on existing assets to repay Extendible ABCP (instead of using those proceeds to purchase new assets) (S&P, 2007) or sell existing assets to raise the required cash (S&P, 2007).

## Structured Credit Products Based on MBS

Investors in search of mortgage-related exposures are not always content with the risk/return profiles offered from MBS. (See Section 3.2.) As a result, investment bankers and dealers began to offer new types of structured credit products collateralized by MBS in the first decade of the 21st Century. The two primary types of such investments are described in the sections below.

### ABS CDOs

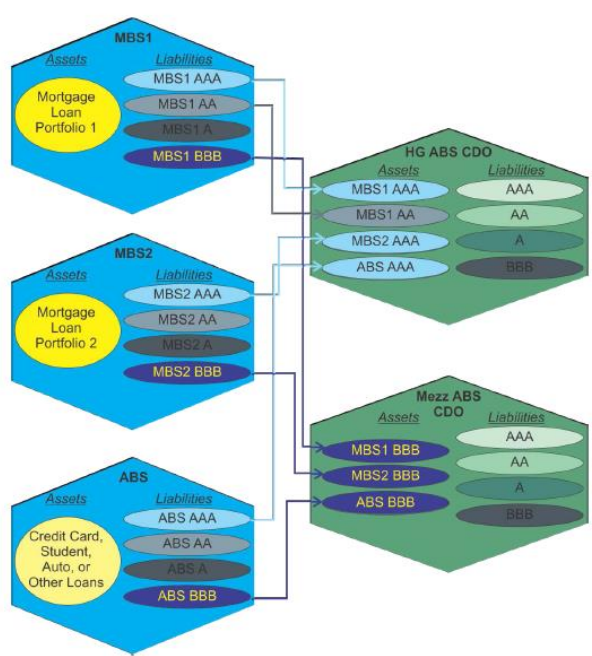
MBS are often purchased and repackaged (along with other ABS based on non-mortgage collateral) into new securities by managers and sponsors of collateralized debt obligations (“CDOs”) backed by ABS (“ABS CDOs”). In a cash ABS CDO, the ABS collateral investments are selected by a collateral manager and purchased by the SPE CDO issuer using the proceeds from the issuance of new securities by the CDO SPE.<sup>12</sup> In a synthetic ABS CDO, by contrast, the SPE issuer of the ABS CDO securities sells credit protection on the underlying reference obligations using credit default swaps (“CDSs”). A CDS is a type of derivatives contract that allows a credit “protection purchaser” to pay a fixed amount (known as the “CDS spread”) to a “protection seller” in return for receiving a payment in the event that the underlying reference security or securities experience an event of default

<sup>12</sup> During a “ramp-up” period when the ABS collateral is being assembled, the ABS may be acquired by the collateral manager and financed by a bank warehouse line or may be warehoused directly by the bank arranger of the CDO.



(Stulz, 2010). The SPE then issues another set of securities, the interest and principal of which are based on the performance of the ABS collateral underlying the CDSs.

As the ABS CDO market evolved through about 2005, two distinct categories of ABS CDOs began to emerge: high-grade ABS CDOs (“HG ABS CDOs”) that typically issued securities collateralized by senior tranches of ABS with ratings of AAA or AA; and mezzanine ABS CDOs (“Mezz ABS CDOs”) backed predominantly by the mezzanine tranches of ABS offerings with ratings of BBB or BBB-. Figure 1 illustrates the relation between MBS, ABS, and the two types of ABS CDOs. Like the MBS and ABS that collateralize ABS CDOs, ABS CDO securities themselves are also tranch.



**Figure 1.** *The Relation Between MBS and ABS CDOs*

From 2000 through 2002, ABS CDOs generally contained relatively modest exposures to real estate. During that period, the average ABS CDO transaction had collateral that consisted of 37 percent HEL ABS, 10 percent commercial

mortgage-backed securities, 24 percent tranches from other CDOs, and 29 percent other collateral (Covey, *et al.*, 2006). But beginning in 2003, ABS CDO collateral became increasingly tilted toward real estate obligations. From 2003 through 2005, for example, the average ABS CDO included 55 percent HEL ABS, 19 percent MBS, 14 percent other CDO tranches, 5 percent commercial mortgage-backed securities, and 7 percent other collateral (Covey, *et al.*, 2006).

### **SIVs and Securities Arbitrage ABCP Conduits**

Typical ABS CDO securities are medium-term notes with several years to maturity or expected redemption. Most CDO securities are ineligible for investment by institutional investors with maximum maturity guidelines (e.g., money market mutual funds). But two other investment structures were available to investors that wished to purchase short-term obligations whose performance was based on exposure to longer-dated ABS and MBS.

Structured Investment Vehicles (“SIVs”) are types of structured financial operating companies (Moody’s, 2005) – often sponsored by large, globally active banks – that issued short-term ABCP and term debt to finance their acquisition of ABS, MBS, and other securities (Gorton, 2009; Tabe, 2010). Similarly, “securities arbitrage ABCP conduits” bought MBS and other ABS to collateralize CP issuance to investors (Moody’s, 2005). SIVs also issued longer-dated debt, but securities arbitrage ABCP conduits relied almost exclusively on ABCP to finance their investments.

Like ABS CDOs, SIVs and securities arbitrage ABCP conduits held collateral that was often relatively difficult (or impossible) for investors in those structures to analyze. Investors in securities issued by those vehicles thus generally relied on broadly defined investment criteria (often based on the credit ratings of the collateral) and the credit ratings of the securities they were purchasing more than the specific risk characteristics of the collateral or the original borrowers (Mahlmann, 2012). Note that this was not the case for typical

MBSs, in which significantly greater amounts of detail were provided in Prospectus Supplements.

# 3

## Foundational Causes of the Credit Crisis

*"If it matters, measure it."*

Michael Walker.

Global macroeconomic conditions and the public policy decisions of the U.S. government contributed to an environment of low interest rates, expansions of credit to mortgage borrowers (especially low-income and higher-risk borrowers), and increases in housing prices. The sections below discuss these root causes of the credit crisis.

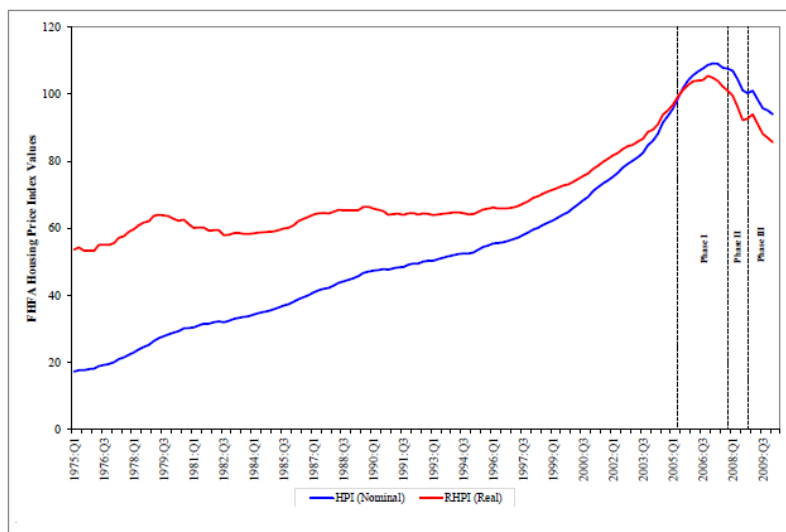
### Monetary Policy, Capital Flows, Credit, and Housing Prices

A country's monetary policy and its net demand for borrowing from foreign investors create a strong linkage between asset price levels (especially housing prices), the supply of and demand for credit, and interest rates (*See, e.g.,* Borio, Furfine, & Lowe, 2001; Borio & Lowe, 2002; Berger & Udell, 2004; Jiménez & Saurina, 2006; Borio, 2008; Obstfeld & Rogoff, 2009; Delis & Kouretas, 2011; Acharya & Naqvi, 2012; Bracke & Fidora, 2012; Jiménez, Ongena, Peydró, & Saurina, 2012; Anundsen & Jansen, 2013; Bordo, & Landon-Lane, 2013; Eickmeier, & Hofmann, 2013; Dou, & Wang, 2014; Jiménez,

Ongena, Peydró, & Saurina, 2014).<sup>1</sup> The period from 2001 through 2006 leading up to the crisis was no exception (See, e.g., Ahrend, 2010; Ahrend, Cournède, & Price, 2008; Reinhart & Rogoff, 2008; Maddaloni & Peydró, 2011; Borio & Disyatat, 2011; Hanke, 2011; Gorton & Metrick, 2012; Gorton & Metrick, 2012). Some combination of loose monetary policy and global capital imbalances gave rise to low nominal (i.e., observed) and real (i.e., inflation-adjusted) interest rates at both short and long maturities and a significant increase in mortgage lending that were associated with the surge in housing prices in many countries during the 2001 to 2006 period, which sowed the seeds of the credit crisis (See, e.g., Ackermann, 2008; Alessi & Detken, 2011; Bracke & Fidora, 2012; Acharya & Naqvi, 2012; Chevallier, 2012).

Total U.S. residential mortgage debt as a proportion of GDP rose significantly from 2001 through 2006 (see Exhibit 1). Exhibit 2 shows U.S. house prices from 1975 to 2009 and the appreciation in those prices that occurred through 2006. The monetary and balance-of-payments factors underlying this surge in home prices and mortgage lending are discussed in the next two sections.

<sup>1</sup> The relation between housing prices and bank lending is bi-directional – i.e., most empirical evidence indicates that higher housing prices can lead to increased bank lending (e.g., because banks can lend more with no increase in their credit risk because of higher collateral values) and that relaxed monetary policy and increased bank lending can put upward pressure on housing prices (e.g., looser monetary policies and lower interest rates reduce the discount rate applied to future cash flows on land and homes and, all else equal, increase housing prices). See, e.g., Segoviano-Basurto, Goodhart, & Hofmann, 2006; and Anundsen & Jansen, 2013.



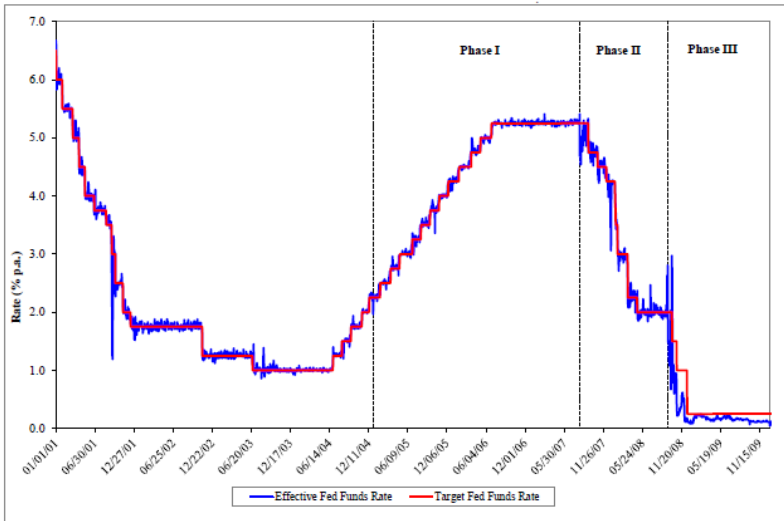
### Exhibit 2. U.S. Housing Prices, 1975 – 2009

**Notes:** Vertical lines reference: Q1-2005 - beginning of Phase I; Q3-2007 - end of Phase II, beginning of Phase III. FHFA Housing Price Index value is set to 100 at 1Q-2005.

**Source:** Federal Reserve Bank of Dallas (Mack, Adrienne, Enrique Martínez-García (2011), "A Cross-Country Quarterly Database of Real House Prices: A Methodological Note.").

## Monetary Policy

The period from 2001 through 2004 was a time of significant monetary easing (See, e.g., [Schwartz, 2009](#); [Taylor, 2009](#); [Taylor, 2009a](#); [Taylor, 2014](#)). The Open Market Committee of the Federal Reserve (“the Fed”) administers U.S. monetary policy in part by setting the target Federal Funds (“Fed Funds”) rate. The effective Fed Funds rate is the market rate at which U.S. commercial banks borrow and lend central bank reserves with one another overnight. Exhibit 3 shows the target and effective Fed Funds rates from 2001 through December 2009 and demonstrates that the Fed pursued a highly accommodative monetary policy beginning in 2001. The target Fed Funds rate was cut repeatedly from 2001 through mid-2003, which encouraged borrowing and stimulated a widespread expansion of credit.



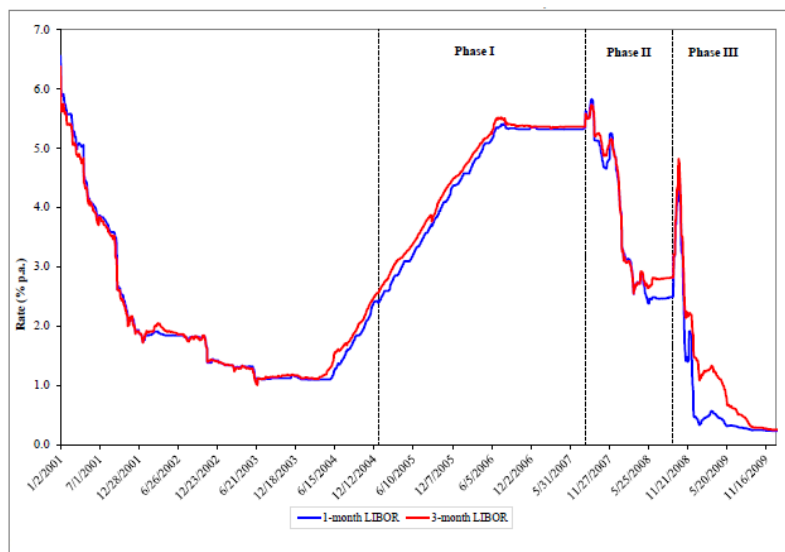
**Exhibit 3.** *Effective and Target Fed Funds Rates, 2001 – 2009*

**Notes:** Vertical lines reference: January 1, 2005 - beginning of Phase I; August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III. Effective December 16, 2008 Federal Funds Target rate is reported as a range. The upper limit of the range is shown. The lower limit is "o".

**Sources:** Federal Reserve Bank, Federal Reserve Bank of St. Louis.

The rate at which banks offer to loan U.S. dollar funds in the London-based wholesale interbank market for fixed maturities ranging from overnight through one year is known as the London Interbank Offered Rate ("LIBOR").<sup>2</sup> At this time, LIBOR was widely regarded as the benchmark private-sector borrowing rate. Exhibit 4 shows one- and three-month LIBOR during the period from 2001 through December 2009. The decline in LIBOR from 2001 through mid- 2004 reflects, in part, the Fed's accommodative monetary policy during that period.

<sup>2</sup> The comparable rate on Euro-denominated wholesale interbank loans is the Euro Interbank Offered Rate ("EURIBOR"). Similar nomenclature applies to Euro deposits in other currencies.



**Exhibit 4.** *One-Month and Three-Month LIBOR, 2001 – 2009*

**Notes:** Vertical lines reference: January 1, 2005 - beginning of Phase I; August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** Bloomberg.

Relatively low nominal interest rates decrease the cost of borrowing for mortgage loan originators, and, all else equal, increase the demand for mortgage loans by borrowers (White, 2009). As interest rates declined to relatively low levels in the pre-crisis period, borrowing in many sectors (not just mortgages) expanded significantly. Professor Steve Hanke of Johns Hopkins University calls the period “the mother of all credit booms” (Hanke, 2010). The lower cost of funds for both loan originators and borrowers put upward pressure on asset prices in general and housing prices in particular (See, e.g., Adrian & Shin, 2008; Taylor, 2009; 2009b; Taylor, 2014, White, 2009; McDonald & Stokes, 2013). Monetary policy *alone* does not explain all of the variation in housing prices, but it is an important determinant. In that context, see Iacoviello & Neri, (2010).<sup>3</sup>

<sup>3</sup> Lower interest rates also reduce the interest component of the rate used to discount future cash flows in valuing financial and real estate assets.



As Exhibits 3 and 4 indicate, the Fed did not begin to raise target interest rates until June 2004, whereupon it continued to increase rates periodically until August 2006. Despite the Federal Reserve's tightening from mid-2004 to 2006, those rate increases are viewed by many as being too little and too late. The late Anna Schwartz (formerly an economist for the National Bureau of Economic Research and a well-known monetary scholar) observed that "[t]he Fed was accommodative too long from 2001 on and was slow to tighten monetary policy....The rate increases in 2004 were too little and ended too soon" (Schwartz, 2009).

The rate increases between mid-2004 and 2006 proved inadequate to stop the expansion of credit.<sup>4</sup> Non-financial sector credit (including household and non-financial corporate borrowings) grew at a quarterly average of 7.41 percent on a year-over-year basis from the first quarter of 2001 (when the Fed began to ease) through the second quarter of 2004 (when the Fed began to tighten). But during the Fed's tightening period from the third quarter of 2004 through the third quarter of 2006, non-financial credit grew by an even higher average of 9.5 percent per quarter on a year-over-year basis.<sup>5</sup> So, despite the Fed's rate increases from 2004 through 2006, monetary policy remained highly accommodative during that period.<sup>6</sup>

## Capital Flows and the U.S. Current Account Deficit

Global macroeconomic conditions also help explain the increase in housing prices and expansion in credit in the United States leading up to the crisis. Specifically, significant capital inflows to the United States from developing economies (like China) gave rise to a strong demand for U.S.

<sup>4</sup> One possible explanation for this is discussed in Section 3.1.2.

<sup>5</sup> Based on historical data from Federal Reserve Flow of Funds Statistical Release Z.1

<sup>6</sup> The "Taylor Rule" – a widely accepted measure of the relatively "tightness" or "looseness" of Fed monetary policy – indicates that monetary policy was too accommodative from early 2002 through mid-2006 despite the rate increases from 2004 through 2006. See Taylor (2009a); Taylor (2009b).

Government and GSE debt, contributed to declining real interest rates, and fueled the pre-crisis run-up in housing prices.

The current account balance for the United States measures the balance on “transactions between the United States and the rest of the world in goods, services, income, and unilateral current transfers” ([Bureau of Economic Analysis, 2012](#)).<sup>7</sup> A negative current account balance indicates that U.S. citizens, businesses, and governmental organizations collectively must raise sufficient funds in the international capital markets to finance that current account deficit. The U.S. current account deficit grew from \$414 billion in 2000 to \$640 billion in 2004 – or, from 4.2 percent of the U.S. GDP to 5.5 percent of GDP ([Bernanke, 2005; 2007](#)). By 2006, the current account deficit was \$811.5 billion ([Bernanke, 2007](#)).<sup>8</sup>

At the same time, developing countries like China and other emerging market economies were experiencing improvements in domestic labor markets (which resulted in higher incomes) and significant export growth ([Jagannathan, Kapoor, & Schaumburg, 2012; Mees, 2012](#)). Those countries experienced substantial increases in savings relative to investment rates, became large net lenders to global capital markets, and ran large current account surpluses ([Bernanke 2005, 2007; Obstfeld & Rogoff, 2010; Greenspan, 2010; Hong & Sraer, 2013](#)). In part (if not largely) because of this global excess of savings relative to investment – Federal Reserve Board Chairman Bernanke referred to it as a “Global Saving Glut” ([Bernanke, 2005, 2007](#)) – real interest rates declined steadily in many parts of the world from 1996 to 2004 ([Bernanke, 2007; Obstfeld & Rogoff, 2010; Greenspan, 2010; Merrouche & Nier, 2010; Jagannathan, Kapoor & Schaumburg, 2012](#)).

<sup>7</sup> Unilateral current transfers are U.S. government and private transactions in which financial assets, goods, or services are transferred from the United States to residents of foreign countries without the receipt of an item with economic value in return. Examples include humanitarian aid and gift exchanges.

<sup>8</sup> The current account deficit shrank slightly in 2007 to \$738 billion – still a significantly high number despite the decline relative to 2006.

In most countries with surplus funds to invest, U.S. investments became relatively more attractive.<sup>9</sup> Foreign demand for U.S. Treasury and Agency securities was especially pronounced as foreign investors sought relatively safe and low-risk assets in the United States (See [Caballero & Krishnamurthy, 2009](#); [Bertaut, DeMarco, Kamin, & Tryon, 2012](#); [Gorton & Metrick, 2012](#); [Jagannathan, Kapoor, & Schaumburg, 2012](#); [Pozsar, 2013](#)). Foreign holdings of U.S. Government debt rose from 18 percent of the total outstanding stock of U.S. Government debt in December 2000 to 28 percent of total debt in June 2008.<sup>60</sup> The heightened foreign demand for U.S. investments put downward pressure on both real and nominal interest rates ([Jagannathan, Kapoor, & Schaumburg, 2012](#)).

Significant capital inflows and low real (and nominal) interest rates can have several impacts on the availability of credit and the levels of asset prices (especially real estate). Low nominal interest rates, for example, reduce borrowing costs for banks and other lenders and thus enable them to finance more loans at a lower cost of funds. Similarly, low mortgage rates lead to increased demand for mortgage loans, which in turn can increase the demand for housing and put upward pressure on housing prices. Not surprisingly, the empirical evidence substantiates that significant capital inflows and low interest rates are historically associated with substantial increases in housing prices (including during the 2001-2006 period) (See, e.g., [Ackermann, 2012](#); [Reinhart & Reinhart, 2009](#); [Aizenman & Jinjark, 2009](#); [Obstfeld & Rogoff, 2010](#); [Merrouche & Nier, 2011](#)).

Not only did the inflow of capital from abroad fuel the pre-crisis increases in housing prices and mortgage credit through lower interest rates, but foreign investors also often invested directly in securities issued by the housing finance GSEs,

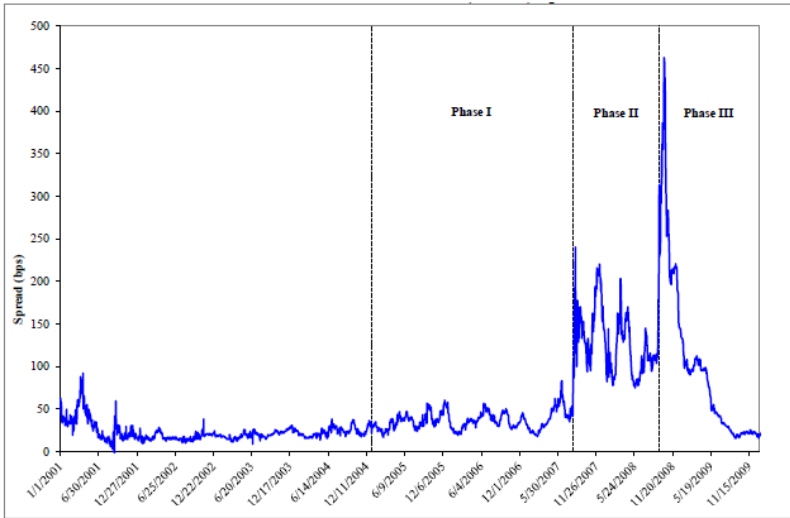
<sup>9</sup> Chairman Bernanke commented in September 2007 – ironically, just after the outbreak of Phase II of the crisis – that the strong demand by foreign investors for U.S. assets “reflect[s] the attractiveness of both the U.S. economy overall and the depth, liquidity, and legal safeguards associated with its capital markets.” See Bernanke ([2007](#)).

which gave those Agencies more capital to invest in the mortgage markets (as discussed further in Section 3.3). For example, in 2000 China held roughly \$72 billion in U.S. Treasury debt and \$20 billion in U.S. housing GSE debt, but in 2007 China held about \$466 billion in Treasuries and \$376 billion in Agency securities (Jagannathan, Kapoor, & Schaumburg, 2012). Indeed, one study suggests that every \$1 in the U.S. current account deficit was associated with roughly a \$2 increase in housing prices (Jagannathan, Kapoor, & Schaumburg, 2012).

## Low Credit Spreads and the Demand for MBS-Based Structured Products

Not only did the levels of interest rates decline significantly from 2001 to 2004, but credit spreads also declined during the same period. Credit spreads reflect the risk premiums that investors demand to compensate for bearing relatively higher default risks than they would bear on financial instruments subject to less credit risk.

For example, bank lenders in the LIBOR interbank market are exposed to the risk of default by unsecured bank borrowers. Treasuries, by contrast, are borrowings by the U.S. Government and thus are viewed by many as being default-risk-free. Accordingly, the spread between LIBOR and comparable-maturity Treasuries – known as the Treasury-Eurodollar or “TED” Spread – reflects the credit and liquidity risk of the banking system (Hammoudeh, Chen, & Yuan, 2011). In the five years leading up to the crisis, the credit risk premium on bank relative to Treasury debt remained at relatively low and stable levels, as demonstrated by the three-month TED Spread shown in Exhibit 5.

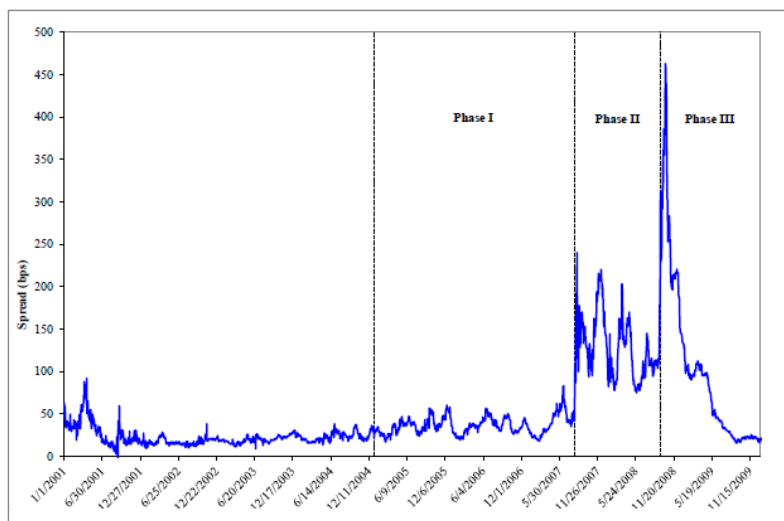


**Exhibit 5.** *Three-Month Treasury-Eurodollar (“TED”) Spread, 2001 – 2009*

**Notes:** TED Spread is defined as 3-month LIBOR minus the 90-day U.S. Treasury Bill rate. Vertical lines reference: January 1, 2005 - beginning of Phase I; August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** Bloomberg.

Exhibit 6 shows short-term credit spreads for corporate borrowers of different credit qualities as measured by spreads between non-financial CP rates for the two highest rating categories. Following an initial contraction, short-term corporate credit spreads remained low and exhibited moderate volatility from 2002 to mid-2007.

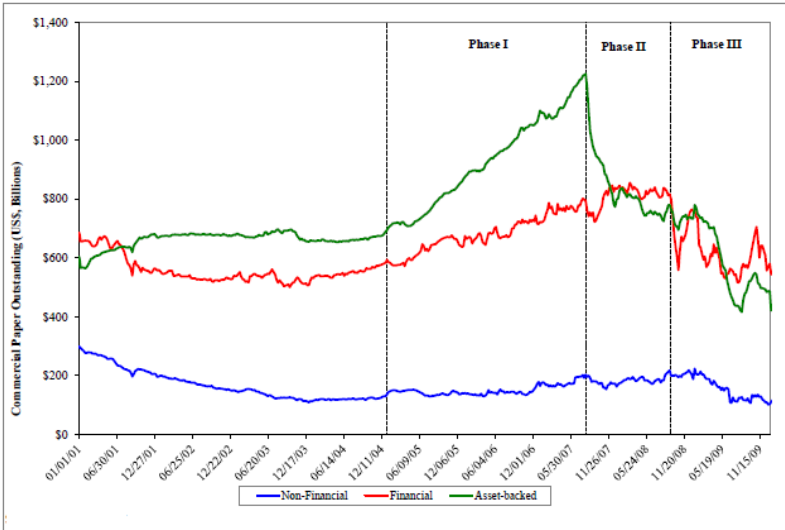


**Exhibit 6.** *Spread between AA and A2/P2 Non-Financial Commercial Paper, 2001 – 2009*

**Notes:** TED Spread is defined as 3-month LIBOR minus the 90-day U.S. Treasury Bill rate. Vertical lines reference: January 1, 2005 - beginning of Phase I; August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** Bloomberg.

During this same period, the CP market experienced tremendous growth (S&P, 2007). Exhibit 7 shows CP outstanding by type from 2001 through December 2009. Year-over-year percentage changes in total outstanding CP showed double-digit growth rates for 27 consecutive months through July 2007 (S&P, 2007). In particular, Exhibit 7 illustrates a significant expansion of credit extended through the ABCP market between 2005 and mid-2007.

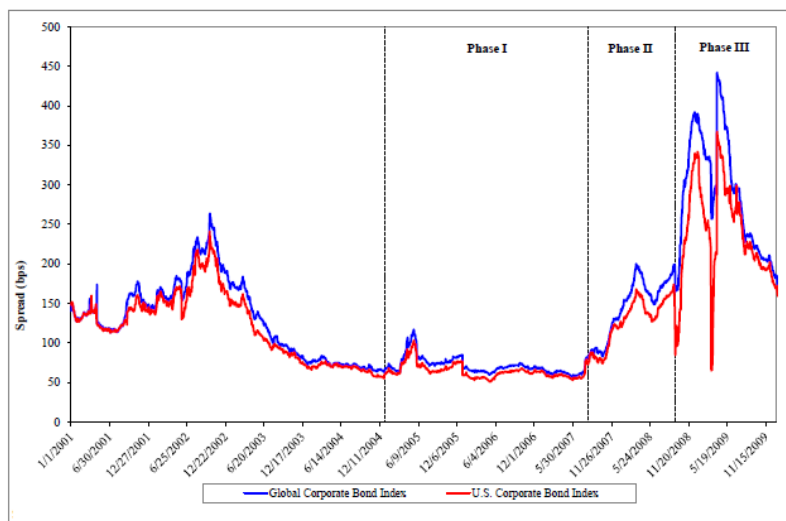


**Exhibit 7.** *Commercial Paper Outstanding, 2001 – 2009*

**Notes:** Vertical lines reference: January 5, 2005 (closest date to January 1, 2005 based on weekly data) - beginning of Phase I; August 8, 2007 (closest date to August 9, 2007 based on weekly data) - end of Phase I, beginning of Phase II; September 17, 2008 (closest date to September 15, 2008 based on weekly data) - end of Phase II, beginning of Phase III.

**Source:** Federal Reserve Board.

Exhibit 8 shows longer-term corporate asset swap spreads, measured by differences between the Merrill Lynch BBB-rated and AAA-rated U.S. and Global corporate bond index asset swap spreads. The indices shown in Exhibit 8 are based on bonds of between four and seven years to maturity and show a decline in default risk premiums between 2003 and 2005 that remained relatively low and stable at these maturities through the end of Phase I.



**Exhibit 8.** *Asset Swap Spreads on AAA & BBB Merrill Lynch Corporate Bond Indices, 2001 – 2009*

**Notes:** The asset swap spread represents the spread over LIBOR at which fixed interest payments on fixed-rate bonds can be swapped for a floating payment equivalent in expected present value terms to the fixed-rate payment at the inception of the swap. Asset swap spreads are used to express interest rates on fixed- and floating-rate bonds on a consistent and comparable basis. The chart shows the difference between BBB- and AAA-rated indices. Vertical lines reference: January 1, 2005 - beginning of Phase I; August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** Bloomberg.

The relatively low credit spreads for short- and long-term debt from 2002 through the end of Phase I indicate that investors were demanding very little compensation for investing in riskier debt during that time. Whereas low interest rates are generally associated with expansions of credit, low credit spreads in turn encourage increased leverage amongst relatively higher-risk borrowers. In addition, low interest rates and credit spreads together can also lead to more risk-taking by banks and other investors (Altunbas, Gambacorta & Marquez-Ibanez, 2014). If such investors cannot achieve desired yield targets through investments in traditional debt instruments, they look instead toward securitized and structured credit products in which



financial assets are repackaged to engineer higher yields (and, of course, the greater risk that accompanies higher yields) (See, e.g., Gross, 2007; Ackermann, 2011; Crouhy, Jarrow, & Turnbull, 2008; Shleifer & Vishny, 2010). Mortgage loans and MBS were popular sources of collateral for structured credit products sought by investors looking to meet yield and asset-class allocation targets during the period from 2001 to early 2007 (Greenspan, 2013; Deng, Gabriel, & Sanders, 2011).

Although some investors obtained mortgage market exposures directly through MBS investments, others sought securities based indirectly on mortgage loans with different risk/return profiles than available through existing MBS offerings. To accommodate that demand, banks and other financial intermediaries offered new investments based on MBS (rather than the original mortgage loans underlying those MBS), including ABS CDOs and SIVs (see Section 2.4). The availability of those products (which significantly contributed to the demand for MBS) expanded the capacity of U.S. housing finance markets and enabled them to absorb the significant capital inflows into the United States during the pre-crisis period, as discussed in Section 3.1.2. (Jagannathan, Kapoor, & Schaumburg, 2012).

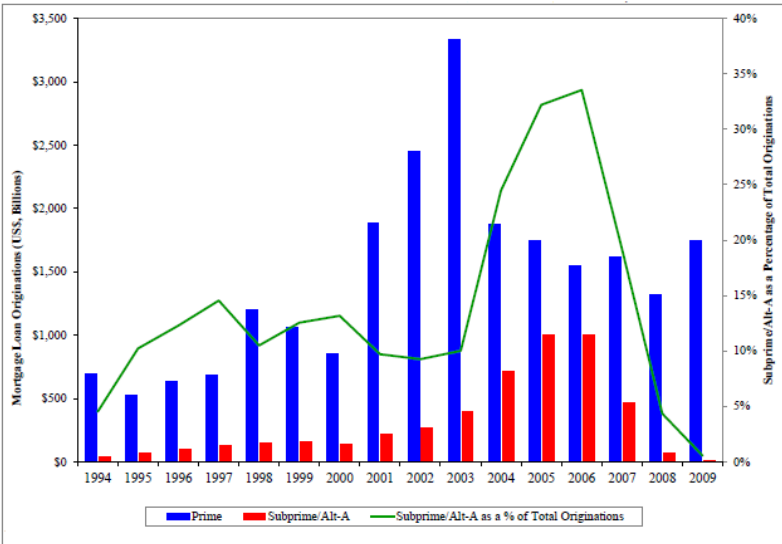
The demand for products like ABS CDOs, SIVs, and ABCP also included large commercial and investment banks seeking to optimize mortgage-related investment returns vis-à-vis regulatory capital requirements. Specifically, sponsoring or holding the relatively senior tranches of structures like ABS CDOs, SIVs, and ABCP conduits enabled large global bank arrangers or sponsors of such products to retain some exposure to mortgage assets with relatively attractive expected returns but relatively low risk-based regulatory capital requirements (as compared to holding whole loans on their balance sheets) (Crouhy, Jarrow, & Turnbull, 2011; Acharya & Richardson, 2009; Erel, Nadauld, & Stulz, 2009; Acharya, Schnabl, & Suarez, 2010).

The yield-based and regulatory arbitrage sources of demand for structured products based on MBS further fueled the already strong demand for the issuance of MBS. Indeed, investor demand (and the resulting competitive pressures to

satisfy that demand) for mortgage exposure contributed to a decline in the average time between a mortgage closing and the securitization of that mortgage in 2006 and 2007 (D'Silva & Gordon, 2008). Two officials from the Federal Reserve Bank of Chicago noted: “In late 2006 and early 2007, the banks’ biggest challenge was not in selling the [MBS] they had created; rather, their challenge was in creating enough [MBS] to meet the demand of investors....” (D'Silva & Gordon, 2008; Demyanyk & van Hemert, 2011).

## Public Housing Policies and Mortgage Lending

Mortgage loan originations between 1994 and 2009 are shown in Exhibit 9 according to the perceived risk of the borrower and loan. Beginning around 2003, subprime and Alt-A mortgage issuances began to rise significantly. Subprime lending grew significantly through 2005, despite a relative decline in income growth by borrowers (Mian & Sufi, 2009).



**Exhibit 9.** *U.S. Prime and Subprime/Alt-A Mortgage Loan Originations, 1994 – 2009*

**Source:** Inside Mortgage Finance, 2013 Mortgage Market Statistical Annual.

Many mortgage bankers relaxed their loan underwriting standards (along at least some dimension) in the years leading

up to the 2007 credit crisis (See, e.g., Office of the Comptroller of the Currency, 2007; Mayer, Pence, & Sherlund, 2009; Demyanyk & Van Hemert, 2008; Bhardwaj & R. Sengupta, 2010).<sup>10</sup> Some relaxation of lending standards is the historical norm during periods of low interest rates, loose monetary policies, expanding credit, and rising asset prices (Gorton & He, 2008; Hall, 2011). Although the rate of increase in housing prices made home ownership relatively less affordable to many Americans (all else equal), new products were developed over time that increased affordable access to mortgage credit, especially for borrowers with relatively lower credit quality (See, e.g., Bhardwaj & Sengupta, 2012; Bhardwaj & Sengupta, 2014). These more affordable mortgage products further increased the demand for home purchases (despite rising house prices) and exacerbated the increase in housing prices (See, e.g., Zimmerman, 2007; Mian & Sufi, 2010). The sustained rise in housing prices also enabled many borrowers to obtain additional mortgage credit through the use of home equity loans and related products (Mian & Sufi, 2011). Empirical evidence suggests that alternative mortgage products have been especially valuable for borrowers that expect higher and less volatile future labor income and that desire to smooth their consumption over time (Cocco, 2013).

The macroeconomic factors discussed in Section 3.1 do not fully account for the substantial rise in U.S. housing prices, the relative increase in higher-risk loans, and the decline in underwriting standards that occurred in the period from 2001 through 2006.<sup>82</sup> Numerous political and social policies promulgated by the U.S. Congress, financial regulators, and federal agencies to expand mortgage lending and encourage more widespread home ownership in the United States (especially by low-income borrowers) also played a pivotal role.<sup>11</sup>

<sup>10</sup> The relaxation of lending standards does not mean that the relaxation was inappropriate or undisclosed or that originators disregarded their underwriting standards.

<sup>11</sup> For an in-depth discussion of these policies, see Wallison, (2011); Pinto, (2011); Calomiris, (2011).

As noted in Section 2.1, public policies designed to promote home ownership in the United States date back to the 1930s (See, e.g., [Green & Wachter, 2010](#); [Financial Crisis Inquiry Commission, 2010](#) (hereinafter “FCIC (GSEs)”). But beginning in the 1990s, there was a particular acceleration of public policies designed to increase mortgage availability to low- and moderate- income (“LMI”) borrowers. In 1992, Congress (apparently responding to pressure from the U.S. Department of Housing and Urban Development (“HUD”)) revised the charters of Fannie Mae and Freddie Mac to include an affordable housing mandate. Specifically, the Federal Housing Enterprises Financial Safety and Soundness Act of 1992. (“1992 Act”) set forth goals to increase homeownership along three dimensions: (i) to LMI borrowers (the “LMI Goal”); (ii) to very low-income borrowers or low-income borrowers living in low-income areas (the “Special Affordable Goal”); and (iii) to borrowers living in low-income or high-minority areas (the “Underserved Areas Goal”) ([FCIC \(GSEs\), 2010](#); [Wallison, 2011](#)). Testifying in 2010, the Acting Director of the Office of Federal Housing Enterprise Oversight noted: “In retrospect, it is easy to see that HUD pushed the housing goals too high” ([Lockhart, 2010](#)).

HUD attempted to implement its goals largely through Fannie Mae and Freddie Mac. In 1994, HUD also implemented a “Best Practices Initiative” that encouraged looser underwriting standards by private mortgage originators in order to extend HUD’s affordable housing goals to private market participants that were not otherwise subject to its affordable housing mandate ([Wallison, 2011](#)). By 1998, 117 members of the Mortgage Bankers’ Association had joined the Best Practices Initiative and had agreed to increase lending to minorities and low-income borrowers (in part by agreeing to sell the resulting subprime and Alt-A loans to the GSEs) ([Wallison, 2011](#)).

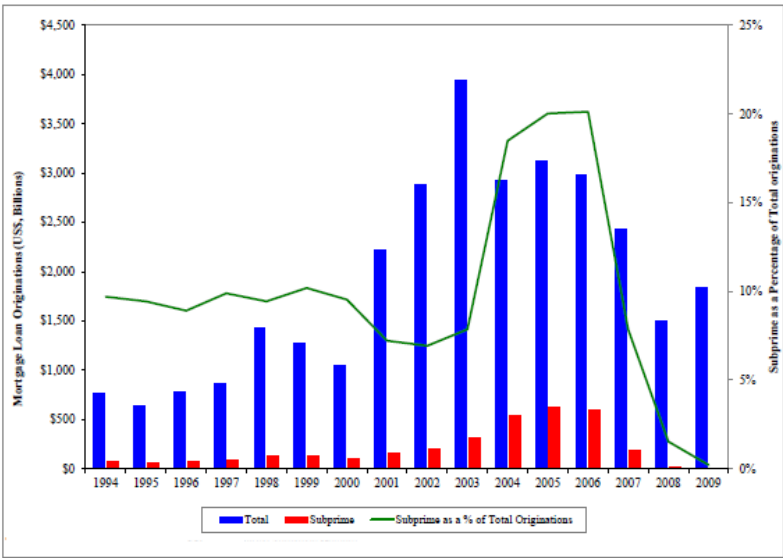
In 1995, HUD articulated its National Homeownership Strategy that, among other things, “commits both government and the mortgage industry to....[r]educe downpayment requirements and interest costs by making terms more flexible, providing subsidies to [LMI] families,

and....[i]ncreas[ing] the availability of alternative financing products in housing markets throughout the country” ([United States Department of Housing and Urban Development, 1995](#)). That same year, U.S. banking regulators also significantly revised their implementation of the Community Reinvestment Act (“CRA”) (enacted in 1977 to help ensure that banks were extending sufficient credit to LMI borrowers) by requiring banks to demonstrate that they were making an adequate number of loans to LMI borrowers and that they were using innovative or flexible means to provide mortgage credit to LMI borrowers and communities ([Wallison, 2011](#)). Because qualifying CRA loans were essentially similar to the loans that the GSEs were required to purchase, the 1992 Act together with the CRA revisions put the GSEs into direct competition with mortgage originators for loans that satisfied the HUD affordable housing goals. In particular, the GSEs were forced to turn to purchases of MBS backed by non-conforming and often non-prime mortgages in order to satisfy HUD mandates.

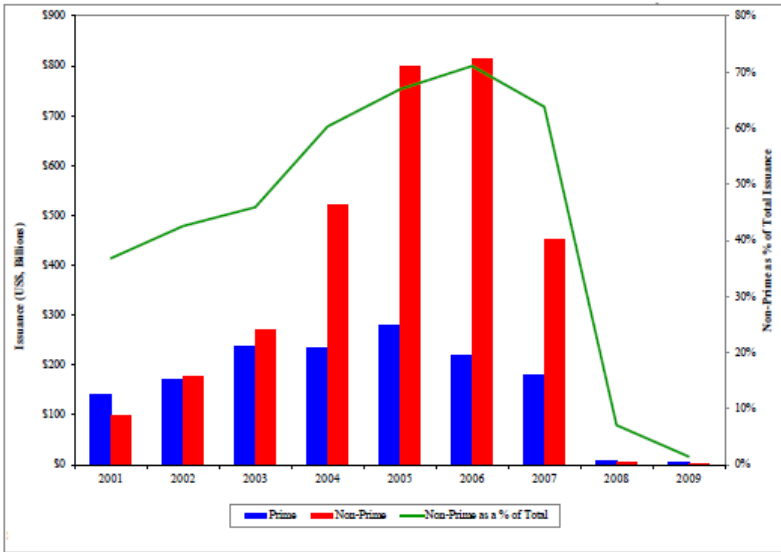
Public policy mandates to extend credit to low-income, high-risk borrowers became even more aggressive in the years following the 1992 Act, HUD Best Practices Initiative, and CRA reform. In 1996, HUD policy targets dictated that 40 percent, 12 percent, and 21 percent of mortgages purchased by Fannie and Freddie should be mortgage loans to LMI borrowers, Special Affordable borrowers, or Underserved Areas borrowers, respectively. By 2008, Fannie and Freddie’s target shares of mortgage purchases had increased to 56 percent for LMI borrowers, 27 percent for Special Affordable borrowers, and 39 percent for borrowers in Underserved Areas ([FCIC, 2010](#)). As a result, by 2006 more than 55 percent of all mortgages purchased by both Fannie and Freddie were loans made to LMI borrowers ([FCIC, 2010](#)).

Fannie Mae and Freddie Mac began purchasing subprime and Alt-A mortgage loans and MBS as early as 1997 in order to comply with HUD’s affordable housing goals ([Pinto, 2011](#); [Wallison, 2011](#)). In fact, the GSEs were the dominant purchasers of subprime and Alt-A mortgages well before the private-label MBS market began to experience significant

growth – see Exhibit 10, which shows the total issuance of Agency and private-label MBS since 1990 (Wallison, 2011). Once purchased, the GSEs either securitized the mortgages or held the mortgages as assets on their own balance sheets. Both Agency and private-label MBS issuance grew significantly beginning around 2001, with private-label MBS issuances equaling (and by some counts surpassing) Agency MBS issuances in 2006. (See Exhibit 10.) As Exhibit 11 shows, a rising proportion of private-label MBS issued in that period was based on subprime loans.



**Exhibit 10.** *U.S. Total and Subprime Loan Originations, 1994 – 2009*  
**Source:** Inside Mortgage Finance, 2013 Mortgage Market Statistical Annual.



**Exhibit 11.** *Private-Label U.S. MBS Issuance – Prime vs. Non-Prime, 2001 – 2009*

**Source:** Inside Mortgage Finance, 2013 Mortgage Market Statistical Annual.

Fannie Mae and Freddie Mac also met their HUD affordable housing goals by purchasing MBS based on subprime and Alt-A loans. GSE purchases of Alt-A and subprime loans and MBS grew significantly from 1997 to 2007. Annual purchases of such loans and MBS by the GSEs totaled \$72 billion in 1997, \$415 billion in 2002, and \$676 billion in 2007 (Pinto, 2010). From 2002 through 2006, Fannie and Freddie were the largest individual purchasers of subprime MBS (Wallison, 2011).

The numerous U.S. housing policies designed to facilitate more widespread home ownership (especially amongst LMI borrowers) had several impacts on U.S. real estate and mortgage markets. First, those public policy decisions engendered an increase in the production of mortgage loans (in both absolute and relative terms) to higher-risk borrowers.

Second, the mandated increase in the supply of mortgages to LMI borrowers placed upward pressure on housing prices by increasing the total supply of mortgage credit to borrowers that might otherwise have been unable to access mortgage

financing opportunities, thus expanding the pool of potential home buyers and increasing demands for housing. Because private and GSE mortgage creditors were instructed to develop new mortgage products to ensure that any increase in housing prices did not restrict the availability of mortgage loans to LMI borrowers, moreover, such policies also ensured that more loans would be extended to higher- risk borrowers notwithstanding any increase in house prices.

Third, the policies fueled demand for Alt-A and subprime MBS from the GSEs (as another channel through which they could meet their affordable housing goals).

Finally, the various policies put private mortgage originators in direct competition with the GSEs for the same types of mortgages.



# 4

## Phase I: Housing Finance Market Disruptions

**B**y some accounts, the credit crisis began at least as early as 2005 with disruptions in U.S. and European real estate and leveraged loan markets.<sup>1</sup> In Phase I of the crisis (which lasted through early August 2007), the market disruptions in U.S. and international housing finance markets and leveraged loan markets were largely independent phenomena.

In August 2007, the market tumult suddenly spread from U.S. and European mortgage and leveraged loan markets to other credit markets, including short-term funding markets and structured credit products with no exposure to mortgage or leveraged loan collateral. Phase II of the crisis was essentially a system-wide banking panic that resulted in severe dislocations in virtually all credit markets and a

<sup>1</sup> The inception date for Phase I of the crisis is subjective and is made for pedagogical simplicity. Although the crisis did not begin to impact MBS markets until late 2006 and early 2007 (see Section 4.2), its impacts were being felt in the subprime mortgage origination business as early as 2005. Choosing an inception date of Phase I of late 2006 would be equally appropriate and would not affect any of my conclusions.

massive reduction in funding liquidity available to financial intermediaries and other market participants.<sup>100</sup> I use August 9, 2007 as the demarcation point between Phase I and Phase II of the crisis (for reasons that will become clear in Sections 5.2 and 5.3).

Phase III of the crisis – a widespread panic and near-meltdown of the financial system – began with the failure of Lehman Brothers and the de facto nationalization of AIG in September 2008. The disruptions arising in this third phase of the crisis continue to be felt to some degree even today. I define the beginning of Phase III of the crisis as the date on which Lehman Brothers failed, September 15, 2008, and I define the end of Phase III as December 31, 2009.<sup>2</sup>

The sections below summarize the key events in the first phase of the credit crisis.

Sections 5 and 6 review the evolution of the crisis in Phases II and III.

## The Mortgage Lending Market Comes Under Stress (2005 & 2006)

Market participants began to recognize mounting pressures on the U.S. mortgage market as early as 2005.<sup>3102</sup> In a report issued on November 30, 2005, for example, S&P described 2005 as “[t]he [y]ear [o]f ‘[w]arnings’ [f]or [t]he [m]ortgage [s]ector” (S&P, 2006). S&P stated: “The credit performance of mortgage loans and HELOCs is expected to decline from year-to-date measures, due to several factors: rising short-term interest rates, which are the basis for the repricing of many adjustable-rate mortgages (ARMs) and HELOCs; more layering of risk; and weaker underwriting standards in some mortgage products” (S&P, 2006). Notwithstanding such concerns, housing price appreciation

<sup>2</sup> August 2007 is widely regarded as the period in which the mortgage crisis evolved into a more widespread credit crisis. See, e.g., Borio, (2008); Greenlaw, Hatzius, Kashyap, & Shin, (2008); Mishkin, (2011); Gorton & Metrick, (2012).

<sup>3</sup> In fact, there was discussion of a possible “bubble” in housing prices even earlier than 2005 at a broad macroeconomic level. See, e.g., Case & Shiller, (2003).

continued for some time to bolster the equity embedded in mortgage loans, which in turn appeared to limit potential losses that could arise in the event of a borrower default.<sup>4 5</sup>

Housing price appreciation did begin to slow in 2006, however, as shown in Exhibit 12. Mortgage delinquencies and foreclosures began to rise (see Exhibit 13), and mortgage lenders started to realize losses. On November 1, 2006, S&P warned of additional adverse developments for the U.S. mortgage market in 2007, including higher-than-normal mortgage delinquencies and credit losses, and relatively greater challenges for subprime mortgages and home equity lines of credit (S&P, 2007). In a Special Report issued on December 11, 2006, Fitch Ratings indicated that more subprime-backed MBS were downgraded between July and October 2006 than in any previous four-month period (Fitch, 2006). Fitch further cautioned:

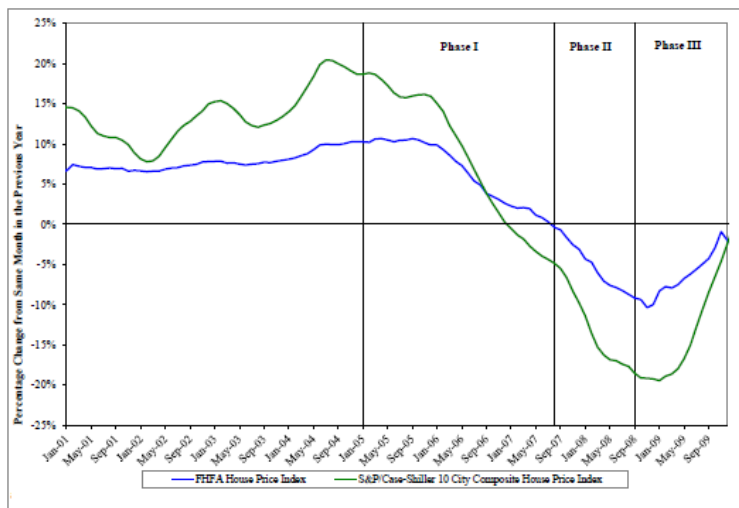
[T]he increase in bond credit risk has been notable in the sub-prime sector, where serious delinquencies have increased almost 50% [year over year] and the number of downgrades has jumped in recent months. Additionally, the sensitivity of sub-prime performance to the rate of [housing price appreciation] and the large number of borrowers facing scheduled payment increases in 2007 should continue to put negative pressure on the sector. Fitch expects delinquencies to rise by at least an additional 50% from current levels throughout the next year and for the general ratings environment to be negative, as the number of

<sup>4</sup> Empirical evidence indicates that the decline in housing prices – not a decline in loan underwriting standards – was the primary driver of increased foreclosures in many markets. See, e.g., Gerardi, *et al.*, 2009; Gerardi, Shapiro, & Willen, 2009; Capozza & Van Order, 2011. For explanations of why borrowers might have perceived default risk as limited in a rising house price environment, see, e.g., Daglish, 2009; Archer & Smith, 2013.

<sup>5</sup> Optimistic expectations about housing prices can cause lenders to focus relatively less on borrower-specific credit risks and, hence, to approve more loans to relatively riskier borrowers. See, e.g., Gerardi, Foote, & Willen, 2011; Brueckner, Calem, & Nakamura, 2012; Goetzmann, Peng, & Yen, 2012.

downgrades is expected to outnumber the number of upgrades (Fitch, 2006, p.18).

These developments did not significantly impact subprime-backed MBS prices until February 2007, however (Kau *et al.*, 2011).<sup>6</sup>

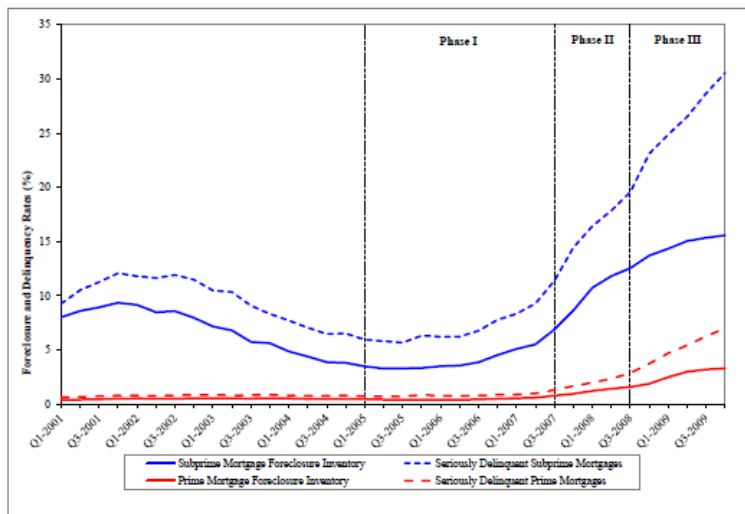


**Exhibit 12.** Annual Change in U.S. Housing Prices, 2001 – 2009

**Notes:** Vertical lines reference: January 1, 2005 - beginning of Phase I; August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Sources:** Federal Housing Finance Agency, Standard & Poor's.

<sup>6</sup> As discussed in Section 2.2.2, MBS typically include credit enhancements that insulate many tranches from underlying loan losses, which helps explain why troubles in the subprime loan market did not immediately translate into disruptions in related MBS markets.



**Exhibit 13.** Foreclosure and Mortgage Delinquency Rates, 2001 – 2009

**Notes:** Seriously Delinquent includes mortgages 90 or more days past due and those which started the process of foreclosure. Vertical lines reference:

Q1-2005 - beginning of Phase I; Q3-2007 - end of Phase I, beginning of Phase II; Q3-2008 - end of Phase II, beginning of Phase III.

**Source:** Mortgage Bankers Association.

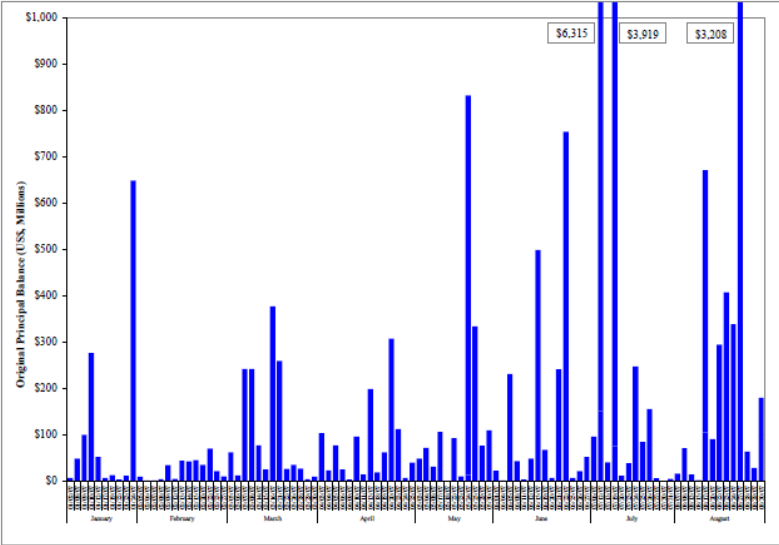
## Market Jitters (February 2007)

As housing prices fell through early 2007, losses in subprime lending enterprises mounted. On February 7, 2007, for example, New Century Financial – a large participant in the subprime market – announced that it was re-stating its financial results for three quarters in 2006 to correct errors in its accounting for loan repurchase losses to reflect much higher realized losses. On the same day, HSBC announced that its year-end 2006 loan impairment provisions would be higher than market participants expected (HSBC Finance Corporation 8-K 2007). HSBC fired its U.S. head of subprime mortgage lending on February 22, 2007, after losses reached \$10.5 billion (BBC News, 2008). New Century filed for bankruptcy protection in early April. In May, UBS closed its internal Dillon Read subprime fund. And later in May, U.K. subprime lender Kensington agreed to a takeover amidst its financial difficulties (BBC News, 2008).

The subprime MBS market responded rapidly and adversely to these negative market developments in early 2007. Exhibit 14 shows MBS downgrade actions by S&P during 2007. The first major subprime MBS downgrades began in late January 2007 and continued through February and March 2007.

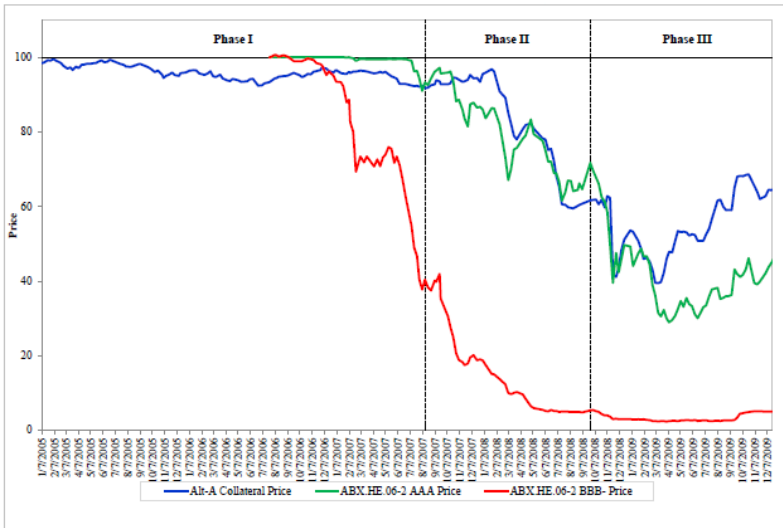
Beginning in late 2006, the price of the BBB- tranche of the ABX index<sup>7</sup> – the main market indicator of value for the relatively riskier mezzanine tranches of subprime MBS – began to decline, as shown in Exhibit 15. The price declines accelerated significantly in early February 2007 with the New Century and HSBC announcements. The subordinated tranches of Mezz ABS CDOs with significant subprime exposure also began to experience price declines in February 2007 (Yan & Ustun, 2007). Note, however, that MBS based on Alt-A mortgage collateral did not begin to experience significant price declines until February 2008.

<sup>7</sup> The ABX index reflects the value of a portfolio of 20 underlying subprime HEL MBS. The composition of the index was changed every six months so that the most recent “series” of the index included HEL MBS based on mortgages originated in the preceding six-month period. The ABX index was essentially the only index product based on subprime mortgage collateral at the time. See, e.g., Gorton (2009).



**Exhibit 14.** *Daily MBS Downgrades by S&P, 1/1/07 – 8/31/07*  
**Note:** Vertical axis is set to a maximum of \$1 billion to preserve scale.  
**Source:** Standard & Poor's.

Following their initial decline in February 2007, subprime MBS and Mezz ABS CDO market prices stabilized briefly. (See Exhibit 15.) This would prove short-lived, however.



**Exhibit 15.** *Alt-A U.S. MBS Collateral Values vs. ABX.HE Subprime Indices, 2005 – 2009*

**Note:** Vertical lines reference: August 13, 2007 (closest date to August 9, 2007 based on weekly date) - end of Phase I, beginning of Phase II; September 25, 2008 (closest available date to September 15, 2008 based on weekly data) - end of Phase II, beginning of Phase III. Alt-A Collateral Price is a price for U.S. RMBS with Alt-A collateral, as reported by Barclays.

**Source:** Barclays Capital.

## The MBS Market Collapses (May-July 2007)

In late May 2007 (around the time that Moody's placed 62 tranches of subprime-backed MBS on downgrade review), the subprime MBS market began to decline again ([Brunnermeier, 2009](#)). This time, the market decline was sharp and sustained. The subprime MBS market tumbled throughout June and July 2007 as one piece of bad news followed another. During that period, Bear Stearns injected about \$3.2 billion in late June 2007 into one of two troubled funds exposed to significant subprime risk to protect it from mounting losses ([Gorton, 2010](#)).

In addition, the rating agencies began a series of aggressive downgrades of MBS (see Exhibit 14) and ABS CDOs. On June 15, 2007, Moody's downgraded 131 second-lien MBS and placed 136 additional securities on downgrade review ([Shah, 2007](#)). On June 22, 2007, S&P downgraded 34 second-lien and 42



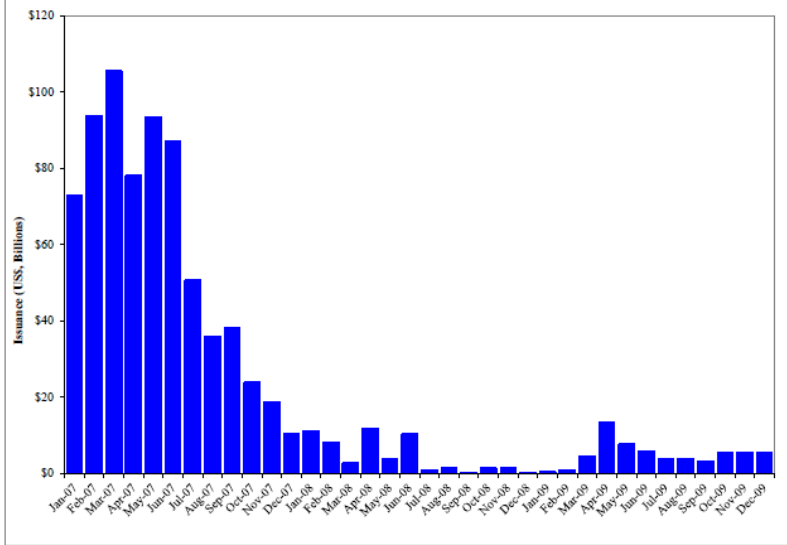
subprime securities (Rosenberg, 2007). Moody's announced ratings cuts for another 399 subprime MBS on July 10, 2007 (Barr, 2007). And on July 11, 2007, Moody's announced that it might cut ratings on \$5 billion in CDO tranches (Moody's Investors Service, 2007).

During June and July 2007, the BBB- tranche of the ABX index of subprime MBS continued to fall sharply, as Exhibit 15 demonstrates. Prices of Mezz ABS CDOs with subprime exposures were also plummeting. And as Exhibit 15 further shows, the AAA tranche of the ABX index (based on higher-rated, lower-risk tranches of subprime MBS) also fell appreciably below its par value in July 2007 for the first time, which in turn affected the senior tranches of Mezz ABS CDOs and the junior tranches of certain HG ABS CDOs. As discussed in Section 2.2.2, because senior MBS tranches are further removed from credit losses than junior tranches, the erosions of value in the AAA tranche of the ABX indicated a growing concern by market participants that subprime-related MBS losses could be higher than previously expected.

Empirical evidence indicates, moreover, that declines in the levels and the higher volatility of ABX prices were a transmission mechanism that exacerbated financial strains on the balance sheets of large banks and other financial intermediaries (Calice, 2011).

By late July 2007, trading in subprime MBS and Mezz ABS CDO markets had nearly ground to a halt. With so little trading activity and liquidity, it became difficult for market participants to determine the actual values of their MBS investments. Making matters worse, investors were beginning to sell distressed subprime securities, leading many to question whether current MBS and ABS CDO mark-to-market prices reflected real, fundamental values or merely depressed, fire-sale prices. (See Section 5.1.)

New private-label MBS issuance also plummeted beginning in July 2007. (See Exhibit 16.) Likewise, the volume of new U.S. CDO issuance declined sharply in the third quarter of 2007. Even CDOs with little or no subprime MBS exposure were adversely affected by the widespread loss of confidence that seized the CDO market (Adams, 2010).



**Exhibit 16.** *New Issuance of U.S. Private-Label MBS, 2007 – 2009*

**Note:** Monthly data from October 2009 to December 2009 is calculated based on quarterly data.

**Source:** Inside Mortgage Finance.

# 5

## Phase II: Global Liquidity and Credit Crisis

In early August 2007, largely independent market disruptions that had previously been confined to U.S. and European mortgage and leveraged loan markets suddenly were accompanied by massive disturbances in other credit markets. As one study observed: “Signs of severe pressures in some credit markets became evident across the globe on August 9, 2007. In an interesting geographic twist, the proximate trigger seemed to be the announcement by a large European bank that it would close three investment funds because problems in the U.S. mortgage market had made it impossible to value the underlying assets” ([Greenlaw, 2010](#); [Acharya & Schnabl, 2010](#)). Yale Professor Gary Gorton emphasizes that subprime market disruptions alone could not possibly have precipitated the widespread illiquidity that occurred beginning in August 2007 across virtually all structured credit markets:

[T]he shock to subprime per se was not the cause of the panic. Other asset classes only experience difficulties when there are problems in the interbank market, starting in August 2007....The Libor-OIS spread

jumps in August 2007, and again when Lehman fails. Other securitized asset classes, with nothing to do with subprime, like credit card receivables, auto loans, and student loans, all move with the proxy for the state of the inter-bank market, not with the ABX....The key question for understanding the panic is: Why were non-subprime-related asset classes affected? Subprime mortgage originations in 2005 and 2006 totaled about \$1.2 trillion...a large number to be sure, but not large enough to cause a systemic crisis. How was the shock turned into a panic? The shock was combined with asymmetric information about the locations and sizes of exposures to subprime (Gorton, 2009, p.32).

The “asymmetric information” to which Gorton refers consisted largely of subprime exposures within financial instruments with opaque collateral – notably, ABS CDOs and ABCP issuers like SIVs (Gorton, 2009). The buckling of the leveraged loan market (as discussed further in Section 7.2) following shortly after the collapse of the subprime MBS market in June and July 2007, moreover, fostered similar uncertainties about the locations and sizes of leveraged loan losses and risk exposures that might be lurking in relatively opaque structured credit products like CDOs, SIVs, and certain ABCP conduits.

As Phase II of the crisis began in August 2007, investors and market participants began to recognize that previous credit spreads had been too low compared ex post to the nature of the risks that were emerging in structured credit instruments (Greenspan, 2010). Investors began to fear that subprime and leveraged loan exposures existed in markets with little or no apparent connection to U.S. mortgage or leveraged finance markets – especially in relatively more complex and harder-to-analyze financial products like certain ABS CDOs.<sup>1</sup>

<sup>1</sup> As Citibank indicated in a research note: “Of the many skeletons hiding in the subprime closet, writedowns on banks’ positions on CDOs of ABS are probably the scariest.” (King, et al., 2007).

## Liquidity Crises and Asset Prices

The eruption of major disturbances in broader global credit markets in August 2007 had profoundly adverse impacts on both liquidity and prices in numerous markets. These effects were exacerbated by two aspects of the financial system that preceded the August 2007 market disruptions. First, leverage at many of the largest U.S. financial intermediaries expanded significantly from 2001 through 2007 (Adrian & Shin, 2010). Higher leverage in the financial sector increased the fragility of the financial system and made it more susceptible to shocks (Longstaff, 2008; FCIC, 2010; Acharya & Viswanathan, 2011; Brealey, Cooper, & Kaplanis, 2012; Fahlenbrach, Prilmeier & Stulz, 2012; Khandani, Lo, & Merton, 2013; Schroth, Suarez, & Taylor, 2014). Second, the significant reliance of commercial and investment banks on short-term debt made those institutions even more vulnerable to the sudden contraction in funding liquidity that occurred in August 2007 (Diamond & 2009; Khandani, Lo, & Merton, 2013; Kacperczyk & Schnabl, 2012; Acharya & Viswanathan, 2011; Acharya, Gale, & Yorulmazer, 2011; Allen, Babus, & Carletti, 2012; Fahlenbrach, Prilmeier, & Stulz, 2012; He & Xiong, 2012).

Before discussing the particular events of crisis Phase II, some additional discussion of the importance of “liquidity” in the global banking system is warranted. “Asset liquidity” (also known as “market liquidity”) reflects the ease with which an asset can be traded, whereas “funding liquidity” references the ability of firms to obtain funding to support their positions and manage their overall cash flows (Brunnermeier & Pedersen, 2011; Gennaioli, Scleifer & Vishny, 2012). In Phase II of the crisis (as in similar, previous historical episodes), these two types of illiquidity risks became strongly interrelated (Langstaff, 2010).

When funding liquidity is in short supply (or is expected to contract in the future), traders may become reluctant to take on new positions in risky assets. That reduces trading activity and asset liquidity in those markets and can increase the price volatility of such assets (Brunnermeier & Pedersen, 2012). In

addition, some financial institutions (especially those with high leverage and limited debt capacity) may be forced to sell assets in order to meet their current or short-term funding needs. In distressed market conditions, those asset sales can occur at “fire-sale” prices – i.e., market prices at discounts to the long-term fundamental values of those assets (Shleifer & Vishny, 2011; Choi & Cook, 2012; Nyborg & Östberg, 2014). In an efficient market, deviations between market prices and fundamental values would not persist. But when funding constraints interfere with the arbitrage mechanism and precipitate forced asset sales by some market participants that must liquidate assets (at any price) to cover current liabilities, such deviations can and do exist (Mitchell, Pedersen, & Pulvino, 2007; Fontana, 2011; Cochrane, 2011).

In a crisis, highly leveraged firms with limited debt capacity and uncovered funding needs must ascertain whether or not to sell illiquid assets at fire-sale discounts. Risk-based capital requirements on banks and insurance companies can lead highly leveraged and cash-constrained firms to engage in fire sales of distressed assets at potentially deep discounts to their fundamental values. In particular, if the distressed, illiquid assets are relatively high-risk (as they are likely to be), they are subject to higher regulatory capital requirements – i.e., regulated financial institutions must hold relatively more capital to cover the risks of those securities. As such, selling those assets, even at fire-sale prices, may be the best (or only) way for a financial institution to remain compliant with its minimum regulatory capital requirements (Merrill, *et al.*, 2014).

Firms that engage in fire sales of distressed assets, moreover, may signal to other market participants that they are in a weakened financial condition, which could potentially exacerbate their funding liquidity problems and depress future quotes for potential sales of illiquid assets. The transaction prices resulting from fire sales, further, may force an institution subject to mark-to-market accounting rules to mark its unsold inventories of illiquid assets to the new lower price, thereby reducing the amount the institution might be

able to borrow against those assets in secured funding markets (Duffie, 2010; Merrill *et al.*, 2014).

Alternatively, some institutions may choose to hold on to their illiquid assets to avoid fire-sale losses. For example, institutions not subject to risk-based capital and mark-to-market accounting requirements may not wish to sacrifice future returns by selling assets at market prices that they perceive are at deep discounts to their fundamental values (Merrill *et al.*, 2014). To generate needed cash, such firms will instead sell relatively higher-quality and more liquid assets, which then puts downward price pressure on those markets and gives rise to “contagion” across markets (for example Hall, 2010). In addition, the portfolio holdings of highly leveraged firms that retain illiquid assets and sell low-risk assets to meet their funding needs will become even more concentrated in the illiquid assets, even more highly leveraged, and even more financially fragile (Diamond & Rajan, 2011).

Asset and funding liquidity shocks can also affect the willingness of healthy firms with ample funding to lend. If funding liquidity begins to contract and/or is expected to contract in the future and certain assets are expected to remain illiquid, healthy lenders may demand a premium on longer-term credit to compensate for the risk that they will experience a funding shortfall and might have to sell illiquid assets at uncertain prices to cover that shortfall. Cash-constrained firms will prefer to borrow short-term funds to cover current liquidity shortfalls and avoid this liquidity premium on longer-dated credit. Credit markets experiencing both funding and asset illiquidity thus may exhibit significant and unusual variations in spreads between interest rates of different maturities. In the extreme, healthy institutions with sufficient funding may “hoard cash” and refuse to lend at any price or maturity in order to preserve a cushion for their own future potential funding needs (Caballero & Simsek, 2009; Shleifer & Vishny, 2011; Acharya & Skeie, 2011; Gale & Yorulmazer, 2013; Malherbe, 2014).

Concerns by healthy lenders about the credit risk of interbank borrowers can also impact interbank lending and asset pricing during periods of funding and asset market

illiquidity (such as the period beginning in August 2007). That can also lead healthy lenders with ample funding to lend primarily on a short-term basis (or to restrict lending altogether to certain counterparties) (Afonso, Kovner, & Schoar, 2011; Iyer & Peydró, 2011; Baglioni, 2012). Somewhat paradoxically, healthy lenders may also hoard cash in order to maximize their opportunities to purchase assets at fire-sale prices (Acharya, Shin, & Yorulmazer, 2011).

With this framework in mind, the remaining sections discuss the outbreak of Phase II of the crisis.

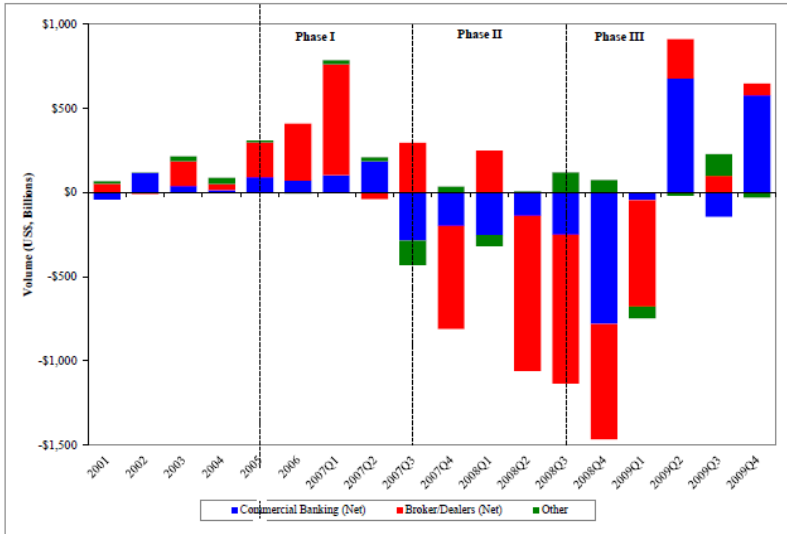
## Secured Interbank Funding Market Disruptions and the “Run on Repo”

A repurchase agreement (“repo”) is a form of secured borrowing in which the cash borrower sells a security (the collateral) for cash and simultaneously agrees to repurchase that security later, usually at a higher price. The difference between the repurchase price and the initial sale price of the security is akin to the interest rate on a loan secured by the underlying repo collateral.

Gorton and Metrick describe the liquidity and credit crisis that began in August 2007 as a “run on repo” (Gorton & Metrick, 2012; Gorton, 2010). Exhibit 17 shows flows of funds from 2001 through 2009 for repos and Fed Funds loans. Following five and a half years of net inflows into the repo and Fed Funds markets from 2002 through June 2007, repo and Fed Funds borrowings by commercial banks contracted sharply in the third quarter of 2007 – net commercial bank repo and Fed Funds liabilities decreased by an astonishing \$469 billion.



Phase II: Global Liquidity and Credit Crisis



**Exhibit 17.** *Flows of Fed Funds and Repurchase Agreement Liabilities, 2001 – 2009*

**Note:** Quarterly figures are seasonally adjusted annual rates. Vertical lines reference: 2005 - beginning of Phase I; Q3-2007 - end of Phase I, beginning of Phase II; Q3-2008 - end of Phase II, beginning of Phase III; Q4-2009 - end of Phase III. Source: Federal Reserve Board, Statistical Release Z.1: Flow of Funds Accounts for the United States, Table F.207.

A repo lender may impose a “haircut” on repo collateral, which is the difference between the value of the underlying collateral and its purchase price (i.e., the cash paid to the repo borrower). Haircuts are intended to help lenders cover any unexpected losses they may incur from sales of collateral in the secondary market following a borrower default.<sup>2</sup> Factors that cause lenders to increase repo haircut amounts include illiquidity of the underlying collateral asset, heightened uncertainty about the true nature of the collateral risks, concern that would-be purchasers of the collateral are better informed about the risks of the collateral, and the like (Duffie,

<sup>2</sup> Expected losses and known risks will already be reflected in the price at which the security must be repurchased by the cash borrower in the repo. Haircuts thus reflect unknown or unquantifiable risks. See Adrian & Shin (2009); Gorton & A. Metrick, (2010); Gorton, (2010).

2012; Gorton, 2010; Gorton & Metrick, 2010, 2012; Krishnamurthy, 2010).

Table 1 shows repo rates and average haircuts on nine different types of repo collateral for the first and second halves of 2007. Prior to the crisis, average repo haircuts across all collateral ranged from zero to five percent.<sup>3</sup> But that changed in August 2007 (Krishnamurthy, 2010; Mishkin, 2012). Yale Professors Gary Gorton and Andrew Metrick demonstrate that “the spread of the crisis from subprime housing assets to non-subprime assets that have no direct connection to the housing market” (Gorton & Metrick, 2012). They show a significant increase in haircuts for virtually all structured credit products – not just subprime-based products – beginning in August 2007, indicating “a loss of confidence in the sense that the non-subprime-related [assets] faced significant haircuts even though it had nothing to do with subprime mortgages. Its only fault is that it is also ‘securitized’” (Gorton & Metrick, 2012). Prof. Gorton summarizes the chain reaction of events that culminated in the run on repo as follows:

[T]he concern about the location of the [subprime] risks led to fear of counterparty default, especially in the repo markets, where defaults would lead to delivery of bonds that could not be sold....This short-term financing market became very illiquid during the crisis, and an increase in repo haircuts (the initial margin) caused massive deleveraging. If no one would accept structured products for repo, then these bonds could not be traded – and then no one would want to accept them in a repo transaction (Gorton, 2009, p.572).

Table 1 shows that the largest haircuts in the second half of 2007 were imposed on CDOs and subprime MBS. But significant haircuts are also evident on assets with no subprime exposure whatsoever, such as ABS collateralized by student loans, auto loans, and credit card receivables.

<sup>3</sup> Table 1 (based on Gorton & Metrick, 2012) reports average haircuts of zero percent prior to Phase II of the crisis. Other sources report pre- crisis haircuts of up to five percent. See, e.g., Duffie, (2010).

**Table 1.** *Repo Rate Spreads in 2007*

Type of Repo Collateral		Repo Rate (bps)					
		Mean	Median	Std Error	Max	Min	Avg Haircut
BBB+/A Corporates	2007H1	2.01	1.95	0.61	5.30	0.50	0.0%
	2007H2	61.85	65.49	36.29	126.35	1.70	0.0%
AA-AAA Corporates	2007H1	-1.69	-2.05	1.90	10.44	-3.50	0.0%
	2007H2	55.27	58.95	34.53	116.35	-2.30	0.0%
A-AAA ABS (auto, credit card, student loan)	2007H1	4.44	4.00	1.77	11.00	1.70	0.0%
	2007H2	68.44	71.78	40.93	141.35	3.70	0.9%
AA-AAA MBS / CMBS	2007H1	6.41	6.00	1.76	13.00	3.70	0.0%
	2007H2	76.35	81.78	43.92	151.35	5.70	1.8%
<AA MBS / CMBS	2007H1	9.41	9.00	1.76	16.00	6.70	0.0%
	2007H2	84.55	88.20	48.62	166.35	8.70	3.7%
Unpriced ABS / MBS / All Subprime	2007H1	10.41	10.00	1.76	17.00	7.70	0.0%
	2007H2	95.62	97.83	58.54	196.35	9.70	7.7%
AA-AAA CLO	2007H1	6.41	6.00	1.76	13.00	3.70	0.0%
	2007H2	85.93	92.65	51.27	171.35	5.70	1.8%
AA-AAA CDO	2007H1	7.41	7.00	1.76	14.00	4.70	0.0%
	2007H2	107.77	109.35	69.56	226.35	6.70	8.3%
Unpriced CLO/CDO	2007H1	9.41	9.00	1.76	16.00	6.70	0.0%
	2007H2	122.63	124.42	80.14	256.35	8.70	10.5%

**Source:** Gorton & Metrick (2012), Table 2 Panel D

The run on repo that began in August 2007 has been likened to the interbank market equivalent of a classic bank run (Gorton & Metrick, 2012; Gorton, 2010; Krishnamurthy, 2010; FCIC, 2010). Instead of depositors withdrawing funds, the August 2007 crisis was sparked by a sudden and unanticipated increase in repo haircuts. When repo haircut rates rose, financial institutions that relied on repos for borrowing were suddenly getting less financing than before for the same collateral. That financing had to be replaced, which forced banks to sell assets (further depressing asset prices and collateral values), hoard cash, and restrict access to short-term credit. So, although the percentage increases shown in Table 1 may seem small in absolute terms, the unexpected financial impact of those increases was significant (Adrian & Shin, 2009). In addition, those increases in haircuts signaled concerns by lenders that repo collateral could not be liquidated at fair market prices, which fostered an even greater loss of confidence in the repo collateral.

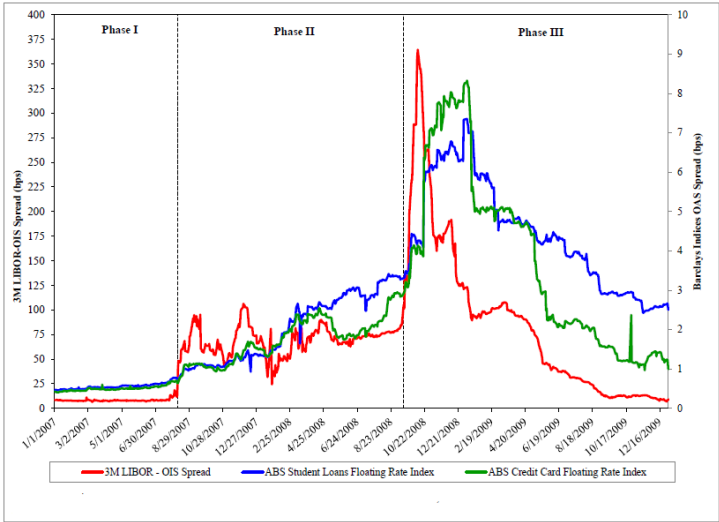
The combination of panic, asymmetric information about the true risks of repo collateral, a general re-pricing of risk, and an inability to value (with any accuracy) illiquid securities (e.g., subprime-based MBS and ABS CDOs) precipitated a run on repo at commercial banks, investment banks, and securities broker-dealers.

## Unsecured Wholesale Interbank Funding Market Disruptions

In August 2007, LIBOR began to rise sharply (Michaud and Upper, 2008). Around the same time, Treasury yields (i.e., the effective interest rate paid on Treasury obligations) fell precipitously in response to re-balancings by investors out of risky debt into government obligations. As a result, the three-month TED spread spiked to over 2.4 percent per annum in August 2007 (see Exhibit 5).

The August 2007 disruptions in interbank funding markets were precipitated both by liquidity concerns (i.e., unexpected increases in banks' demand for short-term unsecured funding, arising in large part from the sharp contraction in short-term secured funding channels) and perceptions of heightened bank credit risk resulting from the rapidly deteriorating financial condition of the commercial banking system (Taylor, 2009a; Acharya & Merrouche, 2012). Exhibit 18 shows the spreads on two non-subprime and non-mortgage ABS indices along with the spread between three-month LIBOR and the Overnight Indexed Swap ("OIS") rate (the "LIBOR-OIS" spread) from January 2007 through December 2009. The OIS rate measures expected overnight Fed Funds rates over the next three months. The LIBOR-OIS spread thus reflects unexpected interbank shocks and is regarded as an indicator of aggregate banking liquidity and credit risk and is shown in Exhibit 19 (Greenlaw, *et al.*, 2010; McAndrews, Sarkar, & Wang, 2008; Michaud & Upper, 2011; Gorton, 2010; Ait-Sahalia, *et al.*, 2012; Gorton & Metrick, 2012; Filipović & Trolle, 2013).

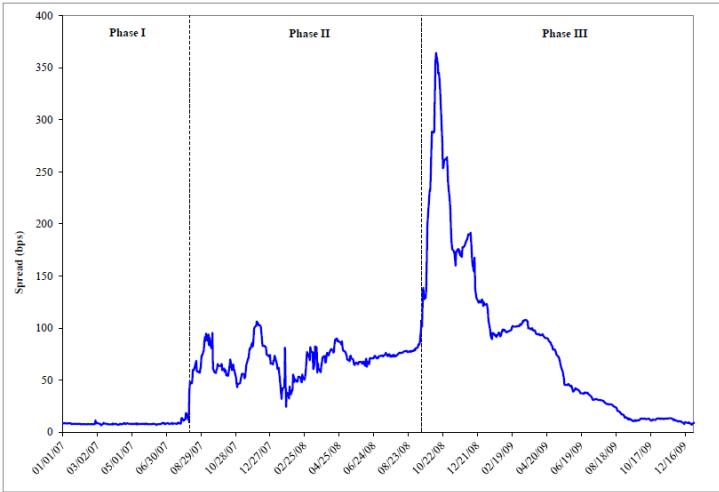
Phase II: Global Liquidity and Credit Crisis



**Exhibit 18.** Student Loan and Credit Card ABS Floating-Rate Indices and 3mLIBOR-OIS Spread, 2007 – 2009

**Notes:** Vertical lines reference: August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Sources:** Barclays Capital, Bloomberg.



**Exhibit 19.** 3mLIBOR – OIS Spread, 2007 – 2009

**Notes:** Spread is defined as 3-month LIBOR minus the 3-month Overnight Indexed Swap rate. Vertical lines reference: August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** Bloomberg.

Gorton and Metrick comment: “[The] real deterioration in bank balance sheets became apparent in the interbank markets in mid-2007, as evidenced by an upward spike in the [LIBOR- OIS spread] in August” (Gorton & Metrick, 2012). As Exhibit 18 demonstrates, the timing of the sharp increases in non- subprime ABS spreads generally tracked the timing of spikes in the LIBOR-OIS spread, thus indicating that all three spreads rose as a result of the broader liquidity crisis and not as a direct result of problems in U.S. subprime mortgage markets.<sup>4</sup>

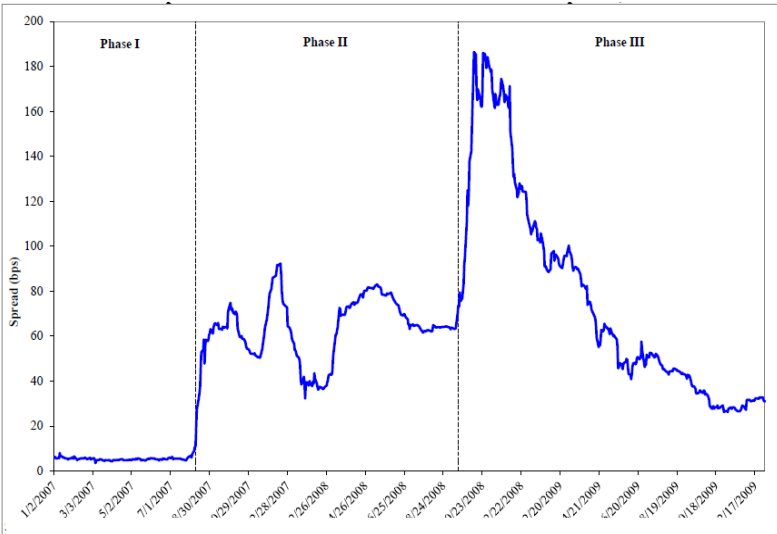
Around the same time, a comparable indicator of liquidity and credit risk in the European banking system experienced a similar increase. Exhibit 20 shows the spread between the three- month Euro Interbank Offered Rate (“EURIBOR”) and the three-month swap rate on the Euro Over-Night Index Average (“EONIA”). EONIA is the effective rate for all overnight unsecured Euro-denominated interbank lending transactions.<sup>5</sup> The three-month EONIA Swap Rate reflects the overnight EONIA rate expected to prevail over the ensuing three months.<sup>6</sup> As shown in Exhibit 20, the spread between the three-month EURIBOR and EONIA swap rate (“EURIBOR-EOIS”) rose by more than 56 basis points in August 2007. The rapid rise in the EURIBOR-EOIS spread demonstrates that concerns about the financial health of the banking system were as pronounced in Europe as in the United States.

<sup>4</sup> Gorton and Metrick have demonstrated this causality using more formal econometric models. See Gorton & Metrick (2012).

<sup>5</sup> Because EONIA is not based on reserve bank balances, it is more directly comparable to the overnight LIBOR than to the U.S. Fed Funds rate.

<sup>6</sup> Banking Federation of the European Union, €ONIA Swap Index: The Derivatives Market Reference Rate for the Euro (June 19, 2008).

Phase II: Global Liquidity and Credit Crisis



**Exhibit 20.** *Spread between 3mEURIBOR and EONIA OIS Swap Rate, 2007 – 2009*

**Note:** Spread is defined as the 3-Month EURIBOR minus the 3-Month Euro Over-Night Swap Index. Vertical lines reference: August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** [www.euribor.org](http://www.euribor.org)

The spikes in the LIBOR-OIS and EURIBOR-EOIS spreads are consistent with the discussion in Section 5.1 – i.e., concerns about both current and future funding liquidity risks and counterparty credit risks drive longer-term rates up relative to short-term rates because healthy lenders will try to protect their own longer-term funding and credit risk profiles. In addition, the empirical evidence also shows that in the last half of 2007 bank lenders were beginning to restrict interbank lending altogether and to hoard cash, as also discussed previously in Section 5.1.<sup>7</sup>

<sup>7</sup> International Monetary Fund, (2010); and Cornett, *et al.*, (2011).

## ABCP Market Dislocation

As of March 2007, mortgage-backed assets accounted for only about 25 percent of ABCP collateral ([Dudley, 2007](#)). As noted in Section 2.4.2, however, the collateral held by ABCP programs and SIVs is often not transparent to ABCP investors. As such, ABCP was afflicted by the asymmetric information and re-pricing-of-risk problems discussed earlier. Federal Reserve Bank of New York President William Dudley explains: “[T]he problem began when commercial paper investors became aware that their investments could be vulnerable to loss but were uncertain as to the extent of their exposure to particular programs....[R]isk-averse investors started to shun the entire asset class” ([Dudley, 2007](#)).

### ABCP Conduits

In late July 2007, ABCP conduits began to experience difficulties rolling over their maturing CP. On July 30, 2007, IKB became the first major casualty.<sup>8</sup> Specifically, IKB was unable to continue providing liquidity support to its ailing ABCP conduit (Rhineland Funding), and IKB’s main shareholder KfW was forced to assume the role of liquidity support provider for Rhineland (IKB Deutsche Industriebank, July 30, 2007). And on August 2, 2007, KfW assumed all the risks to which IKB was exposed through its sponsorship of Rhineland Funding (IKB Deutsche Industriebank, August 2, 2007).

In early August 2007, additional ABCP conduits struggled to roll over their maturing CP, and several such conduits extended the maturities of their Extendible ABCP ([Kacperczyk & Schnabl, 2013](#); [Covitz, Liang, & Suarez, 2013](#)). Particularly hard-hit were Extendible ABCP conduits without full third-party liquidity support ([Schroth, Suarez, & Taylor, 2012](#)). In those programs, conduit administrators were forced to liquidate assets to cover Extendible ABCP repayments ([Fitch Ratings, 2007](#); [S&P, 2007](#); [Fitch Ratings, 2007](#)). Given the illiquidity in MBS and CDO markets (and the rapidly

<sup>8</sup> The international dimension of the ABCP market crisis is reviewed in [Acharya & Schnabl, 2010](#).



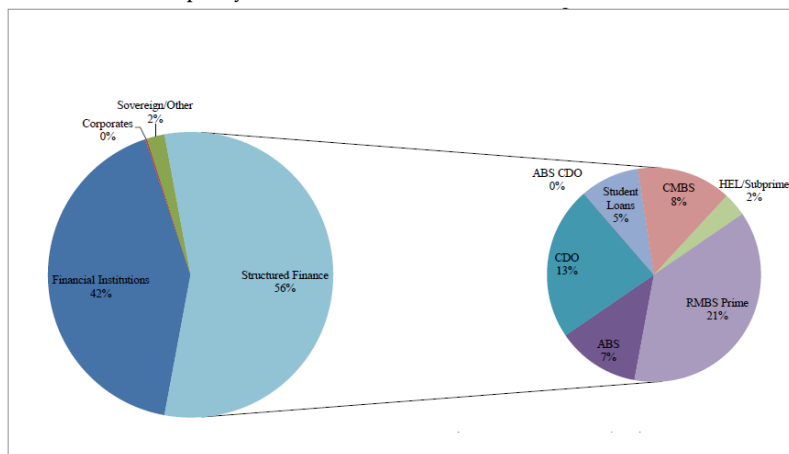
evaporating liquidity in other credit markets), many of those conduits engaged in liquidations that exacerbated the problems those conduits were already experiencing.

The distresses experienced by some bank-sponsored ABCP programs exacerbated the financial and liquidity stresses at those bank sponsors. Many bank sponsors of ABCP programs, for example, provided liquidity guarantees that obliged those banks to repurchase maturing CP in the event that conduits could not roll over their maturing CP (Acharya, Schnabl, & Suarez, 2010). As such, when Phase II of the crisis erupted and conduits began to experience problems rolling over their maturing CP, many bank conduit sponsors were forced to assume the liquidity and credit risks of the mortgage collateral backing the outstanding ABCP.

## SIVs

Exhibit 21 shows the types of securities held in SIVs rated by S&P as of August 24, 2007. Although 56 percent of SIV collateral was comprised of securitized products, only two percent of SIV assets were directly exposed to subprime mortgage collateral (with another 29 percent of SIV assets exposed to real estate more generally). But 42 percent of SIV assets were debt obligations of financial institutions, thereby tying the performance of SIVs strongly to the general performance of the financial institution sector. As concerns about as-yet-unknown subprime and leveraged loan exposures in the banking system mounted, SIVs suffered – i.e., because investors could not ascertain the true risk exposures to subprime collateral inside SIVs via their exposures to financial institutions generally, they assumed the worst (Gorton, 2009).<sup>9</sup>

<sup>9</sup> By August 2007, investors were also concerned about potential hidden exposures of various products to leveraged loans, which came under stress and began to impose significant mark-to-market losses on banks in June and July 2007. See, e.g., Standard & Poor's, (2007); See also Coffey, (2007).



**Exhibit 21.** *SIV Collateral for S&P-Rated SIVs as August 24, 2007*

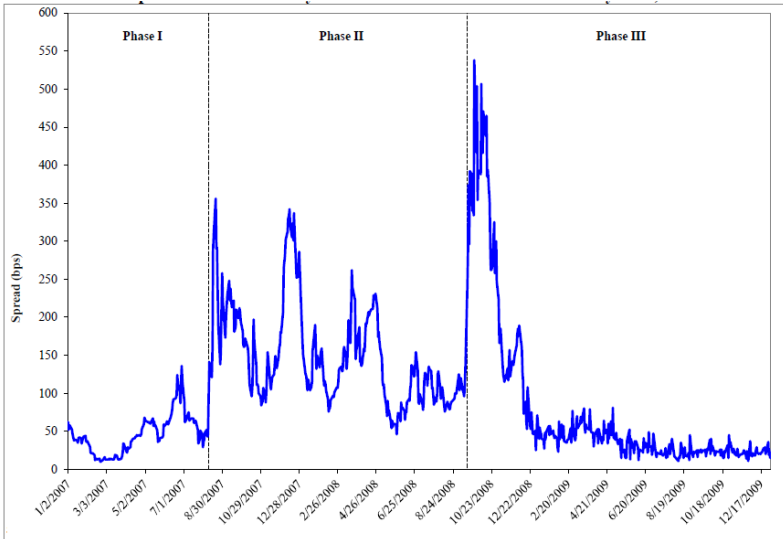
**Source:** "Structured Investment Vehicles: Under Stormy Skies, An Updated Look at the Weather," Standard & Poor's (August 30, 2007).

As a result of severe asymmetric information problems, SIVs began to experience difficulties rolling over CP (i.e., issuing new CP to the same investors that held the maturing CP) beginning in mid-August 2007. That, in turn, exacerbated the already substantial dislocations occurring in ABCP markets (Duley, 2012). The first rating agency downgrades of SIVs began in mid-August 2007 and continued through 2008.<sup>10</sup> S&P, for example, took downward rating actions through mid-September 2007 on 11 of the 315 structured CP issuers rated globally by the rating agency (Standard & Poor's, 2007). Two features that distinguished those 11 ABCP issuers from the issuers that were not downgraded were their dependence on liquidations of securities to finance maturing ABCP and their relatively high concentration of assets in U.S. residential mortgage loans and MBS (Standard & Poor's, 2007; Covitz, Liang & Suarez, 2012).

<sup>10</sup> "SIV-Lites" also began to experience problems during this period. Like SIVs, SIV-Lites were investment management vehicles that relied on ABCP to finance their longer-term asset purchases. But unlike SIVs, SIV-Lites were set up as SPEs with defined expiration and termination dates. SIV-Lites thus can be viewed as a hybrid of SIVs and ABS CDOs.

### ABCP Spreads by Issuer Type

In August 2007, the ABCP market almost completely seized up. As Exhibit 22 demonstrates, spreads on ABCP rates skyrocketed, and total outstanding ABCP began to decline precipitously (as demonstrated in Exhibit 7.)



**Exhibit 22.** *Spread between 30-Day AA ABCP and 4-Week U.S. Treasury Bills, 2007 – 2009*

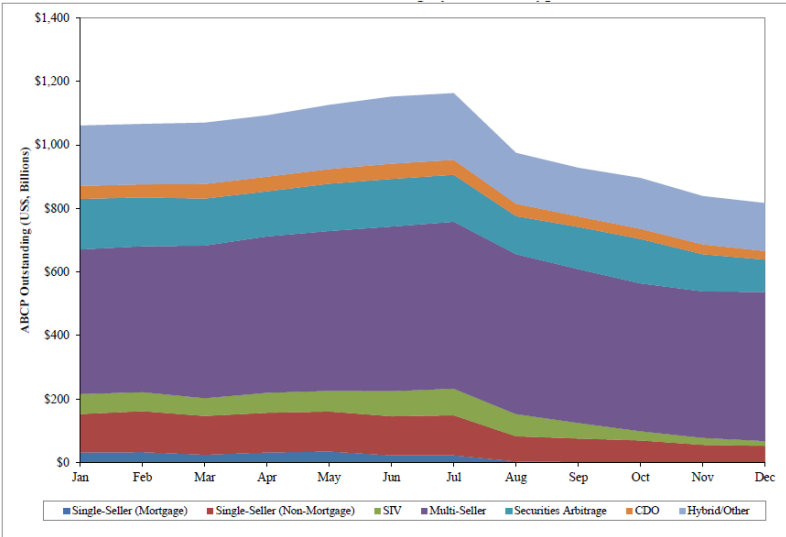
**Note:** Vertical lines reference: August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** Federal Reserve Board

As Exhibit 23 indicates, the decline in ABCP outstanding was most pronounced for single-seller mortgage conduits and SIVs.<sup>11</sup> Exhibit 24 shows monthly averages of spreads on newly issued short-term (i.e., 1-4 day) ABCP less the target Fed Funds rate by ABCP program type.<sup>18o</sup> As explained in Section 3.2, credit spreads indicate the relative risk perceived by investors in securities. The rise in those spreads shown in Exhibit 24 thus indicates heightened investor concerns about

<sup>11</sup> Evidence indicates that the increase in rates and decline in issuance were not the result of a decreased demand by ABCP sponsors for short-term funds, but rather a sharp decline in investor demand for holding ABCP. See, e.g., Covitz, Liang, & Suarez, (2012).

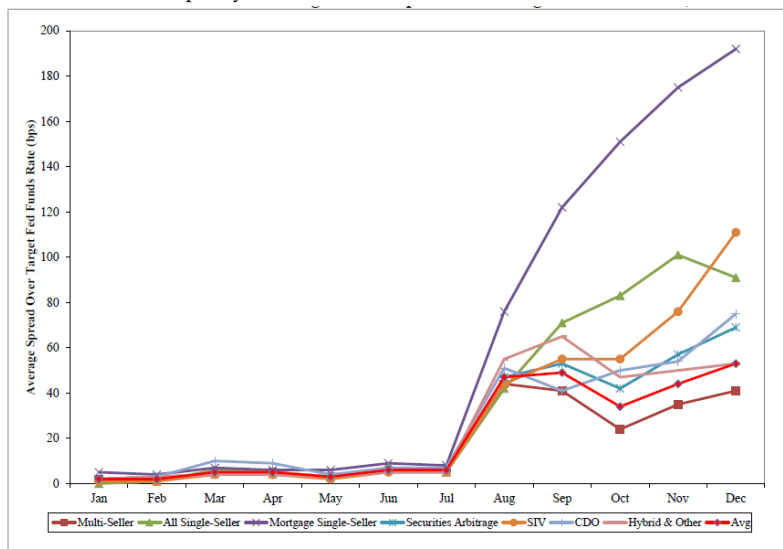
the risk of short-term ABCP, much as the LIBOR-OIS spread shown in Exhibit 19 showed similar market participant concerns about commercial banks.



**Exhibit 23.** *ABCP Outstanding by Conduit Type, 2007*  
**Source:** Covitz, Liang, & Suarez, (2013).

Exhibit 24 indicates that the dramatic increase in the risk premiums demanded by investors to hold newly issued overnight ABCP was not unique to ABCP backed by U.S. mortgage collateral. From January through July 2007, ABCP risk spreads were generally similar across conduit types and typically between three and six basis points over the target Fed Funds rate. But beginning in August 2007, ABCP risk spreads rose sharply across all conduit types.

Although spreads on single-seller mortgage-backed ABCP rose more than spreads on other conduit types (i.e., a 68 bps increase from July to August), the average increase in risk spreads across all conduits between July and August was 41 bps.



**Exhibit 24.** Month-End Overnight ABCP Spreads over Target Fed Funds Rate, 2007

**Source:** Covitz, Liang, & Suarez, (2013).

The data thus shows an implosion in the entire ABCP market – not just subprime mortgage-backed ABCP. As explained earlier in Section 5, losses in mortgage markets were not by themselves large enough to precipitate the widespread outbreak of panic that occurred in so many unrelated credit markets (including ABCP) in August 2007 (Covitz, Liang & Suarez, 2013). A much more widespread repricing of known risk, de-leveraging of bank balance sheets, and contraction in liquidity was underway.

### Implications of the ABCP Market Freeze

The freeze in the ABCP market had a significant impact both on bank sponsors of those programs and on short-term and interbank funding markets in general (Krishnamurthy, Nagel, & Orlov, 2014). For banks that sponsored conduits as a source of short-term funding (including funding for mortgage warehouses, as discussed in Section 2.3), the sharp contraction in the ABCP market resulted in the disappearance of an important source of short-term liquidity that suddenly

had to be replaced. In addition, many bank sponsors of conduits were forced to absorb those conduits on their own balance sheets, which exacerbated the existing balance sheet stresses to which banks were subject in August 2007.

Commercial banks domiciled in the United States replaced their lost short-term funding source after the ABCP market freeze primarily by raising new depository financing (Government guarantees of deposits seem to have played an important role in the short run (See, e.g., [Goedde-Menke, Langer, & Pfingsten, 2014](#)). and seeking advances from GSEs, especially Federal Home Loan Banks ([Ashcraft, Bech, & Frame, 2010](#); [Acharya, Afonso, & Kovner, 2013](#); [Gatev & Strahan, 2006](#)). Foreign banks, however, faced a significantly bigger problem for several reasons. Many foreign banks with the largest exposures to the ABCP market did not have significant U.S. banking operations and thus lacked the ability to rely on new deposits for short-term financing ([Acharya, Afonso, & Kovner, 2013](#)). Foreign banks also had limited access to government-sponsored credit facilities in the United States until the Federal Reserve created the Term Auction Facility in December 2007 to which foreign banks had access.<sup>12</sup>

Foreign sponsors of ABCP programs, moreover, had significant exposures to U.S. credit markets on both the asset and liability sides of their conduits' balance sheets. As concerns the former, most of the largest conduits had significant assets used to collateralize their CP issuance that were denominated in U.S. dollars ([Acharya & Schnabl, 2013](#)). Foreign sponsors of ABCP conduits thus were not immune from the information asymmetry issues that plagued U.S. sponsors – i.e., concerns that their U.S. dollar holdings included possibly significant subprime exposures.

Foreign sponsors of ABCP conduits also had significant exposure to the U.S. market through their liabilities, which were disproportionately dollar-denominated. Specifically, of the \$1,235 trillion in total ABCP outstanding in the 296 conduits rated by Moody's as of January 1, 2007, \$973 billion

<sup>12</sup> For an overview of the Term Auction Facility, see [Armantier, Krieger, & McAndrews, \(2008\)](#).

was denominated in U.S. dollars (Acharya & Schnabl, 2013). Yet, only \$489 billion of that total was issued by conduits domiciled in the United States (Acharya & Schnabl, 2011). In other words, 79 percent of all ABCP outstanding was dollar-denominated, but only 40 percent of all ABCP was issued by U.S. sponsors. Indeed, about 60 percent of all ABCP outstanding from conduits sponsored by French, German, and U.K. banks was denominated in dollars rather than Euros or Pound sterling (Acharya, Afonso & Schnabl, 2007).

One significant result of these funding pressures on foreign sponsors of ABCP conduits was that, as a result of their inability to replace dollar-denominated short-term funding quickly following the ABCP market freeze, they significantly reduced their dollar-denominated interbank lending (Acharya, Afonso & Schnabl, 2007).

On net, the dislocation of the U.S. ABCP market had three significant impacts that exacerbated the liquidity crisis of August 2007. First, the freeze in the ABCP market forced both

U.S. and foreign banks to replace an important short-term funding source on very short notice, thereby placing dramatically higher strains on other short-term funding markets and weakening the balance sheets of ABCP sponsors. Second, the significant U.S. exposure of foreign-sponsored conduits to U.S. asset and liability markets acted as a transmission mechanism of the liquidity crisis from the United States to the rest of the world. Third, the response by foreign ABCP sponsors to reduce interbank lending as a reaction to their foregone short-term liquidity exacerbated the already significant strains on U.S. interbank markets.

## Summary of Phase II

Various explanations have been advanced to explain the sharp and violent reaction of global credit markets in August 2007 (and thereafter) to the U.S. subprime market disruptions and to the leveraged loan market disruptions in Phase I. The most commonly advanced explanations are as follows: the highly leveraged condition of large money center banks and broker-dealers leading up to August 2007; the heavy reliance of large banks and broker-dealers on short-term funding

sources; uncertainties about the amounts and locations of subprime exposures, especially in opaque financial products like ABCP conduits, SIVs, and some ABS CDOs (Coval, Jurek, & Stafford, 2009; Demyanyk, 2009; Das & Kim, 2014); asset illiquidity and the inability of market participants to value illiquid (and often complex) products using market prices (which precipitated an unexpected and massive shift in August 2007 from “informationally insensitive” assets to “informationally sensitive” assets (Borio, 2008; Demyanyk, 2011; Greenlaw, *et. al.*, 2010; Gorton, 2008; Gorton, 2009; Gorton & Metrick, 2012; FCIC Shadow Banking Report, 2007; Hanson & Sunderam, 2013); and the downward pressure on both illiquid and relatively safe asset prices as liquidity-constrained firms were forced to sell assets to cover actual or expected funding shortfalls.

The events that occurred in August 2007 and in the months that followed during Phase II of the crisis can be described as an unexpected and unpredictable shock to the global banking system. The severity of Phase II of the crisis seems to be traceable in part to the fact that the stresses suddenly experienced in the banking system were a surprise. One study by two MIT economists explains the sudden eruption of Phase II of the crisis as follows: “[T]he surprise was in the distress of many parts of the financial system, even those very distant from the subprime market itself, including all structured products, commercial paper, and interbank lending.

Linkages became too complex and hard to understand, prime counterparties were no longer perceived as such, and panic ensued” (Caballero & Kurlat, 2009).

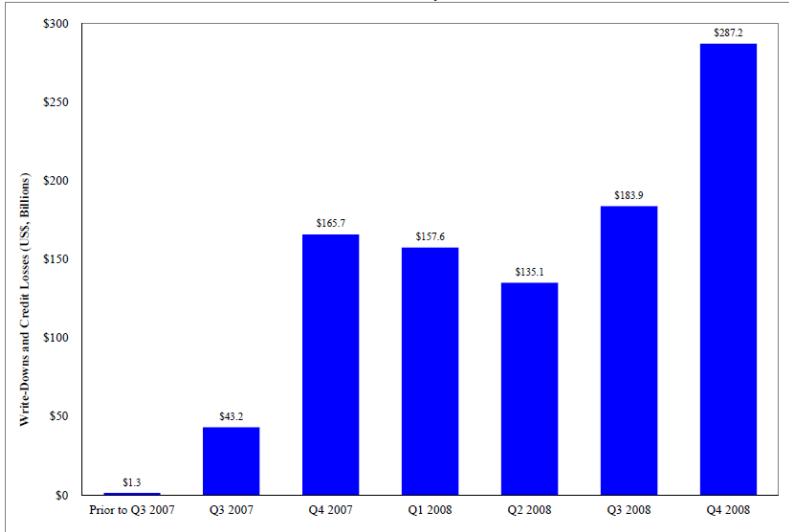


# 6

## Phase III: Panic and Near-Meltdown

In retrospect, the disruptions of various credit markets leading up to August 2007 were mild in comparison to the gyrations in numerous markets that followed. Exhibit 25 shows the accumulating losses in the banking sector as losses on subprime and leveraged loans mounted amidst increasingly volatile and stressed interbank and short-term funding markets through the end of 2008 (He, Khang, & Krishnamurthy, 2010). The resulting deterioration of bank capital is reflected in Exhibit 26, which shows CDS spreads for major banking institutions (i.e., the cost of purchasing default protection on debt issued by those banks).

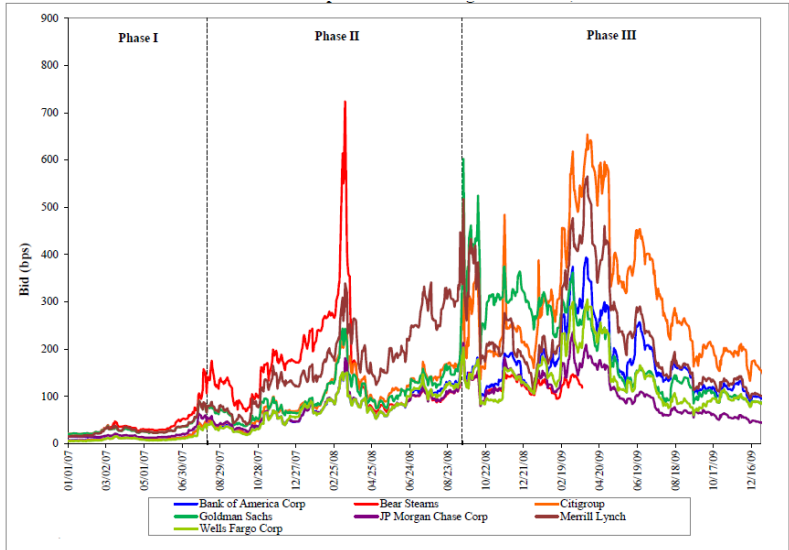
Phase III: Panic and Near-Meltdown



**Exhibit 25.** *Write-Downs and Credit Losses by Commercial and Investment Banks*

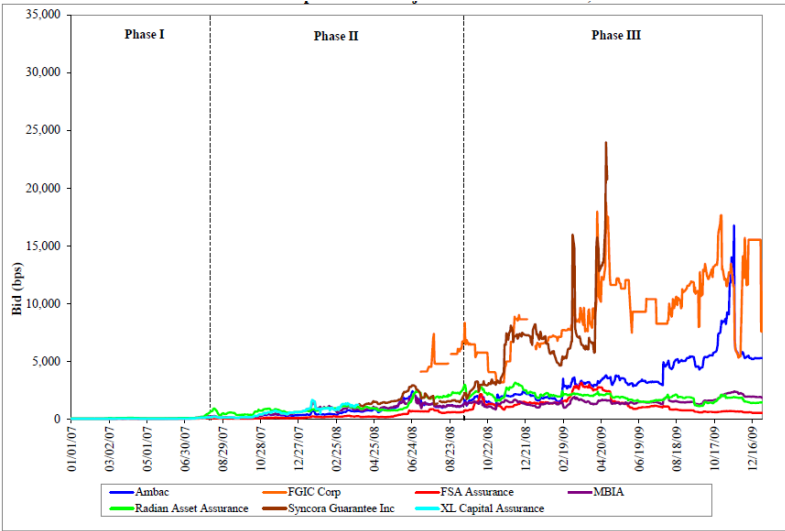
**Note:** Includes write-downs and credit losses resulting from subprime, leveraged loans, and other credit crisis related exposures.

**Source:** Bloomberg.



**Exhibit 26.** *5-Year CDS Spreads on Banking Institutions, 2007 – 2009*

Beginning in late 2007, the monoline insurance industry also started to come under significant financial pressure. Monoline insurance companies are financial guarantors that provide credit insurance, often for municipal bonds and structured finance securities. By 2007, several of the large monolines had significant exposure to subprime MBS, ABS CDOs, and the financial services sector generally. Although all of the major monolines were still rated AAA at the end of 2007, a series of rating agency downgrades beginning in February 2008 ushered in a period of extreme financial difficulty for most of those firms. Exhibit 27 shows the CDS spreads for the obligations of the major monolines. By mid-2008, those CDS spreads (i.e., the cost of purchasing default protection on those monoline liabilities) exceeded even the worst-performing bank CDS spreads shown in Exhibit 26.



**Exhibit 27.** 5-Year CDS Spreads on Major Monoline Insurers, 2007 – 2009

The 2008 global market turmoil included some spectacular financial failures and corporate actions – e.g., Lehman Brothers failed on September 15, 2008; AIG turned to the U.S. Government in September 2008 for a multi-billion dollar bailout; the Reserve Primary Fund (a money market mutual

fund) “broke the buck” (i.e., its net asset value fell below \$1, which is nearly unprecedented in the history of money market mutual funds) on September 16, 2008 (McCabe, 2010; and Brady, Anadu, & Cooper, 2012); Morgan Stanley and Goldman Sachs reorganized themselves as regulated bank holding companies; and various public-sector initiatives were adopted to try and save the U.S. banking industry (the most notable of which was the Troubled Asset Relief Program, or “TARP”). I use September 15, 2008 – i.e., the date on which Lehman Brothers filed for bankruptcy protection – as the demarcation of the evolution of the crisis from Phase II to Phase III.<sup>1</sup>

As discussed in Section 5.3, the LIBOR-OIS spread is regarded as a measure of the overall financial health of the banking system. Shown in Exhibit 19, the LIBOR-OIS spread from 2007 through the end of Phase III illustrates just how dramatically the condition of the banking system deteriorated in September 2008 following the failure of Lehman. By the end of 2008, sovereign wealth funds and governments were large stakeholders in most of the large banks around the world as a result of equity infusions made in order to help keep banks afloat.

Throughout this tumultuous period, MBS and ABS CDO markets continued their downward plunge. As Exhibit 15 shows, by the end of 2008 the BBB- tranche of the ABX was trading at 3 percent of par, and the AAA tranche of the ABX had traded to a deep discount of 49.4 percent of par. Even the Barclays price index of MBS backed by relatively less risky Alt-A mortgages was 54 percent of par.

<sup>1</sup> The specific date when the crisis evolved from Phase II to Phase III is used here for pedagogical purposes only.

# 7

## International Real Estate and Leveraged Loan Markets

**M**arkets wholly unrelated to U.S. residential real estate experienced a similar expansion- and-contraction cycle that culminated in severe market dislocations beginning in Phase I of the crisis. Indeed, declines in these markets were either coincident with or followed shortly after the

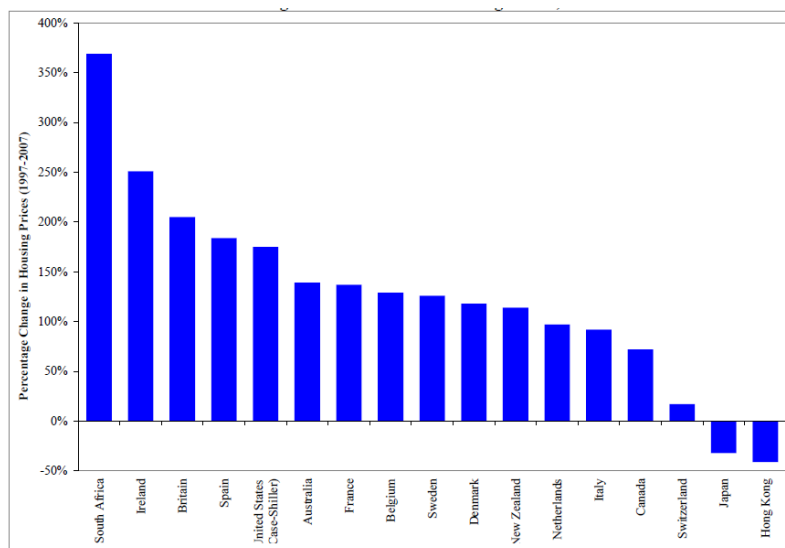
U.S. subprime MBS market collapse. That provides further indication that a common set of macroeconomic and financial factors were impacting these otherwise largely independent markets.

### International Real Estate

The real estate expansion-and-contraction cycle was not purely a U.S. phenomenon. A similar cycle played out in many international residential real estate markets.<sup>1</sup> Exhibit 28 shows changes in international residential real estate prices and

<sup>1</sup> This is consistent with the empirical evidence reviewed in Section 3, which shows a strong historical linkage between low interest rates, expanding credit, and rising housing prices (followed by a reversal of those trends).

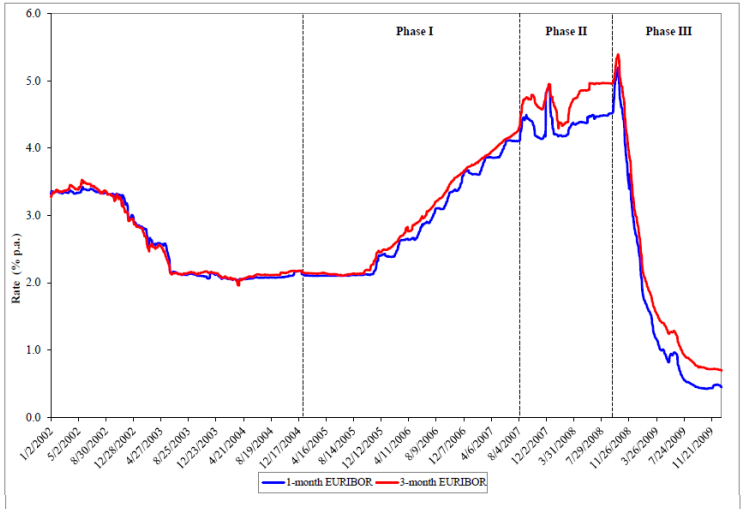
reveals the widespread nature of the global housing boom. From 1997 through 2007, the U.S. residential real estate boom was unremarkable by international standards.



**Exhibit 28.** *Changes in International Housing Prices, 1997 – 2007*  
**Source:** "Checking the Engine," The Economist (June 9, 2007)

The role of loose central bank monetary policy in fueling the housing price appreciations illustrated in Exhibit 28 was not unique to the United States. Exhibit 29 depicts similar monetary accommodation in Europe over the same period, for example, by showing one- and three-month EURIBOR. The international housing booms shown in Exhibit 28 were greatest in countries where monetary policies were loosest (Taylor, 2009a; Ahrend, 2013). In addition, consistent with the discussion in Section 3.1.2, many of the countries that ran large current account deficits and had low real interest rates experienced significant increases in housing prices (and subsequent reversals) (Hubbard & Mayer, 2009; Jagannathan, Kapoor, & Schaumburg, 2012). The empirical evidence suggests, moreover, that the lower the levels of interest rates,

the more sensitive were housing prices to changes in interest rates.<sup>2</sup>



**Exhibit 29.** *1mEURIBOR and 3mEURIBOR, 2002 – 2009*

**Note:** Vertical lines reference: August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.

**Source:** [www.euribor.org](http://www.euribor.org).

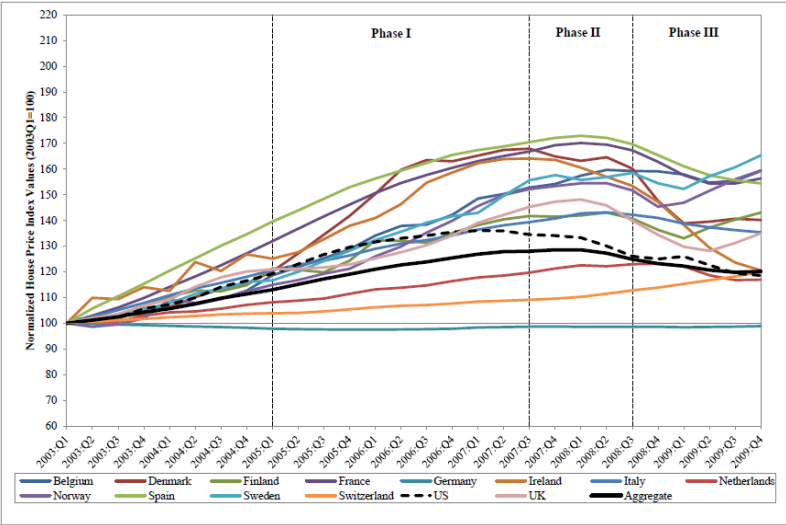
Although the magnitude and timing of the decline in housing prices was more pronounced in the United States than in many other countries, the overall expansion-and-contraction cycle was far from a uniquely U.S. phenomenon. Exhibit 30 shows residential real estate price indices<sup>2</sup> for the major European countries and the United States.<sup>3</sup> The average real estate price index is also shown for the Aggregate, which includes all of the countries shown individually in Exhibit 30 as well as eight others.<sup>4</sup> As Exhibit 30 indicates, the

<sup>2</sup> For a discussion of the underlying data, see Mack & Martínez-García, (2014).

<sup>3</sup> The index values have been normalized so that 2003Q1=100

<sup>4</sup> The countries not shown in Exhibit 30 (to prevent additional clutter) are Australia, Canada, Croatia, Japan, Luxembourg, New Zealand, South Africa, and South Korea. The housing price indices for these countries are, however, included in the Aggregate index shown in Exhibit 30. Data for the countries shown in Exhibit 30 are representative of data from the excluded countries.

general pattern of the expansion-and-contraction cycles experienced by most of these countries is similar – i.e., housing prices rose from 2003 to 2006 and then either fell or rose at a sharply lower rate from 2007 to 2009.



**Exhibit 30.** *International Home Prices, 2003 – 2009*

Table 2 illustrates this common pattern from a different perspective by showing the percentage changes in the various housing indices in two periods: from 2003 through 2006, and from 2007 through 2009. The last column in Table 2 shows the difference (in percentage points) between the house price index growth rates in the latter period vis-à-vis the earlier period.



**Table 2.** *Percentage Changes in Housing Price Indices*

Country	2003Q1 – 2006Q4	2007Q1 – 2009Q4	Difference <sup>a</sup>
Belgium	42.23%	7.21%	35.03%
Denmark	63.02%	(15.18%)	78.19%
Finland	35.12%	3.58%	31.54%
France	60.49%	(4.11%)	64.60%
Germany	(2.14%)	0.52%	(2.65%)
Ireland	58.65%	(25.70%)	84.35%
Italy	34.20%	(0.80%)	35.00%
Netherlands	16.42%	(0.72%)	17.13%
Norway	39.89%	9.52%	30.37%
Spain	65.53%	(7.77%)	73.30%
Sweden	41.63%	15.67%	25.97%
Switzerland	7.64%	10.57%	(2.92%)
United States	35.49%	(12.81%)	48.30%
United Kingdom	34.10%	(2.94%)	37.04%
Aggregate <sup>b</sup>	25.43%	(5.27%)	30.70%

**Notes:** <sup>a</sup>: Defined as the difference between the percentage change in the housing index in the 2007–09 period and the 2003–06 period.

<sup>b</sup>: Includes all countries listed by name in this Table 2 plus Australia, Canada, Croatia, Japan, Luxembourg, New Zealand, South Africa, and South Korea.

**Source:** [Retrieved from]. (last visited August 13, 2014); Mack and Martínez-García (June 2014).

U.S. housing prices rose by 35.5 percent from 2003 through 2006, and fell by 12.8 percent from 2007 through 2009. Similarly, the Aggregate average housing price index rose by 25.5 percent from 2003 through 2006 and then fell by 5.3 percent from 2007 through 2009.

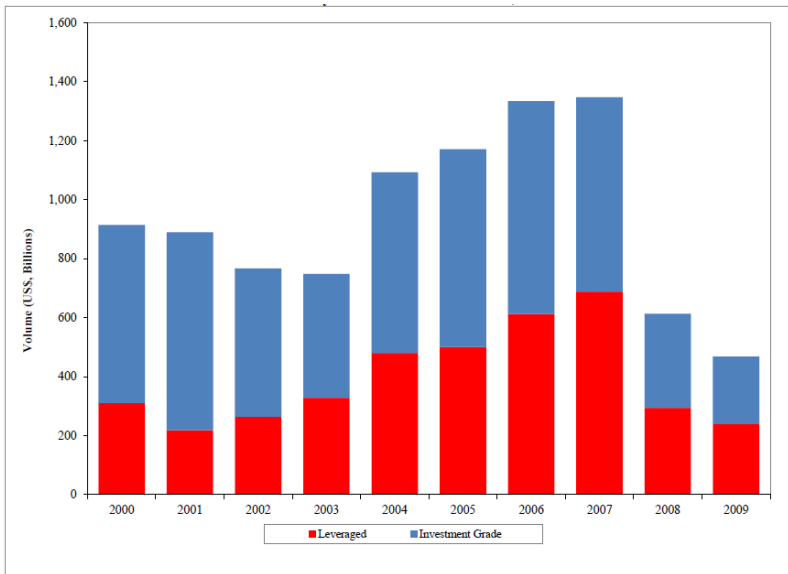
Indeed, the United States did not even exhibit the most extreme fluctuation in housing prices over this period, as illustrated in the last column of Table 2. For example, the growth rate in Danish housing prices was 78.2 percentage points higher from 2003 through 2006 than in the 2007 to 2009 period, as compared to a 48.3 percentage point differential in the growth rate of

U.S. housing prices over the same periods. Even in countries where housing prices did not fall from 2007 through 2009, rates of increase in house prices were still much lower in the latter period than the earlier one. For example, Finnish

housing prices rose by 35.1 percent from 2003 through 2006. In the period from 2007 through 2009, Finnish housing prices rose by only 3.6 percent.

## U.S. and European Leveraged Loan Markets

A leveraged commercial and industrial (“C&I”) loan is a loan to a below-investment-grade borrower with an interest rate (pre-crisis) of at least 1.5 to 2 percent above LIBOR (S&P, 2007).<sup>205</sup> Leveraged loans are often used to finance mergers and acquisitions, LBOs, restructurings, and other highly leveraged transactions. Exhibit 31 shows total loans syndicated in the United States from 2000 through 2009. Leveraged loan syndications grew each year from 2001 through 2007.



**Exhibit 31.** U.S. Syndicated Loan Volume, 2000 – 2009

Source: Thomson Reuters LPC

In a typical syndicated C&I loan, a group of lenders provides financing to a borrower through a facility that is arranged, structured, and administered by one or more banks.<sup>206</sup> From the 1980s through the mid-1990s, most leveraged loans were syndicated primarily to other banks that financed their shares of those loans using deposits and

borrowings (Taylor & Yang, 2007). Bank syndicate members typically followed the O&H banking model and thus retained their original loan exposures until borrowers repaid the loans.<sup>5</sup>

Beginning in the mid-to-late 1990s, arrangers began to retain an increasingly smaller portion of the C&I loans they originated. Instead, banks began to adopt the same O&D banking model discussed in Section 2.2 for mortgages. In other words, bank syndicates began to distribute large portions of the loans they originated to banks that were not in the original syndicate and to institutional investors (BIS-CGFS, 2008; Culp, 2013).

In the late 1990s, the primary institutional buyers of leveraged loans were mutual funds that specialized in bank loan investments (i.e., prime funds). By the 2000s, however, collateralized loan obligations (CLOs) replaced prime funds as the dominant institutional purchasers of leveraged loans (Taylor & Yang, 2012; BIS-CGFS, 2008). CLOs are to the loan market what CDOs are to the bond market. In a typical CLO, an SPE purchases loans and holds them as collateral against senior and subordinated securities issued to finance the purchase of the loans by the SPE.

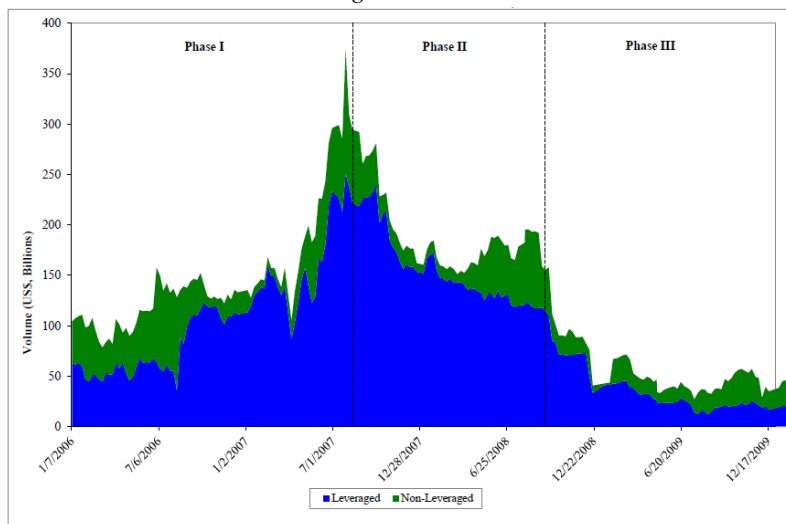
By May 2007, default rates on leveraged loans (and high-yield bonds) had fallen to historically low levels. At the same time, credit spreads between investment-grade debt and both leveraged loans and high-yield bonds were also at historical lows (Altman, 2007; Culp, 2013). As discussed in Section 3.2, those low credit spreads led to a significant increase in investor demand for structured credit products that offered higher yields and more tailored risk/return exposures. In addition to ABS CDOs backed by MBS, CLOs backed by leveraged loans were appealing to investors for that purpose. As such, CLO issuance grew significantly in 2006 and the first half of 2007. In 2007, CLOs accounted for about 60 to 70

<sup>5</sup> During this time, banks engaged in some secondary market trading of loans and loan participations, but the secondary market was generally limited to loan trading with other banks.

percent of institutional leveraged loan purchases (Fitch Ratings, 2008).

The same monetary and balance-of-payments environment discussed in Section 3.1 that contributed to the expansion of mortgage credit prior to 2007 – together with growing demand for leveraged finance investments by CLOs – helped fuel a boom in LBO transactions in 2006 and early 2007 (Kaplan, 2007; S&P, 2007). During that time, loans with few (if any) financial covenants and second-lien loans also increased significantly (Altman, 2007; Fitch Ratings, 2007). Such borrower-friendly loans exposed lenders to relatively greater risks, but the higher yields offered on such loans were attractive to CLO managers and investors in CLO securities (Fitch Ratings, 2006). Indeed, the willingness of CLO managers to purchase these borrower-friendly loans contributed to banks' keenness to arrange them (S&P, 2007; BIS-CGFS, 2008).

As the summer of 2007 approached, the growth in demand for LBO financing together with the demand for leveraged loan investments led to a sharp increase in the forward calendar for leveraged loans (i.e., bank commitments to finance new leveraged loans). As Exhibit 32 illustrates, that forward calendar was in excess of \$150 billion in early May 2007 and later grew to nearly \$250 billion by July 2007. The overhang in loan commitments became a serious problem for many money center banks when the demand for leveraged loans by CLOs began to wane in June and July 2007.



**Exhibit 32.** *U.S. Forward Loan Calendar, 2006 – 2009*

**Notes:** Volume of Non-Leveraged loans on the calendar is shown stacked above the volume of Leveraged loans. Vertical lines reference: August 10, 2007 (the closest date to August 9, 2007 using weekly data) - end of Phase I and beginning of Phase II; September 12, 2008 (the closest date to September 15, 2008 using weekly data) - end of Phase II and beginning of Phase III.

**Source:** Thomson Reuters LPC.

By July 2007, the \$250 billion forward leveraged loan calendar (i.e., loans in the pipeline for future financing and syndication) represented a massive financial commitment by the banking sector to provide credit to below-investment-grade borrowers. Many of those loans, moreover, were relatively borrower-friendly, and thus higher-risk for lenders. In addition, a large amount of the \$250 billion in leveraged loans on the forward calendar in July 2007 consisted of LBO loans that banks were obligated to fund even if the loans could not be subsequently syndicated to institutional investors like CLO issuers. As a result, the banking system as a whole was highly vulnerable to disruptions that might interfere with the efforts of money center banks to distribute and securitize their leveraged loan commitments.

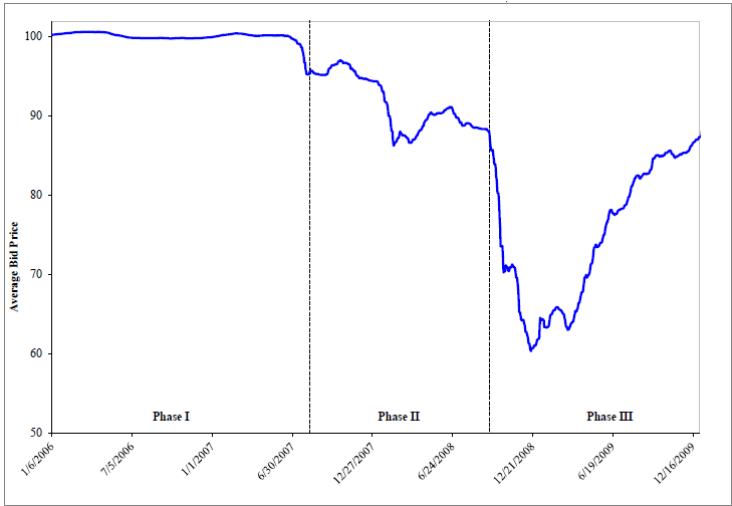
Around the same time that MBS markets destabilized and banks began to realize subprime losses in May and June 2007,

the leveraged loan market also began to stumble under the weight of a huge forward loan calendar heavily laden with relatively high-risk and aggressively priced loans, thanks largely to the appetite of CLO managers and investors for those products. Despite the lack of any direct subprime exposure in CLOs, the similar design of the products (and their parallel evolution) created a link between the two product types.<sup>6</sup> As confidence in structured credit markets was shaken by subprime-related losses on ABS CDOs, the demand for CLO securities also waned. In consequence, the demand by CLO managers for relatively higher-risk leveraged loans began to evaporate, which greatly reduced the demand for such loans relative to their saturated supply at that time (BIS-CGFS, 2008).<sup>7</sup>

From June through early August 2007, the average price of the most active leveraged loans traded in the U.S. secondary market fell precipitously. (See Exhibit 33.) (S&P, 2007). Exhibit 34 shows similar declines in European leveraged loan prices. Those price declines generated huge mark-to-market losses for banks on the portions of the leveraged loans they retained. And as CLOs disappeared and new leveraged loan syndications became increasingly difficult, banks took further losses on leveraged loans they had to sell or absorb onto their own balance sheets at a steep discount (Fitch Ratings, 2008). Those events placed significant strains on the balance sheets of money center banks and, in turn, fueled the banking panic that occurred in August 2007.

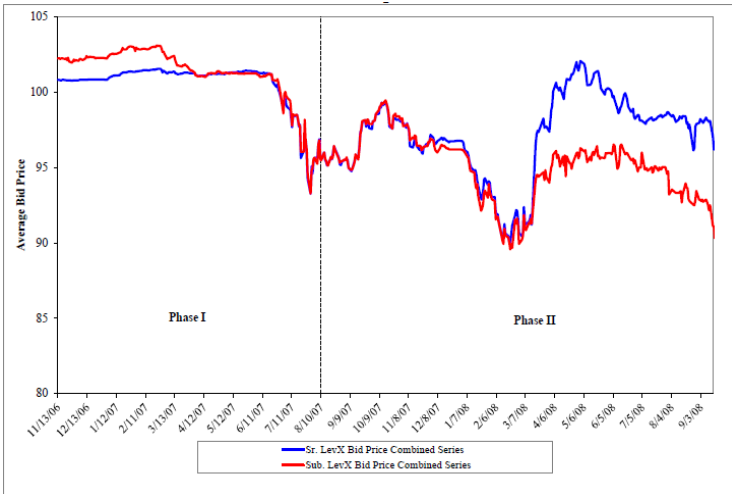
<sup>6</sup> In addition, the banks that provided warehouse lines to finance the acquisition of CLO collateral were essentially the same banks that financed similar warehouse lines for CDOs.

<sup>7</sup> The contraction in lending was also apparently the result of lenders' limited access to short-term credit (as discussed in Section 5). See, e.g., Ivashina & Scharfstein, (2010); Acharya, Afonso, & Kovner, (2012).



**Exhibit 33.** *S&P/LSTA Secondary Market Index of Leveraged Loan Prices, 2006 – 2009*

**Note:** Vertical lines reference: August 9, 2007 - end of Phase I, beginning of Phase II; September 15, 2008 - end of Phase II, beginning of Phase III.  
**Source:** Thomson Reuters LPC



**Exhibit 34.** *Senior and Subordinated LevX European Leveraged Loan Index Prices, November 2006 – September 15, 2008*

**Notes:** The LevX is an index of credit default swaps on European leveraged loans computed by Markit. Vertical line references August 9, 2007 - end of Phase I, beginning of Phase II.  
**Source:** Thomson Reuters LPC.

Losses incurred by large money center banks simultaneously on their subprime and leveraged loan exposures in Phase I of the crisis significantly and rapidly eroded the capital of the banking system, thereby exacerbating the seizing-up of the broader interbank market that occurred in Phase II of the crisis.

Indeed, the parallels between the boom-and-bust cycle in domestic residential mortgage and global leveraged loan markets are striking (Culp, 2013):

- Both markets experienced rapid expansions of lending during the easy credit period leading up to 2007;
- Participants in both markets employed innovative financing techniques to help relatively higher-risk borrowers obtain access to the affordable credit they demanded;
- CDOs were major purchasers of MBS, and CLOs were major purchasers of leveraged loans; and
- Both markets came under stress beginning in June 2007.



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# **A Review of the Academic Literature on the Causes and Evolution of the Credit Crisis**

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## Christopher Culp

The late Christopher Culp was a Fellow at the Johns Hopkins Institute for Applied Economics, Global Health, and the Study of Business Enterprise, Senior Advisor with Compass Lexecon, Adjunct Professor at the Swiss Finance Institute, and Adjunct Professor at Universität Bern in the Institut für Finanzmanagement. From 1998 through 2013, Dr. Culp was an adjunct faculty member at The University of Chicago's Booth School of Business. Culp was the author of four books – Structured Finance & Insurance (Wiley, 2006), Risk Transfer: Derivatives in Theory & Practice (Wiley, 2004), The ART of Risk Management (Wiley, 2002), and The Risk Management Process (Wiley, 2001) – and the co-editor of two books – Corporate Aftershock: The Public Policy Consequences of the Failure of Enron and Other Major Corporations (Wiley, 2003; co-edited with William Niskanen), and Corporate Hedging in Theory & Practice (Risk Books, 1999; co-edited with Merton Miller). He held a Ph.D. from The University of Chicago's Booth School of Business and a B.A. in economics (Phi Beta Kappa, general honors, and departmental honors) from The Johns Hopkins University, where he was one of Steve Hanke's students.

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