



The Credit Crunch of 2007-2008: A Discussion of the Background, Market Reactions, and Policy Responses

Paul Mizen

This paper discusses the events surrounding the 2007-08 credit crunch. It highlights the period of exceptional macrostability, the global savings glut, and financial innovation in mortgage-backed securities as the precursors to the crisis. The credit crunch itself occurred when house prices fell and subprime mortgage defaults increased. These events caused investors to reappraise the risks of high-yielding securities, bank failures, and sharp increases in the spreads on funds in interbank markets. The paper evaluates the actions of the authorities that provided liquidity to the markets and failing banks and indicates areas where improvements could be made. Similarly, it examines the regulation and supervision during this time and argues the need for changes to avoid future crises. (JEL E44, G21, G24, G28)

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The concept of a “credit crunch” has a long history reaching as far back as the Great Depression of the 1930s.¹ Ben Bernanke and Cara Lown’s (1991) classic article on the credit crunch in the *Brookings Papers* documents the decline in the supply of credit for the 1990-91 recession, controlling for the stage of the business cycle, but also considers five previous recessions going back to the 1960s. The combined effect of the shortage of financial capital and declining quality of borrowers’ financial health caused banks to cut the loan supply in the 1990s. Clair and Tucker (1993) document

that the phrase “credit crunch” has been used in the past to explain curtailment of the credit supply in response to both (i) a decline in the value of bank capital and (ii) conditions imposed by regulators, bank supervisors, or banks themselves that require banks to hold more capital than they previously would have held.

A milder version of a full-blown credit crunch is sometimes referred to as a “credit squeeze,” and arguably this is what we observed in 2007 and early 2008; the term credit crunch was already in use well before any serious decline in credit supply was recorded, however. At that time the effects were restricted to shortage of liquidity in money markets and effective closure of certain capital markets that affected credit availability *between banks*. There was even speculation

¹ The term is now officially part of the language as one of several new words added to the *Concise Oxford English Dictionary* in June 2008; also included for the first time is the term “sub-prime.”

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whether these conditions would spill over into the real sector, but there is little doubt now that there will be a decline in the terms and availability of credit *for consumers and entrepreneurs*. Disorder in financial markets occurred as banks sought to determine the true value of assets that were no longer being traded in sufficient volumes to establish a true price; and uncertainty prevailed among institutions aware of the need for liquidity but unwilling to offer it except under terms well above the risk-free rate. These conditions have now given way to the start of a credit crunch, and the restrictions on the credit supply will have negative real effects.

Well-informed observers, such as Martin Wolf, associate editor and chief economics commentator of the *Financial Times*, are convinced that the credit crunch of 2007-08 will have a significance similar to that of earlier turning points in the world economy, such as the emerging markets crises in 1997-98 and the dotcom boom-and-bust in 2000 (Wolf, 2007). Like previous crises, the credit crunch has global implications because international investors are involved. The asset-backed securities composed of risky mortgages were packaged and sold to banks, investors, and pension funds worldwide—as were equities in emerging markets and dotcom companies before them.

The 2007-08 credit crunch has been far more complex than earlier crunches because financial innovation has allowed new ways of packaging and reselling assets. It is intertwined with the growth of the subprime mortgage market in the United States—which offered nonstandard mortgages to individuals with nonstandard income or credit profiles—but it is really a crisis that occurred because of the mispricing of the risk of these products. New assets were developed based on subprime and other mortgages, which were then sold to investors in the form of repackaged debt securities of increasing sophistication. These received high ratings and were considered safe; they also provided good returns compared with more conventional asset classes. However, they were not as safe as the ratings suggested, because their value was closely tied to movements in house prices. While house prices were rising, these

assets offered relatively high returns compared with other assets with similar risk ratings; but, when house prices began to fall, foreclosures on mortgages increased. To make matters worse investors had concentrated risks by leveraging their holdings of mortgages in securitized assets, so their losses were multiplied. Investors realized that they had not fully understood the scale of the likely losses on these assets, which sent shock waves through financial markets, and financial institutions struggled to determine the degree of their exposure to potential losses. Banks failed and the financial system was strained for an extended period. The banking system as a whole was strong enough to take these entities onto its balance sheet in 2007-08, but the effect on the demand for liquidity had a serious impact on the operation of the money markets.

The episode tested authorities such as central banks, which were responsible for providing liquidity to the markets, and regulators and supervisors of the financial systems, who monitor the activities of financial institutions. Only now are lessons being learned that will alter future operations of the financial system to eliminate weaknesses in the process of regulation and supervision of financial institutions and the response of central banks to crisis conditions. These lessons include the need to create incentives that ensure the characteristics of assets “originated and distributed” are fully understood and communicated to end-investors. These changes will involve minimum information standards and improvements to both the modeling of risks and the ratings process. Central banks will review their treatment of liquidity crises by evaluating the effectiveness of their procedures to inject liquidity into the markets at times of crisis and their response to funding crises in individual banks. Regulators will need to consider the capital requirements for banks and off-balance sheet entities that are sponsored or owned by banks, evaluate the scope of regulation necessary for ratings agencies, and review the usefulness of stress testing and “fair value” accounting methods.

This article consists of two parts: an outline of events and an evaluation. The first part discusses the background to the events of the past

year to discover how and why credit markets have expanded in recent years due to an environment of remarkably stable macroeconomic conditions, the global savings glut, and the development of new financial products. These conditions were conducive to the expansion of credit without due regard to the risks. It then describes the market responses to the deteriorating conditions and the response of the authorities to the crisis. The second part discusses how the structure and incentives of the new financial assets created conditions likely to trigger a crisis. It also evaluates the actions of the authorities and the regulators with some recommendations for reform.

EVENTS

Background: The Origins of the Crisis

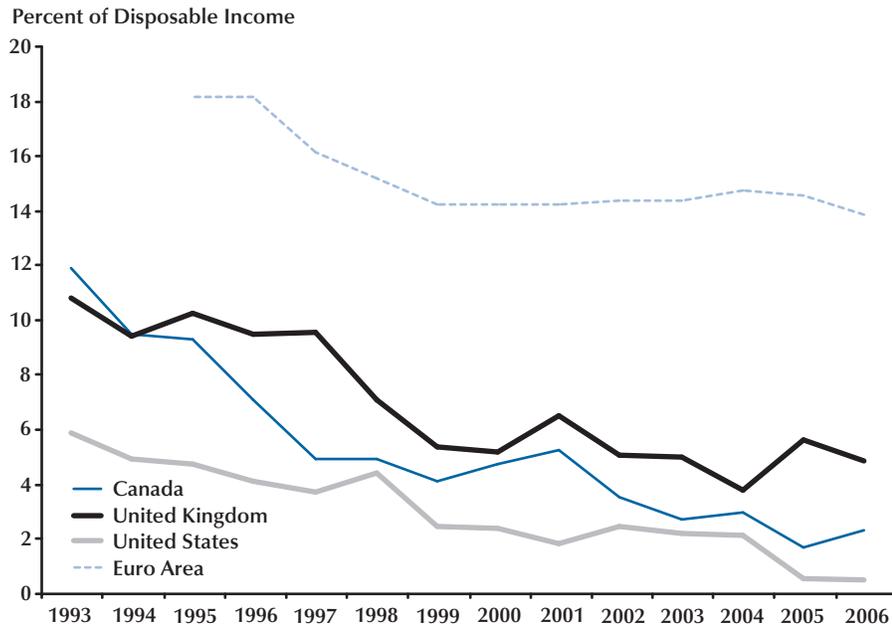
The beginnings of what is now referred to as the 2007-08 credit crunch appeared in early 2007 to be localized problems among lower-quality U.S. mortgage lenders. An increase in subprime mortgage defaults in February 2007 had caused some excitement in the markets, but this had settled by March. However, in April New Century Financial, a subprime specialist, had filed for Chapter 11 bankruptcy and laid off half its employees; and in early May 2007, the Swiss-owned investment bank UBS had closed the Dillon Reed hedge fund after incurring \$125 million in subprime mortgage-related losses.² This also might have seemed an isolated incident, but that month Moody's announced it was reviewing the ratings of 62 asset groups (known as tranches) based on 21 U.S. subprime mortgage securitizations. This pattern of downgrades and losses was to repeat itself many times over the next few months. In June 2007 Bear Stearns supported two failing hedge funds, and in June and July 2007 three ratings agencies—Fitch Ratings, Standard & Poor's, and Moody's—all downgraded subprime-related mortgage products from their "safe" AAA

status. Shortly thereafter Countrywide, a U.S. mortgage bank, experienced large losses, and in August two European banks, IKB (German) and BNP Paribas (French), closed hedge funds in troubled circumstances. These events were to develop into the full-scale credit crunch of 2007-08. Before discussing the details, we need to ask why the credit crunch happened and why now? Two important developments in the late 1990s and early twenty-first century provided a supportive environment for credit expansion. First, extraordinarily tranquil macroeconomic conditions (known as the "Great Moderation") coupled with a flow of global savings from emerging and oil-exporting countries resulted in lower long-term interest rates and reduced macroeconomic volatility. Second, an expansion of securitization in subprime mortgage-backed assets produced sophisticated financial assets with relatively high yields and good credit ratings.

The Great Moderation and the Global Savings Glut. The "Great Moderation" in the United States (and the "Great Stability" in the United Kingdom) saw a remarkable period of low inflation and low nominal short-term interest rates and steady growth. Many economists consider this the reason for credit expansion. For example, Dell'Ariccia, Igan, and Leavan (2008) suggest that lending was excessive—what they call "credit booms"—in the past five years. Beori and Guiso (2008) argue that the seeds of the credit booms were sown by Alan Greenspan when he cut short-term interest rates in response to the 9/11 attacks and the dotcom bubble, which is a plausible hypothesis, but this is unlikely to be the main reason for the expansion of credit. Short-term rates elsewhere, notably the euro area and the United Kingdom, were not as low as they were in the United States, but credit grew there, too. When U.S. short-term interest rates steadily rose from 2004 to 2006, credit continued to grow. It is certainly true that the low real short-term interest rates, rising house prices, and stable economic conditions of the Great Moderation created strong incentives for credit growth on the demand and supply side. However, another important driving force of the growth in lending was found in the global savings glut flowing from China, Japan, Germany, and the oil exporters

² As we will explain in more detail, defaults on subprime mortgages increased, causing losses; but, because investors "scaled up" the risks by leveraging their positions with borrowed funds, which were themselves funded with short-term loans, these small losses were magnified into larger ones.

Figure 1
Saving Ratios



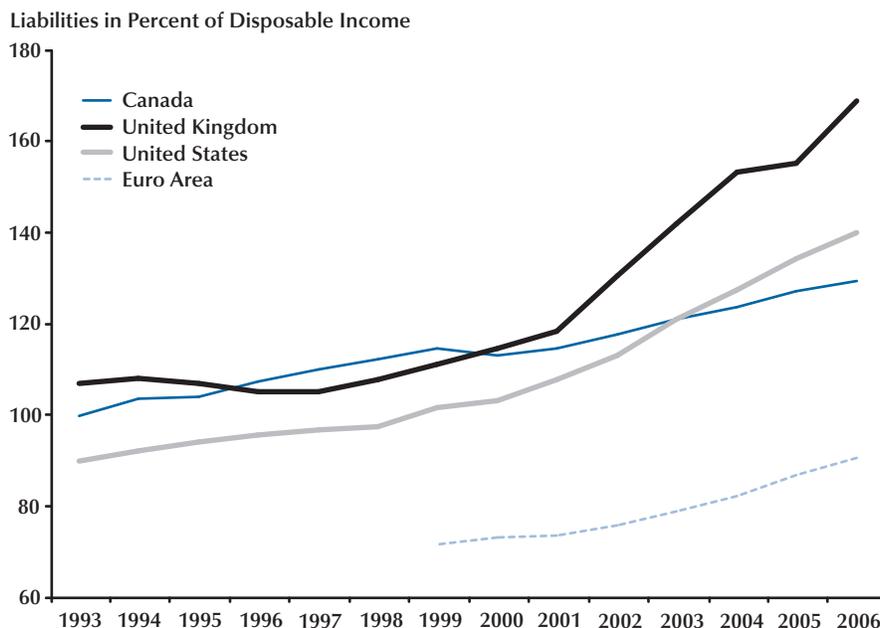
SOURCE: OECD Economic Outlook and ECB Monthly Bulletin.

that kept *long-term* interest rates down, as then-Governor Bernanke noted in 2005 in a speech entitled, “The Global Saving Glut and the U.S. Current Account Deficit.”

After the Asian crisis of 1997, many affected countries made determined efforts to accumulate official reserves denominated in currencies unlikely to be affected by speculative behavior, which could be used to defend the currency regime should events repeat themselves. (With larger reserves, of course, those events were unlikely to be repeated.) Strong demand for U.S. Treasuries and bonds raised their prices and lowered the long-term interest rate. Large savings flows from emerging markets funded the growing deficits in the industrialized countries for a time, and significant imbalances emerged between countries with large current account surpluses and deficits. These could not be sustained indefinitely; but, while they lasted and long-term interest rates were low, they encouraged the growth of credit.

Figures 1 and 2 show that saving ratios declined and borrowing relative to income increased for industrialized countries from 1993 to 2006. The U.S. saving ratio fell from 6 percent of disposable income to below 1 percent in little over a decade, and at the same time the total debt-to-disposable income ratio rose from 75 percent to 120 percent, according to figures produced by the Organisation for Economic Co-operation and Development (OECD). The United Kingdom and Canada show similar patterns in saving and debt-to-income ratios, as does the euro area—but the saving ratio is higher and the debt-to-income ratio is lower than in other countries.

Similar experiences were observed in other countries. Revolving debt in the form of credit card borrowing increased significantly, and as prices in housing markets across the globe increased faster than income, lenders offered mortgages at ever higher multiples (in relation to income), raising the level of secured debt to income. Credit and housing bubbles reinforced

Figure 2**Debt to Income Ratios**

SOURCE: OECD Economic Outlook and ECB/Haver Analytics.

each other. Borrowers continued to seek funds to gain a foothold on the housing ladder, reassured by the fact that the values of the properties they were buying were rising and were expected to continue to rise. Lenders assumed that house prices would continue to rise in the face of strong demand. In some cases, lenders offered in excess of 100 percent of the value of the property. Conditions in housing markets were favorable to increased lending with what appeared to be limited risk; lenders were prepared to extend the scope of lending to include lower-quality mortgages, known as subprime mortgages.

Growth in the Subprime Mortgage Market.

In the United States mortgages comprise four categories, defined as follows:

- (i) prime conforming mortgages are made to good-quality borrowers and meet requirements that enable originators to sell them to government-sponsored enterprises (GSEs, such as Fannie Mae and Freddie Mac);
- (ii) jumbo mortgages exceed the limits set by Fannie Mae and Freddie Mac (the 2008 limit set by Congress is a maximum of \$729,750 in the continental United States, but a loan cannot be more than 125 percent of the county average house value; the limit is higher in Alaska, Hawaii, and the U.S. Virgin Islands), but are otherwise standard;
- (iii) Alt-A mortgages do not conform to the Fannie Mae and Freddie Mac definitions, perhaps because a mortgagee has a higher loan-to-income ratio, higher loan-to-value ratio, or some other characteristic that increases the risk of default; and
- (iv) subprime mortgages lie below Alt-A mortgages and typically, but not always, represent mortgages to individuals with poor credit histories.

Subprime mortgages are nevertheless difficult to define (see Sengupta and Emmons, 2007). One approach is to consider the originators of mort-

gages: The U.S. Department of Housing and Urban Development (HUD) uses Home Mortgage Disclosure Act (HMDA) data to identify subprime specialists with fewer originations, a higher proportion of loans that are refinanced, and, because subprime mortgages are nonconforming, those that sell a smaller share of their mortgages to the GSEs. A second approach is to identify the mortgages by borrower characteristics: The Board of Governors of the Federal Reserve System, the Office of the Comptroller of the Currency, the Federal Deposit Insurance Corporation, and the Office of Thrift Supervision list a previous record of delinquency, foreclosure, or bankruptcy; a credit score of 580 or below on the Fair, Isaac and Company (FICO) scale; and a debt service-to-income ratio of 50 percent or greater as subprime borrowers. Subprime products also exist in other countries where they may be marketed as interest-only, 100 percent loan-to-value, or self-certification mortgages, but they are not as prevalent as in the United States.

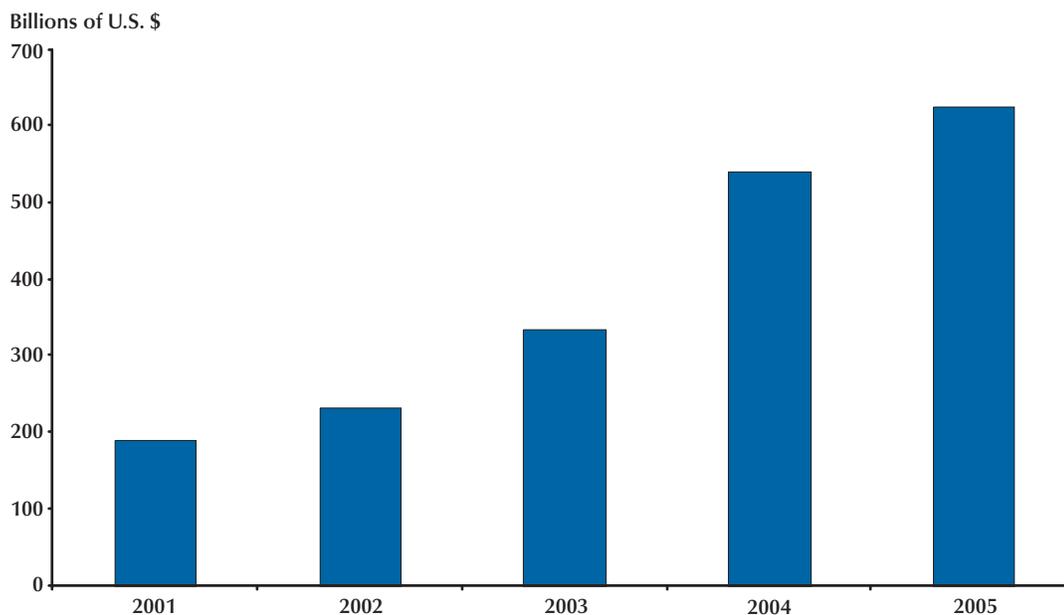
The main differences between a prime mortgage and a subprime mortgage from the borrower's perspective are higher up-front fees (such as application and appraisal fees), higher insurance costs, fines for late payment or delinquency, and higher interest rates. Therefore, the penalty for borrowing in the subprime market, when the prime market is inaccessible, is a higher cost in the form of loan arrangement fees and charges for failing to meet payment terms. The main difference from the lender's perspective is the higher probability of termination through prepayment (often due to refinancing) or default. The lender sets an interest rate dependent on a loan grade assigned in light of the borrower's previous payment history, bankruptcies, debt-to-income ratio, and a limited loan-to-value ratio, although this can be breached by piggyback lending. The lender offers a subprime borrower a mortgage with an interest premium over prime mortgage rates to cover the higher risk of default given these characteristics. Many other terms are attached to subprime mortgages, which sometimes benefit the borrower by granting allowances (e.g., to vary the payments through time), but the terms often also protect the lender (e.g., prepayment conditions that make it easier

for the lender to resell the mortgage loan as a securitized product).

The market for subprime mortgages grew very fast. Jaffee (2008) documents two periods of exceptional subprime mortgage growth. The first expansion occurred during the late 1990s, when the volume of subprime lending rose to \$150 billion, totalling some 13 percent of total annual mortgage originations. This expansion came to a halt with the dotcom crisis of 2001. A second expansion phase was from 2002 until 2006 (Figure 3), when the subprime component of mortgage originations rose from \$160 billion in 2001 to \$600 billion by 2006 (see Calomiris, 2008), representing more than 20 percent of total annual mortgage originations. Chomsisengphet and Pennington-Cross (2006) argue that these expansions occurred because changes in the law allowed mortgage lending at high interest rates and fees, and tax advantages were available for secured borrowing versus unsecured borrowing.³ Another strong influence was the desire of mortgage originators to maintain the volume of new mortgages for securitization by expanding lending activity into previously untapped markets. Subprime loans were heavily concentrated in urban areas of certain U.S. cities—Detroit, Miami, Riverside, Orlando, Las Vegas, and Phoenix—where homeownership had not previously been common—as well as economically depressed areas of Ohio, Michigan, and Indiana, where prime borrowers that faced financial difficulties switched from prime to subprime mortgages.

Securitization and “Originate and Distribute” Banking. Securitization was popularized in the United States when the Government National Mortgage Association (Ginnie Mae) securitized mortgages composed of Federal Housing Administration and Veterans Administration (FHA/VA) mortgages backed by the “full faith

³ Chomsisengphet and Pennington-Cross (2006) indicate that the Depository Institutions Deregulation and Monetary Control Act (1980) allowed borrowers to obtain loans from states other than the state in which they lived, effectively rendering interest rate caps at the state level ineffective. The Alternative Mortgage Transaction Parity Act (1982) allowed variable-rate mortgages, and the Tax Reform Act (1986) ended tax deduction for interest on forms of borrowing other than mortgages. These changes occurred well before the growth in subprime mortgage originations, but they put in place conditions that would allow for that growth.

Figure 3**Subprime Mortgage Originations, Annual Volume**

SOURCE: Data are from Inside Mortgage Finance, as published in the *2006 Mortgage Market Statistical Annual*, Vol. 1.

and credit” of the U.S. government for resale in a secondary market in 1968.⁴ In 1981, the Federal National Mortgage Association (Fannie Mae) began issuing mortgage-backed securities (MBSs), and soon after new “private-label” securitized products emerged for prime loans without the backing of the government.⁵ The European asset securitization market emerged later, in the 1990s, and picked up considerably in 2004. The originations occurred mainly in the Netherlands, Spain, and Italy (much less so in Germany, France and Portugal), but they were widely sold: More than half were sold outside the euro area, with one-third sold to U.K. institutions in 2005-06.

⁴ Ginnie Mae is a government-owned corporation within the Department of Housing and Urban Development (HUD) that was originally established in 1934 to offer “affordable” housing loans. In 1968 it was allowed by Congress to issue MBSs to finance its home loans.

⁵ Private-label MBSs dated back to the 1980s, but the process of repackaging and selling on auto loan receivables and credit card receivables goes back much farther—to the 1970s.

Securitization was undertaken by commercial and investment banks through special purpose vehicles (SPVs), which are financial entities created for a specific purpose—usually to engage in investment activities using assets conferred on them by banks, but at arm’s length and, importantly, not under the direct control of the banks. The advantage of their off-balance sheet status allows them to make use of assets for investment purposes without incurring risks of bankruptcy to the parent organization (see Gorton and Souleles, 2005). SPVs were established to create new asset-backed securities from complex mixtures of residential MBSs, credit card, and other debt receivables that they sold to investors elsewhere. By separating asset-backed securities into tranches (senior, mezzanine, and equity levels), the SPVs offering asset-backed securities could sell the products with different risk ratings for each level. In the event of default by a proportion of the borrowers, the equity tranche would be the first to incur losses, followed by mezzanine

and finally by senior tranches. Senior tranches were rated AAA—equivalent to government debt. In addition, they were protected by third-party insurance from monoline insurers that undertook to protect holders from losses, which improved their ratings.

A market for collateralized debt obligations (CDOs) composed of asset-backed securities emerged; these instruments also had claims of different seniority offering varying payments. Banks held asset-backed securities in “warehouses” before reconstituting them as CDOs, so although they were intermediating credit to end-investors, they held some risky assets on their balance sheets in the interim. Some tranches of CDOs were then pooled and resold as CDOs of CDOs (the so-called CDOs-squared); CDOs-squared were even repackaged into CDOs-cubed. These were effectively funds-of-funds based on the original mortgage loans, pooled into asset-backed securities, the lower tranches of which were then pooled again into CDOs, and so forth. As the OECD explains, the process involved several steps whereby “[the] underlying credit risk is first unbundled and then repackaged, tiered, securitized, and distributed to end investors. Various entities participate in this process at various stages in the chain running from origination to final distribution. They include primary lenders, mortgage brokers, bond insurers, and credit rating agencies” (OECD, 2008).

Some purchasers were structured investment vehicles (SIVs)—off balance-sheet entities created by banks to hold these assets that could evade capital control requirements that applied to banks under Basel I capital adequacy rules. Others were bought by conduits—organizations similar to SIVs but backed by banks and owned by them. The scale of these purchases was large; de la Dehasa (2008) suggests that the volumes for conduits was around \$600 billion for U.S. banks and \$500 billion for European banks. The global market in asset-backed securities was estimated by the Bank of England at \$10.7 trillion at the end of 2006. Ironically, many of the purchasers were off-balance-sheet institutions owned by the very banks that had originally sold the securitized products. This was not recognized at the time but

would later come home to roost as losses on these assets required the banks to bring off-balance-sheet vehicles back onto the balance sheet.

A well-publicized aspect of the development of the mortgage securitization process was the development of residential MBSs composed of many different types of mortgages, including subprime mortgages. Unlike the earlier securitized offerings of the government-sponsored agency Ginnie Mae, which were subject to zero-default risk, these private-label MBSs were subject to significant default risk. Securitization of subprime mortgages started in the mid-1990s, by which time markets had become accustomed to the properties of securitized prime mortgage products that had emerged in the 1980s, but unlike government or prime private-label securities, the underlying assets in the subprime category were quite diverse.

The complexity of new products issued by the private sector was much greater, introducing more variable cash flow, greater default risk for the mortgages themselves, and considerable heterogeneity in the tranches. In an earlier issue of this *Review*, Chomsisengphet and Pennington-Cross (2006) show that the subprime mortgages had a wide range of loan and default risk characteristics. There were loans with options to defer payments, loans that converted from fixed to flexible (adjustable-rate) interest rates after a given period, low-documentation mortgages—all of which were supposedly designed to help buyers enter the housing market when (i) their credit or income histories were poor or (ii) they had expectations of a highly variable or rising income stream over time. Not all the mortgages offered as subprime were of low credit quality, but among the pool were many low-quality loans to borrowers who relied on rising house prices to allow refinancing of the loan to ensure that they could afford to maintain payments. The link between default risk and the movement of house prices was not fully appreciated by investors who provided a ready market for such securitized mortgages in the search for higher yields in the low-interest-rate environment. These included banks, insurance companies, asset managers, and hedge funds. Developments in the securitized subprime mort-

gage market were the trigger for the credit crunch. For this reason, the crisis is often referred to as a “subprime crisis.” In fact, as we shall see, any number of high-yield asset markets could have triggered the crisis.

Subprime as a Trigger for the Credit Crunch

Conditions in the housing and credit markets helped fuel the developing “crisis.” Credit scores of subprime borrowers through the decade 1995-2005 were rising; loan amounts on average were greater, with the largest increases to those borrowers with higher credit scores; and loan-to-value ratios were also rising (see Chomsisengphet and Pennington-Cross, 2006). The use of brokers and agents on commission driven by “quantity not quality” added to the problem, but provided the mortgagees did not default in large numbers (triggering clauses in contracts that might require the originator to take back the debts), there was money to be made. Mortgages were offered at low “teaser” rates that presented borrowers affordable, but not sustainable, interest rates, which were designed to increase. Jaffee (2008) suggested that the sheer range of the embedded options in the mortgage products made the decision about the best package for the borrower a complex one. Not all conditions were in the borrower’s best interests; for example, prepayment conditions that limit the faster payment of the loan and interest other than according to the agreed schedule often were even less favorable than the terms offered to prime borrowers. These conditions were designed to deter a borrower from refinancing the loan with another mortgage provider, and they also made it easier for the lender to sell the loan in a securitized form. In addition, brokers were not motivated as much by their future reputations as by the fee income generated by arranging a loan; in some instances, brokers fraudulently reported information to ensure the arrangement occurred.

Policymakers, regulators, markets, and the public began to realize that subprime mortgages were very high-risk instruments when default rates mounted in 2006. It soon became apparent that the risks were not necessarily reduced by

pooling the products into securitized assets because the defaults were positively correlated. This position worsened because subprime mortgage investors concentrated the risks by leveraging their positions with borrowed funds, which themselves were funded with short-term loans. Leverage of 20:1 transforms a 5 percent realized loss into a 100 percent loss of initial capital; thus, an investor holding a highly leveraged asset could lose all its capital even when default rates were low.⁶

U.S. residential subprime mortgage delinquency rates have been consistently higher than rates on prime mortgages for many years. Chomsisengphet and Pennington-Cross (2006) record figures from the Mortgage Bankers Association with delinquencies 5½ times higher than for prime rates and foreclosures 10 times higher in the previous peak in 2001-02 during the U.S. recession. More recently, delinquency rates have risen to about 18 percent of all subprime mortgages (Figure 4).

Figure 4 shows the effects of the housing downturn from 2005—when borrowers seeking to refinance to avoid the higher rates found they were unable to do so.⁷ As a consequence, subprime mortgages accounted for a substantial proportion of foreclosures in the United States from 2006 (more than 50 percent in recent years) and are concentrated among certain mortgage originators. A worrying characteristic of loans in this sector is the number of borrowers who defaulted within the first three to five months after receiving a home loan and the high correlation between the defaults on individual mortgage loans.

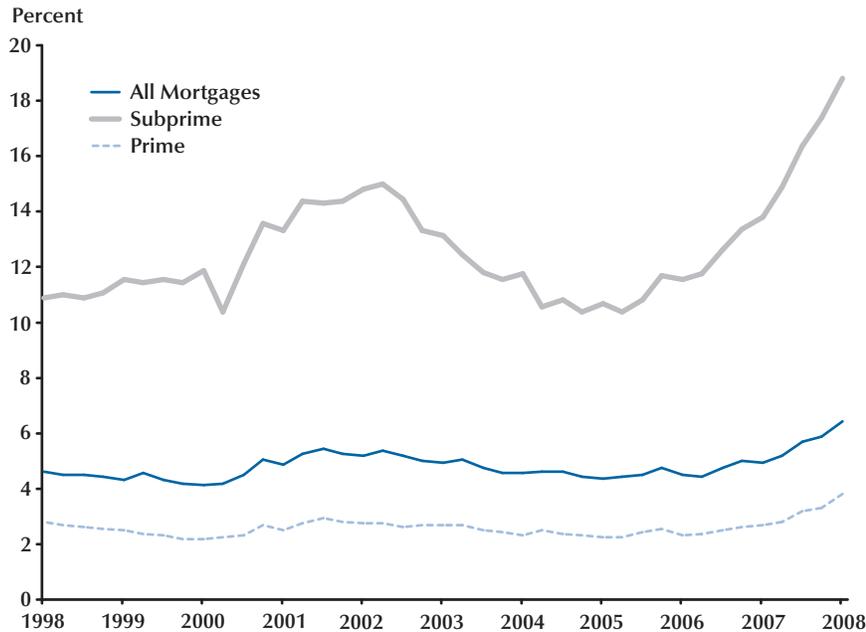
Why did subprime mortgages, which comprise a small proportion of total U.S. mortgages, transmit the credit crunch globally? The growth in the scale of subprime lending in the United States was compounded by the relative ease with which these loans could be originated and the returns that could be generated by securitizing

⁶ This is why Fannie Mae and Freddie Mac faced difficulties in July 2008, because small mortgage defaults amounted to large losses when they were highly leveraged.

⁷ In the United States the process of obtaining a new mortgage to pay off an existing mortgage is known as “refinancing,” whereas in Europe this is often referred to as “remortgaging.”

Figure 4

U.S. Residential Mortgage Delinquency Rates



SOURCE: Mortgage Bankers Association/Haver Analytics.

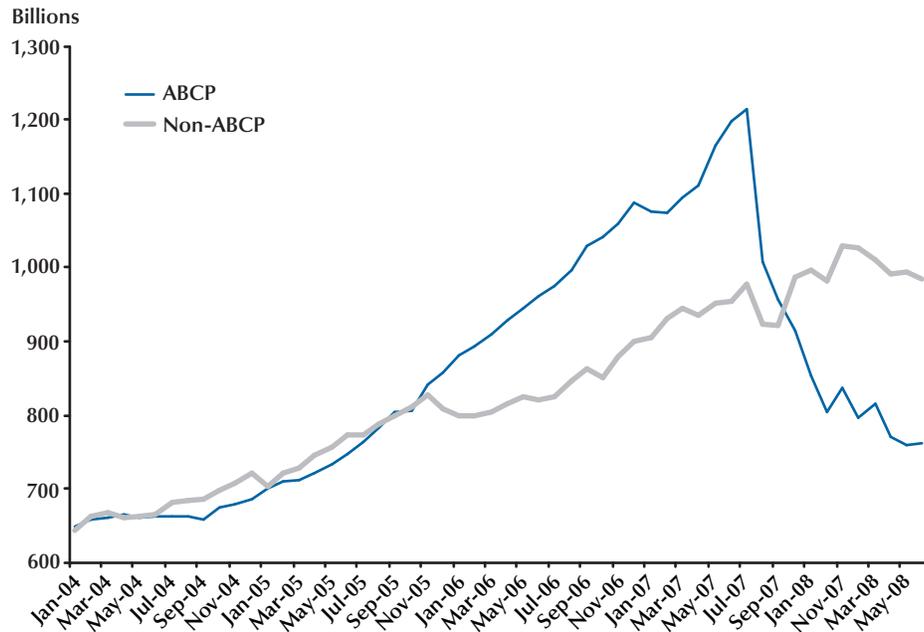
the loans with (apparently) very little risk to the originating institutions. Some originators used technological improvements such as automatic underwriting and outsourcing of credit scoring to meet the requirements of downstream purchasers of the mortgage debt, but there is anecdotal evidence that the originators cared little about the quality of the loans provided they met the minimum requirements for mortgages to be repackaged and sold. The demand was strong for high-yielding assets, as the Governor of the Bank of England explained in 2007 (King, 2007):

[I]nterest rates...were considerably below the levels to which most investors had become accustomed in their working lives. Dissatisfaction with these rates gave birth to the “search for yield.” This desire for higher yields could not be met by traditional investment opportunities. So it led to a demand for innovative, and inevitably riskier, financial instruments and for greater leverage. And the financial sector responded to the challenge by providing ever

more sophisticated ways of increasing yields by taking more risk.

Much of this demand was satisfied by residential MBSs and CDOs, which were sold globally, but as a consequence the inherent risks in the subprime sector spread to international investors with no experience or knowledge of U.S. real estate practices. When the lenders foreclosed, the claims on the underlying assets were not clearly defined—*ex ante* it had not been deemed important. Unlike in most European countries where there is a property register that can be used to identify—and repossess—the assets to sell them to recoup a fraction of the losses, the United States has no property register that allows the lender to repossess the property. As a consequence, once the loans had been pooled, repackaged, and sold without much effort to define ownership of the underlying asset, it was difficult to determine who owned the property. Moreover, differences in the various state laws meant that the rules permitting

Figure 5
Commercial Paper



SOURCE: Federal Reserve Board/Haver Analytics.

the lender to pursue the assets of the borrower were not uniform across the country.

It has been commonly asserted that the root of the problem lies with the subprime mortgage market in the United States, but this is not the full story. Subprime was the trigger for the crisis, but mispricing of risk was widespread, and any number of other high-yield asset classes could have provided the trigger (e.g., hedge funds, private equity, emerging market equity). Originators were willing to sell and investors were willing to buy securitized products in *subprime mortgage markets* with complex characteristics because of the high returns. High yields on these products made them attractive to international investors, and the crisis spread internationally, influencing many other financial markets. Fundamentally, sellers of subprime mortgage securities mispriced risks by using models that assumed house prices would continue to rise, while interest rates remained low. The investment climate of the

time meant risks of many kinds were underpriced, with unrealistic assumptions about rising valuations of underlying assets or commodities. Therefore any number of other high-yielding asset classes could have started the crisis—it so happened that the subprime market soured first.

The complexity of the structured products increased the difficulty of assessing the exposure to subprime and other low-quality loans. Even after the credit crunch influenced the capital markets in August 2007, many banks spent months rather than weeks evaluating the extent of their losses. The doubts about the scale of these losses created considerable uncertainty in the interbank market, and banks soon became reluctant to lend to each other unless they were compensated with larger risk premiums.

The Response in the Markets

Capital and Money Market Paralysis. The effects of the subprime mortgage defaults created

Table 1**Top Corporate Writedowns**

Bank	Writedowns (billion U.S.\$)
Citigroup	46.40
Merrill Lynch	36.80
UBS	36.70
AIG	20.23
HSBC	18.70
RBS	16.50
IKB Deutsche	14.73
Bank of America	14.60
Morgan Stanley	11.70
Deutsche Bank	11.40
Ambac	9.22
Barclays	9.20
Wachovia	8.90
MBIA	8.41
Credit Suisse	8.13
Washington Mutual	8.10
HBOS	7.50

SOURCE: Reuters.

a reappraisal of the hazards of all types of risky assets. The first effect was seen in capital markets. In June and July 2007, many assets backed by subprime residential MBS products were downgraded by the ratings agencies from AAA to A+ (four notches down)—an unusually large downgrade given that downgrades normally occur in single notches. The OECD described these downgrades as “unexpected” and indicated that this “exposed ratings agencies to considerable criticism” (OECD, 2007). The ratings agencies began to reassess their ratings procedures for these products, thereby introducing further uncertainty about the reliability of their ratings.

Conduits and SIVs had funded their purchases of CDOs and other securitized assets by issuing their own asset-backed commercial paper (ABCP) at short maturities. The expansion of mortgage-related ABCP issuance accounted for half the growth in the commercial paper market in recent

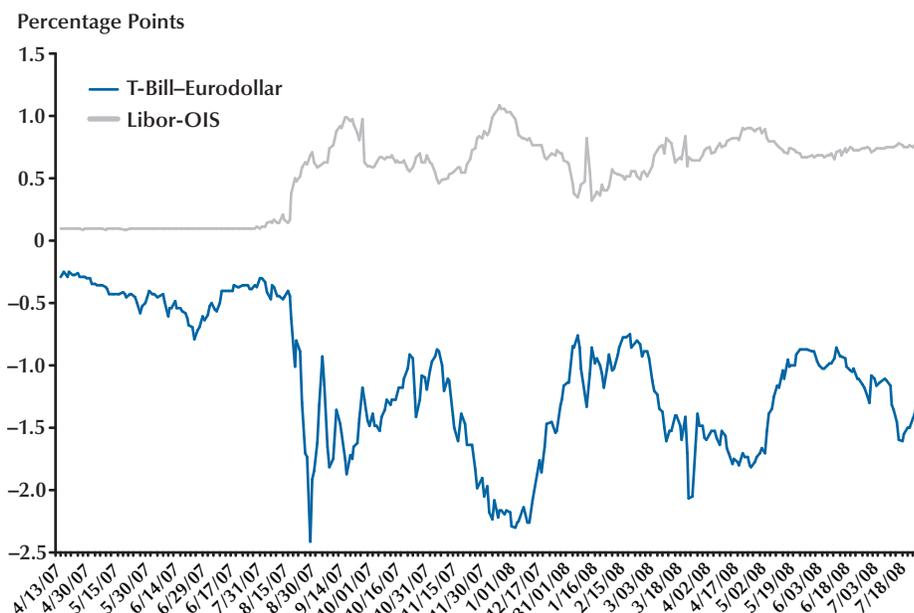
years. The ABCP needed to roll over periodically, usually monthly, but as investors were less willing to purchase short-term paper in the capital markets, these entities could not obtain the necessary short-term funding from these markets. Figure 5 shows that ABCP issuance peaked in July 2007 and fell sharply in subsequent months.

As a result of these developments, Bear Stearns warned investors on July 18 that they would lose money held by hedge funds in subprime-related assets and an IKB Deutsche Industriebank AG conduit incurred losses and was not able to roll over its ABCP; it drew on a credit line from its parent bank but this was insufficient and IKB was bailed out through a fund organized by its major shareholder, KfW Bankengruppe, on August 7, 2007. Two days later, BNP Paribas suspended withdrawals from three hedge funds heavily invested in CDOs that it was unable to value. On August 17, Sachsen LB, a German bank, had failed to provide enough liquidity to support its conduit Ormond Quay, and Sachsen LB was taken over by Landesbank Baden-Württemberg (LBBW) at the end of August. The need for rollover funding by conduits and SIVs created pressure on banks’ liquidity, giving them little incentive to lend on the interbank market to other banks or to invest in short-term paper. The spread between the ABCP rate and the overnight interest swap rate (the rate on overnight lending converted to the same maturity as the ABCP assets using a fixed-rate swap rate), which measures the default and liquidity risk of ABCP, rose substantially by more than 100 basis points in August 2007.⁸

Banks hoarded liquidity to cover any losses they might experience on their own books through conduits, or those of their SIVs, which might need to be taken back onto their balance sheets. These losses turned out to be substantial and involve large investment banks, such as UBS, Merrill Lynch, and Citigroup (Table 1), whose CEOs would pay the price by resigning as losses were revealed.

The uncertainty associated with the scale of the losses that banks might face created a dislocation in the interbank markets. Banks would not

⁸ 1 basis point (bp) = 1/100 percentage point.

Figure 6**Interest Rate Spreads**

SOURCE: Federal Reserve Board, *Financial Times*, Reuters, and Haver Analytics.

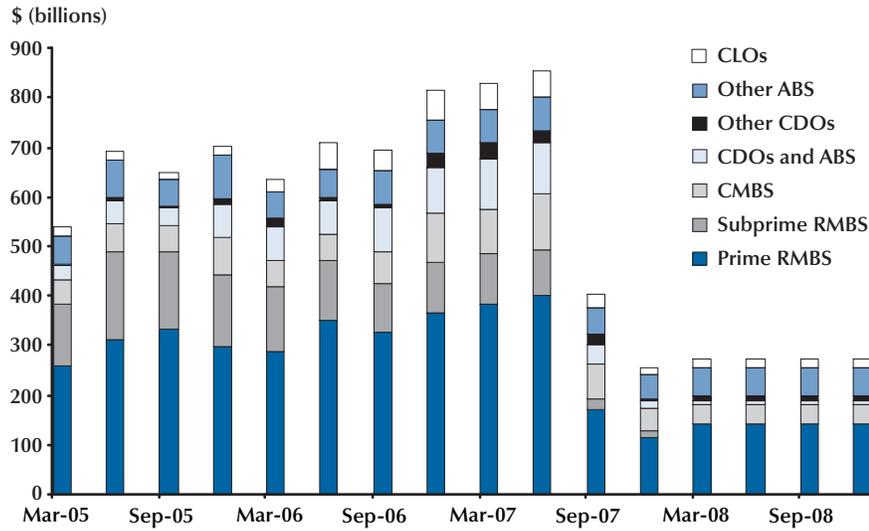
lend to other banks for fear of the scale of counterparty risk. If borrowing banks had unrevealed losses they might not repay the funds that they borrowed from other banks. The market response was demonstrated by two other interest rate spreads shown in Figure 6: the LIBOR-OIS spread (the London Interbank Offered Rate [LIBOR] minus the overnight index swap rate [OIS]) and the Treasury-eurodollar (TED) spread. The first spread reflects the difference between the rate at which banks will lend to each other, say for one or three months, compared with the overnight

indexed swap (OIS) rate, which jumped 100 basis points.⁹ Secondly, the TED spread, which is the difference between the U.S. Treasury bill rate and the eurodollar rate, widened even more. This reflected the desire to shift into safe U.S. Treasuries and the desire to obtain Treasuries as collateral. These effects were observed in the LIBOR and EURIBOR markets, as well as in the United States, resulting in a global freeze in capital and money markets.

The growing concern caused a sharp drop in the issuance of asset-backed securities, particularly those of lower quality, in August 2007. All types of asset-backed securities and CDOs were adversely affected from September 2007, subprime residential MBSs and CDOs of asset-backed securities issues shrank, and even prime residential MBSs were substantially lower (Figure 7). Investors realized that the assets were riskier than had previously been thought, and the cost of insurance to cover default risk using credit default swaps (CDS) also had become much more expen-

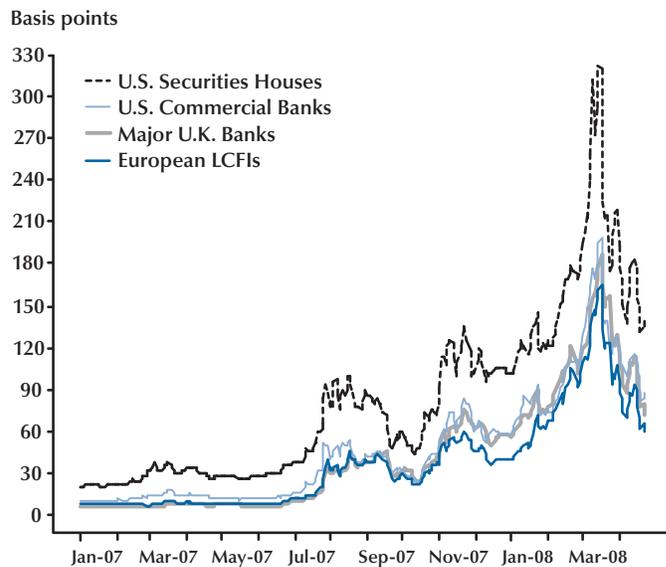
⁹ The LIBOR-OIS spread is the spread most often used by central banks to describe the increase in the cost of interbank lending, reflecting credit and liquidity risk. See Arain and Song (2008, p. 2) and Bank of England (2008, p. 15). LIBOR is set by the British Banker's Association in London. The LIBOR is fixed by establishing the trimmed average of rates offered by contributor banks on the basis of reputation and scale of activity in the London interbank markets. There is also a dollar LIBOR that determines rates at which banks offer U.S. dollars to other banks. EURIBOR is calculated in a similar way for prime European banks by Reuters, with a few minor differences.

Figure 7
Global Issuance of Asset-Backed Securities and CDOs



SOURCE: Bank of England, Dealogic, and Sifma.

Figure 8
Credit Default Swap Premia



NOTE: Data are valid through close of business April 22, 2008. "Premia" indicates asset-weighted average five-year premia.
 SOURCE: This figure is reprinted with permission from the Bank of England's April 2008 Financial Stability Report, Chart 2.18, p. 35. Data are from Markit Group Ltd, Thomson Datastream, published accounts, and Bank of England calculations.

sive.¹⁰ Figure 8 indicates that CDS markets peaked in August, making insurance costly, and asset-backed securities issues were therefore more difficult to sell. Since that August they have reached further highs, culminating in the peak of March 2008 before the Bear Stearns rescue.

The upshot of these events had two important implications. First, because the capital markets were effectively closed for certain types of asset-backed securities, particularly the riskiest types, it became difficult if not impossible for banks to evaluate their exposure to these products and quantify their losses. In the absence of a liquid market for these products from which to determine a current price, the best possible solution was to attempt to predict prices—so mark-to-market was replaced by mark-to-model, but it was not possible to establish whether these prices were accurate. Under U.S. accounting standard FASB 157 (on fair value measurement), banks are required to value their assets according to a hierarchy of three levels. Level 1 uses market prices, level 2 uses market-based inputs including interest rates or credit spreads, and level 3 values assets using only model information, relying on assumptions and extrapolations, not market data. As secondary markets for many asset-backed securities and CDOs dried up, the valuation of portfolios and losses stepped down from level 2 to level 3.

The second implication in August 2007 was that the LIBOR-OIS spreads increased markedly as the supply of funds dwindled but did not return to normal.¹¹ The widening spreads were far from a temporary phenomenon; these spreads were high for an extended period, which had an adverse effect on certain financial institutions that depended on the markets for their funding and on their depositors. Commercial banks with

funding models that relied on short-term commercial paper found that they could not obtain funds to provide new loans. Similarly, investment banks that had relied on short-term paper to purchase asset-backed securities were unable to make payments when they were due. The result of the dislocation in the capital and money markets would lead to the Northern Rock bank run in the United Kingdom and the threat of bankruptcy for Bear Stearns in the United States (these topics are discussed in greater detail later), but the actions of the authorities to provide more liquidity in the markets are considered first.

The Need for Market and Funding Liquidity

Market Liquidity. Central banks provided funding liquidity for distressed institutions and market liquidity.¹² The actions of the Fed, the Bank of England, and the European Central Bank (ECB) were initially different, but there was convergence as the crisis evolved. On August 17, 2007, the Fed extended its normal lending period to 30 days and cut the interest rate offered to banks at the discount window by 50 basis points, acting swiftly and decisively. This was followed by cuts to the federal funds target rate of 50 basis points on September 18 and two cuts of 25 basis points in quick succession on October 31 and December 11. The ECB also acted quickly to stem the crisis by moving forward auctions for liquidity by injecting €94.8 billion, with more operations totalling €108.7 billion in the following weeks, to “frontload” the liquidity operations into the first part of the maintenance period.¹³

¹⁰ A financial institution buying a claim to a package of mortgages or loans can insure itself against default on the underlying repayments through the credit default swap market (CDS). A fixed premium is exchanged for payment in the event of default. As the probability of default rises, so do the premia. There is a primary market for CDS and a secondary market known as the CDX (Commercial Data Exchange) market in the United States and iTraxx in Europe.

¹¹ McAndrews, Sarkar, and Wang (2008) indicate that “rates of interbank loans with maturity terms of one-month or longer rose to unusually high levels”; they also add that “borrowers reportedly could not obtain funds at posted rates.”

¹² “Funding liquidity” refers to the ease of access to external finance and depends on the characteristics of the borrower. When a borrower is not regarded as creditworthy, it may face higher borrowing costs and quantity restrictions that present a funding problem; this will need to be resolved by borrowing from nonmarket sources, and in the case of a bank, from the central bank. Market liquidity is a property of the relative ease with which markets clear at a fair value. When markets become very thin, the authorities may intervene to ensure they are able to clear, by for example “making the market” by accepting certain assets in exchange for more liquid ones.

¹³ Central banks may require commercial banks to hold a certain proportion of their deposits at the central bank; the proportion is calculated over a “maintenance period.” The proportion may be mandated or voluntary, but once set it is usually enforced on average over the relevant period.

But it kept interest rates steady. The Bank of England started to respond to the money market shortage later than other central banks. In August 2007 when approached by the commercial banks to provide further liquidity at no penalty to the borrower, it refused. As a consequence, the commercial banks increased their reserves targets by 6 percent in the maintenance period beginning September 6, 2007.¹⁴ The Bank responded by promising to supply an additional 25 percent of the reserves target if interbank markets did not normalize, and when they did not do so, on September 13, they increased the supply of reserves. Ultimately the Bank of England increased liquidity provision by 42 percent from August 2007 to April 2008.

Central banks found that they had to be innovative in issuing liquidity directly to the most troubled parts of the financial system by developing term lending. The problem for the central banks was that although there was plenty of liquidity in overnight markets, there was a shortage of funds at 1-, 3- and 6-month maturities where the banks needed it, causing the cost of funds at these maturities to rise. The standard tools did not work well in dealing with this problem. Although central banks would normally have used standing facilities to provide more liquidity to the markets, recourse to borrowing from the central bank through standing facilities was seen as an indicator of weakness that carried with it a certain stigma. In the United Kingdom, Barclays bank experienced repercussions in the equity markets when it borrowed from the Bank of England in August 2007. For this reason, commercial banks in the United States bypassed the discount window and borrowed instead for one-month terms from the markets, because rates were almost equal on average to the expected discount rate and did not carry any stigma (see Armantier, Krieger, and McAndrews, 2008, p. 4). Banks also increased

borrowing from the Federal Home Loan Banks.¹⁵ The FHL system provided \$200 billion of additional lending in the second half of 2007.¹⁶

Central banks found it very hard to keep short-term market interest rates on 1-month and 3-month LIBOR (the interbank lending rate) close to OIS rates at the same maturity despite the fact that overnight rates were kept at their desired levels. The disparity at 1- and 3-month maturities reflected banks' anticipation of the need for funding at that maturity that they could no longer easily obtain from these markets. Standing facilities were not addressing the problem because of stigma in the markets, so there were moves to develop term lending. A significant feature of the response to the credit crunch has been the recognition that the markets needed liquidity at maturities longer than overnight. The development of term lending has been the means adopted by central banks to provide liquidity at terms of 1 month, 3 months, and 6 months. Outside the United States this has also involved extending the types of collateral that they are willing to accept (i.e., non-government-asset-backed securities such as AAA-rated private sector securities including residential MBSs).¹⁷

The ECB was the first institution to lend at longer maturities, thereby offering help to European banks by lending against a wide range of collateral, including mortgage securities. It initiated a supplementary liquidity-providing longer-term refinancing operation with a maturity of 3 months for an amount of €40 billion on August 22, 2007, and a second operation on

¹⁴ The Bank of England's money market operations mechanism allows eligible banks to choose a target level of positive balances (voluntary reserves) that they will be required to hold with the Bank on average over a maintenance period lasting from one monetary policy meeting to the next. Reserves held are remunerated at Bank rate. The Bank is able to set ceilings on individual institutions' reserves targets when demand for reserves is high.

¹⁵ There are 12 Federal Home Loan (FHL) Banks, which are owned by 8,100 member financial institutions in the United States. Their purpose is to provide stable home loan funding to their member institutions. The FHL Banks issue AAA-rated debt through the U.S. Office of Finance to fund their loans. Financial institutions were able to obtain funds from the FHL Banks by exchanging assets such as residential MBSs for liquid assets such as U.S. Treasuries. The FHL Banks' members historically have been smaller banks and thrifts, but this has been changing in recent years and the lending of the FHL Banks has broadened to include many larger banks.

¹⁶ See www.fhlb-of.com/specialinterest/financialframe.html for information on these additional loans.

¹⁷ The Federal Reserve Open Market Desk has accepted only U.S. Treasuries, government-sponsored agencies debt, and their mortgage-backed securities, but at the discount window they have accepted a much broader range of collateral.

September 6, 2007, without a specified limit, again at a 3-month maturity. This move was quickly followed on September 19, 2007, by the Bank of England's announced plans for an auction of £10 billion at a 3-month maturity against a wide range of collateral, including mortgage collateral, with three further auctions offering £10 billion at weekly intervals. The Bank of England recorded in April 2008 that three-quarters of its lending was at terms of 3 months or longer, up from about one-third since the beginning of the credit crunch.

On December 12, 2007, the Federal Reserve announced a term auction facility (TAF) to allow U.S. banks to bid anonymously for a predetermined amount of one-month money direct from the Fed to ensure an efficient distribution of funds to banks to augment the stigma-ridden discount window. The TAF was designed to reduce the premium in interest rate spreads for liquidity risk by making liquidity available at the maturity terms required by the financial system. The TAF had a number of new features that combined attributes of open market operations and discount window lending. Distributions of funds were arranged through auctions of fixed amounts (as were open market operations). This allowed the Federal Reserve to (i) determine how much and when funds would be injected into the markets, (ii) ensure that the process of obtaining funds was competitive (and therefore not subject to stigma), and (iii), broadly based, offer funds to a larger number of banks. Similar to discount window lending, the lending was on a collateralized basis using collateral that was acceptable for discount window lending. A bidder for funds through the TAF would be required to offer a bid above a minimum market-determined rate; the Fed would impose a cap on the size of the bid at 10 percent of the total auction size and would distribute funds at a single-price once the auction was completed.¹⁸ The first TAF auction of \$20 billion was scheduled to provide 28-day-term funds and included facilities to swap dollars for euros; there

have been 16 auctions for amounts varying from \$20 billion to \$75 billion up to July 2008.¹⁹

In March 2008, the Federal Reserve established two further facilities: a primary dealer credit facility intended to improve the ability of primary dealers to provide financing to non-bank participants in securitization markets and promote the orderly functioning of financial markets more generally, and a weekly term securities lending facility to offer Treasury securities on a one-month loan to investment banks against eligible collateral such as residential MBSs. Totaling all the sources of new liquidity made available by the Federal Reserve, Cecchetti (2008c) estimated in April 2008 that the liquidity committed so far amounts to nearly \$500 billion (\$100 billion to the TAF; \$100 billion in 28-day repurchases of MBSs; \$200 billion to the term securities lending facility; \$36 billion in foreign exchange swaps with the ECB; \$29 billion to facilitate acquisition by JPMorgan Chase of Bear Stearns; and \$30 billion to the primary dealer credit facility). There have been larger TAF auctions of \$150 billion since April, but term securities lending and primary dealer credit have been lower, at \$143 billion and \$18 billion, respectively. The Federal Reserve has taken major steps to intervene in the markets to ensure that banks can obtain funds efficiently, but in doing so it has offered Treasuries in exchange for eligible collateral, not cash, and these provide liquidity in the sense they have a well-functioning market for their exchange into cash.

The Bank of England also injected marketable assets into the banking system through a newly devised special liquidity scheme implemented April 21, 2008 (see Bank of England, 2008). This provides long-term asset swaps to any bank or building society eligible to borrow from the Bank using its standing facilities. Under the swap arrangement the Bank stands willing to exchange *existing* AAA-rated private sector securities that were issued before December 2007 for government securities for up to a year, with the provision to roll over the swaps for up to three years. The price of the swaps is determined by the riskiness of the underlying assets and does not release 100 percent of the face value of the private securities being exchanged, but it injects a substantial

¹⁸ The minimum rate is the OIS one-month swap rate and the agreed price for the distribution is the "stop-out rate"; see McAndrews, Sarkar, and Wang (2008).

¹⁹ See www.federalreserve.gov/monetarypolicy/taf.htm for further details of the TAF auction dates and amounts.

amount of marketable government securities into the markets that can be exchanged on markets to provide the vital additional liquidity required. When the scheme was unveiled, the value of the swaps was expected to be up to £50 billion.

Funding Liquidity

The Northern Rock Bank Run. The paper by Alistair Milne and Geoffrey Wood in this issue of the *Review* details many of the developments in the Northern Rock bank run, so the discussion here is brief. Northern Rock had adopted a business model that relied very heavily on wholesale funding and securitization of its mortgages (House of Commons Treasury Committee, 2008a,b,c.). Funding from the increase in retail deposits was only 12 percent of total sources of new funding. Of the wholesale borrowing it undertook, 50 percent was short-term, at less than one year to maturity, and among the securitized bonds it issued £6 billion were purchased by its master trust Granite and funded using ABCP with maturities of one to three months. The funding model depended on regular access to both capital and money markets to fund the bank's activities. Although Northern Rock had adequate liquidity to cover shortages of wholesale funds for brief periods (as evidenced by the 9/11 episode when, according to its then-chairmen giving evidence before a Parliamentary committee, it rode out the liquidity shortage that lasted for a few days), it could not endure a long freeze in money markets. The problem for Northern Rock was that it had not envisaged a simultaneous freeze of all its sources of short-term finance, and it had not taken insurance against this eventuality (House of Commons Treasury Committee, 2008a,b,c).

As the possibility of funding problems emerged, the Bank of England, the Financial Services Authority, and the HM Treasury, which were jointly responsible for financial stability, considered three options: (i) to allow Northern Rock to resolve its funding problems in the markets, (ii) to seek a liquid buyer from among U.K. banks, or (iii) to rescue the bank using public money through a support operation by the Bank of England backed by the Treasury. Initially, the authorities opted for a support operation, but a leak of the details by the broadcast media before

an official announcement could be made precipitated a run on the bank between Friday, September 14, and Monday, September 17, after which the Treasury announced a guarantee in full of the deposits in Northern Rock. Subsequent efforts to find a liquid buyer were attempted but failed and the bank was brought into public ownership at a cost of £25 billion in loans from the Bank of England and other guarantees from HM Treasury.

Milne and Wood (2008) note that it was the first run since the nineteenth century on a British bank of any significance in the British banking system, and Brunnermeier (2008) rightly considers Northern Rock to be a classic bank run, but these events were highly unusual for two reasons. First, the run was triggered by the leak of information about an operation planned by the authorities to *support* the bank in its difficulties. Second, it was entirely contained within just *one* institution and did not spread to other banks. On the contrary, depositors withdrawing money redeposited their cash in other banks, and the change in bank deposits by individuals in 2007:Q3 rose by £9.1 billion and continued to grow in 2007:Q4. This suggests that the banking model of Northern Rock was largely to blame, but also that the unfortunate revelation of support procedures intended to rescue an institution in trouble before an official announcement could be made resulted in an adverse signal to the markets—the opposite of what was intended. The banking system itself was not distrusted, just Northern Rock.

The run on Northern Rock occurred because it used a business model that was inherently risky if the financing of its mortgages, held for sale as MBSs by Granite through the issue of short-term asset-backed paper, could not be rolled over. A similar failure occurred in the United States when Home State Savings Bank of Cincinnati, Ohio, failed.²⁰ Home State Savings had about \$700 million in deposits in 1985 when it ran into trouble because a rapidly expanded new business financed by the issue of short-term paper failed. Home State Savings Bank had bought Ginnie Mae

²⁰ I thank Dick Anderson, who observed firsthand both the Home State loan run in Columbus, Ohio, in 1985 and the Northern Rock run in Birmingham, United Kingdom, in 2007.

MBSs and U.S. Treasuries from E.S.M. of Fort Lauderdale, Florida. It had financed the purchase by issuing its own short-term paper with a one-year maturity, which it sold back to E.S.M. When E.S.M. collapsed, Home State Savings' losses threatened its banking business. This precipitated a bank run that threatened to spread to other institutions because the losses of Home State Bank absorbed almost all of the Ohio state deposit insurance fund, leaving all other savings and loans companies effectively without deposit insurance. The governor of Ohio closed 71 institutions until they were able to obtain federal deposit insurance. The nature of this run was very similar to that of Northern Rock inasmuch as it resulted from a rapidly expanded new business that the regulators and the bank itself failed to recognize as highly risky, which subsequently caused the institution to fail.

Bear Stearns. The response of the U.K. government to the Northern Rock run recognized the need to protect commercial bank depositors from the fallout in the financial system following a funding problem. The move in recent months by the Federal Reserve to rescue the private sector investment bank Bear Stearns has been an attempt to limit the damage of the crunch on settlement in the financial system more generally. Bear Stearns' hedge funds had invested heavily in structured finance products because these allowed the *actual* leverage ratio to be much higher than the reported leverage ratios on funds under management.²¹ Concerns had mounted over the degree of leverage and the quality of the MBSs in which Bear Stearns had invested. Reportedly, Goldman Sachs had provided indications to the hedge fund Hayman Capital that it would not take exposure to Bear Stearns. As news spread of this warning, an investment bank run occurred, reducing Bear Stearns' ability to finance its activities. These had been funded by the sale of short-term ABCP assets and had been rolled over regularly, but on Friday, March 14, 2008, it became

clear that Bear Stearns would not be able to roll over the assets as normal and as a result would fail to meet payments due on Monday, March 17. To avoid the costly unraveling of over-the-counter interest rate, exchange rate, and credit default derivatives—for which Bear Stearns was a counterparty—that might threaten to bring into bankruptcy other financial institutions, including JPMorgan Chase, Bear Stearns' banker, the Federal Reserve Bank of New York stepped in to support the institution with a 28-day loan via JPMorgan Chase. Analysis over the weekend revealed that a takeover would be necessary, and this was arranged through a shares purchase by JPMorgan Chase initially set at \$2 per share, but later increased to \$10 per share to placate shareholders and ensure the deal would be accepted, combined with a \$29 billion loan from the Federal Reserve, and with JPMorgan Chase taking on the first \$1 billion of losses to Bear Stearns. The actions averted a financial system crisis that might have resulted in what Brunnermeier (2008) refers to as “network and gridlock risk,” and intervention appears to have prevented this from occurring.

Freddie Mac and Fannie Mae. In different circumstances than those of Bear Stearns, Freddie Mac and Fannie Mae received support from the U.S. Treasury following advice from the Federal Reserve Bank and the Securities and Exchange Commission (SEC) in July 2008.²² Confidence in the institutions' ability to raise \$3 billion of new funds through an auction in the markets was fragile. Freddie Mac and Fannie Mae held MBSs that they had issued in their own name or bought to encourage “affordable” loans at the behest of HUD. Many of these were subprime mortgages, which were affected by the downturn in house prices, and rising delinquencies on their own mortgages or those they insured for others pointed to further financial problems ahead. A fall of 20 percent in the value of the equity of the institutions in mid July 2008 reflected the fears of lower future profitability

²¹ Brunnermeier (2008) reports that Bear Stearns' Asset Management Fund reported leverage ratios of 2:1 and 3:1 on, respectively, High-Grade Structured Credit Strategies Fund and its Enhanced Leverage Fund, but CDO investments would have increased these leverage ratios considerably.

²² Freddie Mac and Fannie Mae are government-sponsored mortgage agencies with debts of \$1.5 trillion, direct guarantees to mortgages to the value of \$5 trillion, and insurance for a further \$2 trillion of other institutions' mortgages, which means, directly or indirectly, they support more than half of the \$12 trillion U.S. mortgage market.

and the circulation of suspicions by Lehman Brothers that between them they would need to raise \$75 billion in additional funding, which could dilute ownership. The scale of the capital required was small in relation to the size of the companies, but failure to obtain a relatively small amount of funding would question the credibility of the institutions and if that meant the debt securities issued by the mortgage agencies might decline in value, greater problems would then occur for other financial institutions. Many banks, money market funds, and pension funds hold Freddie Mac and Fannie Mae debt securities and used them as collateral for borrowing. The possibility that agencies' government-sponsored MBSs might be sold off by investors was a major concern. The proposal put forward by U.S. Treasury Secretary Hank Paulson on Sunday, July 14, 2008, involved a credit line of \$300 billion as a temporary measure; the Housing and Economic Recovery Act of 2008 passed by Congress in late July approves the plan to allow the Treasury to purchase debt securities and shares in the agencies with the agreement of the companies until December 31, 2009, when the authority expires. Once again, failure of the institutions to continue to operate as normal would have resulted in a severe dislocation in the financial system.

EVALUATION

The Problems with “Originate and Distribute” Banking

A number of commentators, including Alexandre Lamfalussy and Willem Buiters,²³ have noted that banks have replaced their traditional “originate and hold” model of lending long and borrowing short, with an “originate and distribute” model, in which they lend and then sell the claims to someone else. They argue that the widespread adoption of an “originate and distribute” model was responsible for the crisis. It is difficult to dis-

agree, but securitization has been operating for 40 years without associated crises, so something more is at work. The change in the past decade has been the growth in residential MBSs backed by subprime mortgages with a larger number of steps between originator and holder and, as a consequence, greater opacity. This has contributed to the mispricing of risk that was not properly appraised. The result is twofold: Investors are far removed from the underlying assets both physically (due to the global market for these assets) and financially (since they often have little idea about the true quality and structure of the underlying assets several links back in the chain). The International Monetary Fund has referred to this as an arm's-length financial system in its *World Economic Outlook* for 2006, and Monacelli (2008) calls it an “atomistic” model. Equity and bond markets can have these features too, but structured financial products are far more complex instruments. The extension of originate and distribute banking to subprime mortgage securities has created an asset class with an opaque ownership structure and therefore imprecision concerning who holds the underlying risks. This feature has distorted the incentive structure at every step in the process and greatly complicated the assessment of risks because few investors understand the structure from top to bottom. Ultimately this is responsible for the crisis.

Poor Incentive Structures Under “Originate and Distribute” Banking. The problem with the extended originate and distribute banking model lies in its weak incentives to measure risk accurately at any stage in the process. There may have been control measures in place, but these were allowed to slip. The model had six badly designed incentive mechanisms as illustrated by the experience in the period leading up to the crisis.

First, brokers and agents of banks selling mortgages were motivated by up-front fee income unadjusted for borrower quality. The bonuses rewarded growth of business over a short time scale (typically a yearly cycle) with no penalties if subsequent developments revealed a lack of due care and attention in the origination process or losses to the originator. There is evidence of manipulation of data, in some cases amounting

²³ Respectively, they are the former general manager of the Bank for International Settlements and former chief economist of the European Bank for Reconstruction and Development and U.K. Monetary Policy Committee member.

to fraud, by brokers, who—with the exception of their appointed appraisers of property—were the sole point of contact with the borrower.²⁴ These brokers and agents were often not employees of the mortgage origination companies; therefore, they were strictly speaking outside the regulators' reach (see de la Dehesa, 2008).

Second, originators had no greater incentive to look more carefully than brokers at borrower quality. The incentives for the originators of the loans, faced with the knowledge that the products would be combined in complex ways and sold, were different from those for an originator who intended to hold the assets to maturity. This fundamentally altered the incentives of the seller. In the years before the crisis occurred, the origination of subprime mortgages increased rapidly because mortgage originators needed new loans to package and sell to investors; in the rush to provide more loans for securitization underwriting standards were allowed to slip as uncritical use of automated underwriting systems and validators were introduced to ease the burden.²⁵ In July 2008, the attorney general of Illinois, Lisa Madigan, filed a civil action against Countrywide for deceitful conduct and lax standards in subprime mortgage lending with hidden fees and risky terms. Moreover, Countrywide is accused of having “used egregiously unfair and deceptive lending practices to steer borrowers into loans that were destined to fail.” This first action against Countrywide by a public prosecutor has been brought on behalf of thousands of borrowers.

Third, the profits from securitization created incentives for originators to obtain new loans regardless of their quality provided they met minimum standards for resale.²⁶ As the quantity of new borrowers declined, lenders reduced their standards to maintain the volume of loans feeding into the securitization market. This generated an increasing share of “NINJA” loans—so called because the recipients had *No* verified *I*ncome, *J*ob, or *A*ssets—and piggyback loans that combined two mortgages to cover the purchase of a single residence. Anderson (2007) reports that between 2003 and 2006 the market share of the NINJA loans doubled and the piggyback loans quadrupled. Later-stage securitized loans were therefore much riskier than the earlier ones: Defaults on 2006 and 2007 vintages of subprime loans are projected to be higher than default for earlier vintages.

Fourth, tranching enabled the SPVs to construct products with ratings suitable for certain types of investors. The senior tranche would obtain a AAA rating, suitable for pension funds; the next tranche would obtain BBB, suitable for conduits and SIVs; and so on. Equity tranches also could be rebundled with other equity tranches into CDOs with higher credit ratings, despite the fact that they were complex combinations of poorer-quality mortgages in a more highly leveraged form.

Fifth, ratings agencies made a large share of their profits from rating structured finance products; for example, Portes (2008) reports Moody's generated 44 percent of its revenues from these activities. There was scope for conflict of interest within ratings agencies because they were paid an up-front fee *by the issuer* to provide a rating of the assets. At the same time, though, the same business would sell advice to clients (for another fee) on how to improve those ratings, identifying “tranching attachment points” to make sure the securitized assets *just* attained the required rating for the intended investor group.

²⁴ The November 28, 2007, Fitch Ratings special report on “The Impact of Poor Underwriting Practices and Fraud in Subprime RMBS Performance” cites BasePoint Analytics LLC, a fraud analytics consulting firm, which “analyzed over 3 million loans originated between 1997 and 2006...including 16,000 examples of non-performing loans that had evidence of fraudulent misrepresentation in the original specifications. Their research found as much as 70% of early payment defaults contained fraud misrepresentation on the application” (p. 1). Fraud might include occupancy misrepresentation, incorrect calculations of debt-to-income ratios, artificially high credit scores (based on authorized use of someone else's credit history), questionable stated income or employment, and so on.

²⁵ When the scale of the early payment defaults became known in 2007, the Fitch Ratings report urged mortgage originators to be more vigilant regarding verification of stated income, credit scores, property valuation, underwriting standards, and internal audit. (See Fitch Ratings “The Impact of Poor Underwriting Practices and Fraud in Subprime RMBS Performance,” p. 7. The special report is available at www.securitization.net/pdf/Fitch/FraudReport_28Nov07.pdf).

²⁶ If a certain proportion of the underlying mortgages defaulted, there was often a clause that required the originator to take back the repackaged assets; but, provided the seller met some fairly minimal standards to ensure the predicted default risk was acceptable to the buyer, the originator could sell the mortgages at a profit.

Sixth, fund managers, like brokers, were motivated by bonuses and usually on a competitive basis relative to their peers. CDOs offered a simple means to enhance portfolio performance, which generated bigger bonuses and improved the performance of funds offered to the public. Greater leverage could be obtained through CDOs that had embedded leverage in their structure, and this offered better returns. Pricing of the least-liquid tranches could be based on mark-to-model valuations that depended on critical assumptions such as the correlation structure of the underlying assets made by the managers themselves (see Brunnermeier, 2008). As Chuck Prince, former chief executive officer of Citigroup, commented concerning the incentives facing the investment banks: “as long as the music is playing, you’ve got to get up and dance. We’re still dancing.” (Nakamoto and Wighton, 2007). This statement above all others suggests that fund managers and investment bank executives were fully aware that a bubble was inflating but until it burst there was money to be made.

Some economists argue the incentives presented a classic example of a principal-agent problem in a world of asymmetric information, in which incentives to different parties were substantially at variance with one another. Here we argue there is reason to believe that the incentives of brokers, originators, SPVs, rating agencies, and fund managers were very much aligned. At every stage, profits could be made by providing assets with characteristics that the buyer required, and providing there was another buyer farther up the chain, the risk considerations were not paramount. Even end-investors were satisfied because the assets met the conditions in the “search for yield.” The regulators should have ensured originators, arrangers, and fund managers focused on the conflicts of interest more carefully, because the complexity and length of the chain between seller and buyer meant poor-quality mortgages securities encouraged the improper consideration of the risks, but this was not done.²⁷

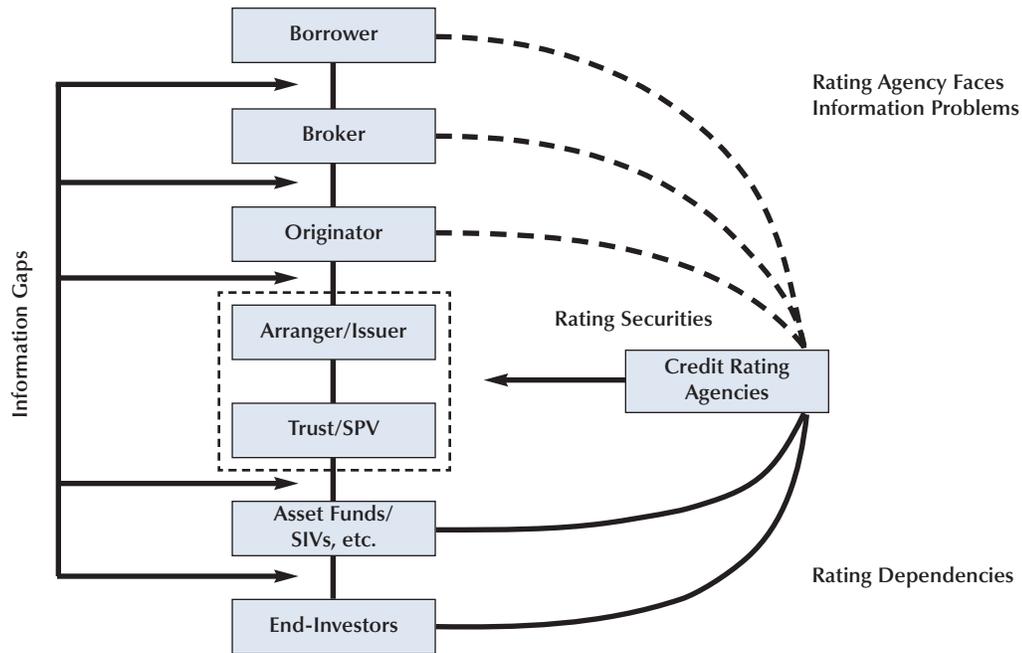
²⁷ Regulators were not sufficiently aware of the dangers offered by incentives set at the time, and some of the agents were outside their jurisdiction in any case.

The incentive structure contributed to what Giovannini and Spaventa (2008) call “the information gap” between the originator and the investor, but there was another issue: complexity in the assessment of risk.

Provision of Information. In many respects, the provision of information and the regulations concerning information lie at the root of the 2007-08 credit crunch. The observed change in banking practice toward originate and distribute models has greatly altered the incentives facing the originators of loans, and information about the risks associated with the assets was lacking but regulators and investors were slow to pick this up. Not only does a lender who intends to sell the securitized loans face less incentive to diligently examine the quality of the borrower, or the collateral against which the loan is made, but there is an information asymmetry between the seller of the securitized assets and buyer that cannot easily be overcome by organizations such as the ratings agencies. Willem Buiter (2008a) has argued information may not have been collected at all, or if it was collected, it may have been neglected during the process of transferring assets from originator to buyer. This differs from a standard information asymmetry model where true information cannot be observed by the lender and must be taken on trust from the borrower or obtained by incurring a monitoring cost (e.g., the information asymmetry facing a bank and a customer, when only the customer knows the true value of an investment project). In this case of an investor-seller relationship, information that could be made known is not revealed—not because the investor could not know it or incurs a cost of obtaining it—but because the investor does not specifically require it to be revealed by the seller. While there were cases of sellers fabricating or adjusting data on mortgage applications, in many more cases true information on the financial condition of the mortgagee was not passed up the chain because it was not required. Originators and arrangers provided just enough information to satisfy the investor at the next stage of the process and no more. This problem occurred at every link in the chain as products were combined, split into tranches, and resold. Figure 9 shows that

Figure 9

Information Asymmetries



SOURCE: Bank of England Financial Stability Report, October 2007.

“information gaps” exist at all points between the seller and buyer.

In a speech to the European Parliament on January 23, 2008, Jean-Claude Trichet, president of the ECB, commented that there were “lessons to be drawn in terms of the *structure of incentives* in all stages of the securitisation process and the ‘originate to distribute’ model. All the relevant players—including originators of loans, arrangers of securitised products, rating agencies, conduits and SIVs, and final investors—should have the right incentives to undertake a proper assessment and monitoring of risks” (ECB, 2008).

A report of the U.S. President’s Working Group on Financial Markets (2008, *italics in original*) explains that the incentives and the information gap are related:

Originators, underwriters, asset managers, credit rating agencies, and investors failed to obtain sufficient information or to conduct

comprehensive risk assessments on instruments that often were quite complex. Investors relied excessively on credit ratings, which contributed to their complacency about the risks they were assuming in pursuit of higher returns. Although market participants had economic incentives to conduct due diligence and evaluate risk-adjusted returns, the steps they took were insufficient, resulting in a significant erosion of market discipline.

An important challenge for policymakers is to consider the options governing information requirements on originators and subsequent sellers of these highly engineered products. Altering the rules over the provision of information will go a long way to making the products transparent and reducing the information gap. This in no way diminishes the institutions’ own responsibilities to change the incentives offered to mortgage originators, agents, brokers, and fund managers.

Complexity in the Assessment of Risk. It seems surprising that investment banks accustomed to dealing with complex assets could be convinced that AAA-rated assets could command returns that had such large spreads over risk-free assets such as Treasuries without being inherently more risky. Perhaps Chuck Prince was right that investment banks knew the risks but were prepared to continue to “dance” while money was being made. For a less sophisticated class of end-investors, several factors made risk assessment more complex and difficult.

The Development of Structured Finance Products for Mortgages of Differing Quality. The process of combining these financial products made evaluation of their riskiness extremely difficult. The purchaser believed that development of structured finance allowed for diversification of risks and at every stage the benefits of diversification would reduce the risks compared with those on the underlying mortgages. But the embedded leverage in these products meant that end-investors were often buying assets with much greater risk characteristics compared with the underlying pool of mortgages, credit card debts, or loans than they might suppose. With high leverage ratios, a level of defaults that might affect a small proportion of an investor’s capital could quickly multiply to threaten to eliminate it all. Despite these dangers the returns on structured finance products were good, and many investors were persuaded that the risks were low because the ratings were good.

Reliance on Ratings to Assess Asset Quality. Given the complexity of the products offered, investors relied on ratings provided by ratings agencies such as Moody’s, Standard & Poor’s, and Fitch. These ratings indicate the likelihood of default on the product, and for the highest ratings—AAA—the likelihood was equivalent to government debt default for developed economies (i.e., negligible). The granting of AAA ratings to asset-backed securities meant many investors believed they were buying very safe assets, and certain organizations such as pension funds, which face restrictions on the assets they are permitted to purchase, were able to buy these assets. These risks were not properly priced because they did not anticipate the potential for lower

house prices or the potential effects house price declines would have on subprime default rates. In addition, there is a widespread view that the complexity of the products offered created a dependence on ratings agencies to evaluate the risk of these types of assets, without (much) further due diligence undertaken by the investor. There is then the question of the risks being rated. In their defense, ratings agencies argue that the purchasers of their services requested default ratings and not ratings of market or liquidity risk, partly because these were more expensive to compute because of the increased work involved. Although the ratings agencies offered assessments of default risk, the ratings themselves were (mis)interpreted by some end-investors as indicators of all three types of risk.

The Belief that Tranching Reduced the Risk to the Senior Holders of Asset-Backed Securities. Ratings agencies were able to provide high ratings because they believed at the time that residential MBSs and CDOs were financially engineered to reduce the risk of default. Models of the default risk suggested the top tranches were very safe, but the models relied on a pooling process, wherein a large number of individually risky loans were assumed to have a reduced risk of default when combined into a package. Because the ratings agencies believed the senior tranches were very safe, CDOs in the senior tranche would be assigned AA or AAA ratings, mezzanine tranches would be assigned BBB ratings, and equity would be BBB to CCC or lower. Whether the risks in the senior tranches were as low as the AAA ratings suggest is difficult to gauge, but with the great benefit of hindsight, it appears unlikely. The loans were low quality, and were not as independent as the models of the risk characteristics had assumed. Delinquencies on the individual loans began to rise together when the housing market slowed; they were much riskier than ratings agencies or end-investors supposed.

Actions by the Central Banks and Government

Market Liquidity. Although opinions differed among central banks on how to manage the crisis

at first, the views have converged considerably since September 2007. The schemes introduced by the Federal Reserve, the Bank of England, and the European Central Bank all widen the range of high-quality collateral the central bank will accept and extend the lending term. These changes merit further consideration.

First, the central banks have all made liquidity available overnight for 28 days, but terms of three months or longer also are available. This change was designed to inject cash at longer maturities, but this also has an effect on shorter rates; so that the change in the composition of the liquidity operations does not affect overnight rates, where necessary, central banks may have to absorb the excess liquidity by withdrawing cash overnight.²⁸ This process is somewhat reminiscent of Operation Twist, the action of the Federal Reserve under the Kennedy administration in the 1960s when it operated at various maturities to twist the yield curve (see Holland, 1967).²⁹ The policy objective at the time was to raise short rates that needed to be high relative to short rates of other countries to deal with the balance of payments problems while lowering long rates that needed to be low to encourage economic growth. The effectiveness of Operation Twist divides the academic community, but then-Governor Bernanke discussed the possibility of such an operation in the context of a speech on deflation in November 2002 (Bernanke, 2002). As Chairman, he has come to rely on it to deliver the term lending to financial institutions while still keeping the federal funds rate at its target value.

Second, the TAF operations and similar activities of the Bank of England and the ECB have not just extended the term of the liquidity operations that central banks offer to the markets, they also have altered the collateral they accept. In this respect, the latest operations are different from Operation Twist, and the move to accept a variety of collateral that previously was not eligible has been critical for the present crisis. Markets for MBSs had dried up as banks were not prepared

to purchase the short-term assets issued by the purchasers of MBSs and withheld liquidity to cover their own needs; therefore, borrowing over terms longer than overnight was restricted by these developments. Central banks engaged in a swap of collateral—government-backed securities in exchange for riskier MBSs—with appropriate conditions to ensure markets had collateral with a market-determined value that could be used to obtain liquidity at the required maturities. As Buiter (2008b) points out, the central banks have in effect become “market makers of the last resort.” Once the market had been made by the central banks to swap the private sector securities for government securities, it was hoped the markets would normalize. The fact that this has not been the case, as indicated by spreads between three-month LIBOR and the expected overnight rates that are still wider than usual, creates a puzzle. Why is there still a larger spread than in previous years? The scale of the operations by central banks has been vast, and it is unlikely that a shortage of funds is the reason for the spread. One answer to this puzzle is that the spreads were unusually compressed in recent years and have widened because they were previously abnormally narrow—many supervisory institutions warned that risk had been mispriced in the run up to the crunch. A second response is that considerable uncertainty remains about the ability of financial institutions to obtain funding in the future, and the injection of liquidity has eased the markets but not eliminated the uncertainty about the future funding. If the first answer is correct, then the central banks should not be concerned about the sustained spreads in the markets: There has been a correction for the true degree of credit risk. If the second answer is correct, the central banks should consider further what can be done to reduce market uncertainty arising from liquidity risk.³⁰

Third, the central banks collaborated to alleviate the shortage of liquidity. When the need for

²⁸ Whether banks need to “mop up” liquidity depends on the size of the operation they intend to carry out.

²⁹ I am grateful to Charles Goodhart for pointing out this connection.

³⁰ McAndrews, Sarkar, and Wang (2008) report research at the Federal Reserve Bank of New York that seeks to determine the effectiveness of the TAF on the spreads in money markets by observing the spread against announcements and operations of the TAF by the Fed. They conclude the TAF had a negative effect on spreads. The effectiveness of the control of the central bank on the liquidity risk premium in money markets is a vital area of research.

liquidity was first identified in late 2007, a joint effort by the central banks of all the major industrialized countries infused liquidity into the markets. The Federal Reserve provided access to dollars for the European banks via a currency-swap arrangement, with the ECB and the Swiss National Bank (SNB) acting as conduits, in December 2007 and January 2008 in amounts up to \$20 billion and \$4 billion to the ECB and the SNB, respectively, on both occasions, which effectively increased lending in another major currency through the currency-swap market. In May 2008, a further injection of liquidity provided dollars in amounts of up to \$50 billion and \$12 billion to the ECB and the SNB, respectively. The move toward common solutions to the liquidity problem is part of an ongoing process that is likely to lead to further collaboration on types of eligible collateral and market operations.

Funding Liquidity. The questions that need to be answered are whether the authorities should have provided funding liquidity and whether they should have provided it in this way. These two questions address concern about the conduct of the authorities in the rescue of illiquid banks—first for Northern Rock in the United Kingdom (whether this is a bailout depends on what eventually happens to the shareholders) and later for Bear Stearns in the United States—and are of considerable interest. All these rescues involved a considerable amount of public money. The guarantee offered by the British government backed the deposits in the Northern Rock not covered by the deposit insurance scheme operated by the Financial Services Authority. The subsequent decision to nationalize Northern Rock on February 18, 2008, involved £25 billion of public money plus the state guarantees to the bank itself. In the United States, the rescue of Bear Stearns on March 17, 2008, involved a loan of \$29 billion, and the credit line offered to the government-sponsored mortgage agencies on July 14, 2008, involved \$300 billion of U.S. Treasury support, and Congressional approval for funding (the size of which is unknown at this point). The question is whether the authorities should have offered funding liquidity and whether it was done in a timely and efficient way.

At a much earlier stage, Mervyn King had voiced concern that central banks should not provide liquidity too freely to institutions facing difficulties to avoid moral hazard. In a letter to the Chairman of the Treasury Select Committee on September 12, 2007, he outlined his views (reported in the Fifth Report of the Committee, House of Commons Treasury Committee, 2008) as follows:

[T]he Governor pointed out that he did not agree with the suggestions for additional measures that others believed the Bank of England should undertake: lending at longer maturities, removing the penalty rate or increasing the range of collateral against which the Bank would be prepared to lend. In the letter, he gave three reasons for his position. First, he stated that “the banking system as a whole is strong enough to withstand the impact of taking onto the balance sheet the assets of conduits and other vehicles.” Second, “the private sector will gradually re-establish valuations of most asset backed securities, thus allowing liquidity in those markets to build up.” Third, there would be a risk of “moral hazard.” In essence, this “moral hazard” argument is that, should the central bank act, and effectively provide extra liquidity at different maturities against weaker collateral, markets would, especially if the liquidity were provided at little or no penalty, take it as a signal that the central bank would always rescue them should they take excessive risk and get into difficulties.

In examining these arguments it is clear that the banking system as a whole could sustain the losses incurred, but individual institutions, like Northern Rock and Bear Stearns, could not. Takeover by the private sector was the preferred option even in the United Kingdom, although it was not possible to find a satisfactory resolution with a private buyer. King’s confidence in the markets to reestablish valuations and liquidity in capital markets now seems optimistic, although most commentators at the time would have expected the markets to settle. Despite actions to provide market liquidity, they markets still have not “normalized,” and “normal” is difficult to define. The actions that Governor King sought to avoid—lending at longer maturities against a wider

definition of collateral—have, in fact, been implemented in the Special Liquidity Scheme, but not without a penalty rate, and under swap arrangements that aim to minimize the risk that the Bank accepts on its balance sheet. It seems that the Bank's reading of the crisis, at this stage, was later to be revised.

What then about King's third point regarding moral hazard? Moral hazard occurs when provision of emergency funding for an institution in trouble today encourages banks to take more risks in the future. King sought to avoid moral hazard by providing a plentiful supply of liquidity through existing schemes—not through special arrangements requested by the banks that carried no penalty rate of interest.³¹ If banks were to act on the knowledge that the central bank stood ready to rescue them, collectively or individually, in the event of another crisis, public money would insure activities of the banks and encourage excessive risk-taking. This is the cost of liquidity provision and needs to be avoided, but a balance needs to be struck between making provision for market and funding liquidity to deal with a bank in crisis and withholding provision to avoid future moral hazard.

Arguably, the crisis in Northern Rock occurred because *all* banks held far fewer liquid assets in recent years than they did, say, 40 years ago (see, by way of comparison, Goodhart, 2008a). Effectively, banks had been allowed to insure some of their funding risk with central bank money for some time. The gradual move toward funding models using short-term paper entailed risks that might require the authorities to provide liquidity when markets were unable or unwilling to do so.³² The run on Northern Rock happened because it had taken this process a step further than other U.K. banks and gambled that it would not face a

funding problem on all short-term money markets simultaneously. Although the U.K. authorities might have wished to see the markets and the banking system resolve the crisis on their own, in the end they needed to support a private sector financial institution with a loan and government guarantees. That they were willing to do so for Northern Rock was explained by its share of the U.K. mortgage loan market and the limited scope of the U.K. deposit insurance scheme.³³ A significant number of depositors stood to face a drawn-out process before a fraction of their assets were returned to them under deposit insurance rules, and this is surely something that needs to be addressed to avoid bank runs in the future. The position of the Governor that moral hazard should be avoided by refusing to lend freely in the event of a crisis was a last-ditch attempt to manage the incentives facing banks, but the banks had been allowed to develop funding models that transferred funding liquidity risk to the central bank for many years. Paul De Grauwe (2008) is right to argue that

[A] new equilibrium must be found in which tighter regulation is reintroduced, aimed at reducing the propensities of too many in the markets to take on excessive risks. The need to re-regulate financial markets is enhanced by the fact that central banks, backed by governments, provide an insurance against liquidity risks. Such insurance inevitably leads to moral hazard and excessive risk-taking.

In the case of Bear Stearns, the Fed stepped in—despite the fact that Bear Stearns was not a depository institution—because the importance of its role as a counterparty to international derivatives trades afforded it strategic importance in the financial markets that made it too embedded to fail. This was emphasized by Christopher Cox, chairman of the SEC, the U.S. regulator, and Timothy Geithner, president of the Federal Reserve Bank of New York. The need to do so was also the result of risky management that adopted a business model too heavily reliant on short-term rollover funding from markets. Bear Stearns stood

³¹ The ECB view was very different. It regarded the crisis as primarily a crisis of confidence, and therefore moral hazard considerations were not a high priority. The ECB argument is about the appropriateness of market liquidity to restore confidence—not funding liquidity to save a failing institution—therefore, this argument addresses a different issue.

³² Warnings in 2007 by the FSA and the Bank of England seem to indicate awareness of the former but not necessarily the hazards of the latter. Perhaps, like the banks themselves, they did not envisage all markets for short-term funds being closed simultaneously.

³³ The deposit insurance scheme in the United Kingdom insures only the first £2,000 and 90 percent of the next £35,000.

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to gain from the high returns that the business models generated, but these returns also involved large risks, and given the scale of the potential losses implied bankruptcy for the institutions concerned unless the government intervened. The risks taken by the managers of these institutions were much larger than the shareholders or the investors would have accepted if they had been aware of them. In this respect, evaluating whether the problem constituted moral hazard again centers on whether Bear Stearns knowingly took more risks than would have been the case if the losses had been borne entirely by the owners. It is difficult to believe that Bear Stearns did not know it was taking large risks to obtain high returns, but there may have been a failure to appreciate just how large would be the potential losses given default. The shareholders experienced losses when shares were sold at \$10 per share to JPMorgan Chase compared with valuations of \$150 per share a year earlier.

The second question concerns the effectiveness of the response mechanism of the authorities in the United States and the United Kingdom. The decisions to defend vital elements of the banking and financial system were made in real time but on the basis of prearranged strategies for crisis resolution. This raises another question: Were the systems well structured to make these decisions when they needed to be made? In the United Kingdom the investigation into the run on the Rock by Parliament concluded that the tripartite arrangement in place in Britain did not resolve the bank run in a smooth fashion (House of Commons Treasury Committee, 2008, p. 107). The origins of the tripartite arrangement for resolving bank crises are found in the separation of monetary policy and financial stability responsibilities when the Bank of England was granted independence in May 1997. Financial regulation and supervision, which had been the Bank's responsibility, was separated and given to the Financial Supervision Authority (FSA). The responsibilities in the case of a crisis were then split among the Treasury, the Bank, and the FSA as documented in a Memorandum of Understanding, which had been reviewed and revised as late as March 2006 (House of Commons Treasury

Committee, p. 104). The weakness of the tripartite system stemmed from the difficulty of knowing who was ultimately "in charge" when events were moving at a swift pace (House of Commons Treasury Committee, pp. 109-10). The ability to make the political decision to involve public money in a rescue implied the Treasury had to be involved, but if there were to be a lender-of-last-resort operation, this would engage the Bank of England in consultation with the banking supervisors at the FSA. Cecchetti (2008a) argues that separation of the liquidity provider from the supervisor was bound to stress the system at a time of crisis, but in testimony to Parliament Mervyn King expressed no desire to take back these responsibilities. Eventually all three institutions were involved in the decisionmaking process concerning the rescue of Northern Rock.

Could the Bank of England have balanced its responsibilities between monetary policymaking and financial stability? The question is about conflicts of interest between monetary policy and financial stability objectives. Cecchetti (2008a) argues that the liquidity provider should have some supervisory responsibility and implies that a central bank is capable of trading off its responsibilities internally. At a time when the financial turmoil requires liquidity to be supplied to the markets but the inflation outlook requires a tightening of monetary policy, the Bank of England has had to innovate to provide term lending and hold rates to control inflation simultaneously, but it has done so quite successfully. Reforms to the arrangements are inevitable, with a strengthening of the financial stability role of the Bank of England proposed. Buiters (2008b) discusses these proposals in detail. The most important issue is to see that action is more effective by establishing a clear line of communication and control for future crises.

The Bear Stearns crisis resolution process appears to have delivered what the Federal Reserve set out to achieve. The crisis was dealt with swiftly, and as a result the financial system did not face the settlements equivalent to a "payments problem." The owners and fund managers of the investment bank were effectively punished

for taking risky strategies, regardless of whether they were aware of their scale, and the creditors of the institution were able to pass the debts of the company to its acquirer. The financial system is now aware of the dangers of highly leveraged investments funded by issue of short-term paper. However, the cost to the Federal Reserve, which provided a \$29 billion loan against collateral of questionable value, depends on the scale of the losses Bear Stearns will incur and where the Fed stands in the line of creditors. The best-case scenario is that JPMorgan Chase will provide sufficient funding to cover all the losses and the loan. The worst case is that the Fed has accepted poor-quality collateral for a loan that will not be repaid and the Fed will be a long way down the list of creditors.

The key question, however, is why Bear Stearns had been allowed to take such risks, while under the oversight of the SEC, that then required the Federal Reserve to step in when it faced difficulties that could have become systemic.³⁴ Bear Stearns had met the SEC requirements until March 10, 2008, but when it failed it did so quickly. The option to ask the private sector to rescue Bear Stearns by liquidating its positions without Fed support was considered not to be an option for two reasons. First, it could not be arranged quickly enough without Fed coordination and support, and second, the resilience of the markets for Bear Stearns' assets was not great—a sell-off of assets would have depressed prices and forced Bear Stearns into insolvency. This seems to have been a situation that the Fed and the SEC did not foresee coming.

In the case of the GSEs Freddie Mac and Fannie Mae, the line of credit from the U.S. Treasury and Congress is much larger. It is not yet clear whether the promise of a large sum will be sufficient to restore confidence, and perhaps the GSEs will not need it, but it may allow the

institutions to continue to operate under the same rules as before. This case seems to involve the largest moral hazard. GSEs have always operated under an implicit government guarantee; this has now been made explicit. But the moral hazard exists because the incentive structure facing GSE executives and the business model they operate continues as before while the extent of the support from the government is unlimited. It has to be hoped that changes to the regulatory environment—the Federal Housing and Economic Reform Act of 2008 provides a regulator for GSEs and the Federal Home Loan Banks—will offset these dangers. The regulator will be able to establish capital standards, prudential management standards, enforce its orders and remove officers, put the agencies into receivership, and review/ approve any new products that they may develop. The key issue is how aggressively these powers are used.

Regulation, Supervision, and Accounting Conventions

A major concern throughout the credit crunch has been the role of supervisors and regulators in the process—a rather obvious conclusion now—but an issue that still needs to be addressed. We note here particular areas where regulators' attention should be concentrated.

Regulation of Originators and Brokers. The first concern is the regulation of the mortgage originators and the subsequent producers of structured finance products. Although U.S. mortgage banks are subject to regulation by federal and state agencies, Jaffee (2008) acknowledges that regulators' benign practices exacerbated the crisis. The process by which mortgages were originated without much attention to borrower quality is an issue that now seems fundamentally important. The accommodating environment provided by the regulations is well documented (U.S. Treasury, 2008, Bernanke, 2007, and Angell and Rowley, 2006).

A second and equally fundamental issue is the conduct of the originators: Did they act in the borrowers' best interests? Some have argued that lenders were in fact engaged in "predatory lending": the selling of loans not in the best inter-

³⁴ Jaffee and Perlow (2008) indicate that the five largest investment banks, including Bear Stearns, submitted to voluntary supervision by the SEC to satisfy European Union requirements for regulation. These "consolidated supervised entities" were required to maintain a 10 percent capital ratio, similar to the Fed's standard for well-managed bank holding companies, and they were required to hold cash and securities of a high quality to cover all their liquidity requirements.

ests of the borrower.³⁵ Jaffee (2008) argues that predatory lending occurred not because consumer protection legislation was lacking but because it was not enforced. The existence (or non-existence) of predatory lending is controversial, and other commentators have suggested that incentives were influenced by the Community Reinvestment Act (CRA, 1977), which required lenders to offer credit, including home ownership opportunities, of their entire community and not just wealthy subsectors.³⁶ HUD required Freddie Mac and Fannie Mae to purchase “affordable” home loan securities in the mid-1990s, and the purchases of these securities increased again from 2004 to 2006. HUD expected the agencies to impose higher standards on lenders, but ironically, because Freddie and Fannie Mae bought subprime MBSs, they provided additional incentives to the originators of the loans without having a direct influence on their lending standards (Leonnig, 2008).

Agents operating on behalf of financial institutions sold mortgages without establishing the financial position of the borrowers, relying instead on the appreciation of the housing asset to ensure repayments could be met out of capital gains. The Federal Reserve moved in July 2008 to establish rules to prevent mortgages being sold without verification of income, and financial assets to ensure repayment is possible without relying solely on the appreciation in the value of the house purchase. Other practices labeled as “unscrupulous” include the imposition of prepayment conditions that prevent a borrower from repaying the loan at a faster rate than scheduled, often on worse terms for subprime than for prime borrowers; these also will be regulated. The Fed has announced a new rule to provide protections for a newly defined category of “higher-priced mortgage loans” (Federal Reserve Board, 2008).

³⁵ A *New York Times* exposé of Countrywide Financial revealed that agents were offered incentives in the form of fees based on profits, not on the best interests of the borrowers.

³⁶ Mortgages lenders are not eligible for credit from the CRA, but banks that purchase loans made by mortgage brokers are eligible if the loans are extended to underrepresented communities.

These rules

- prohibit a lender from making a loan without regard to borrowers’ ability to repay the loan from income and assets other than the home’s value;
- require creditors to verify the income and assets they rely upon to determine repayment ability;
- ban any prepayment penalty if the payment can change in the initial four years; for other higher-priced loans, a prepayment penalty period cannot last for more than two years;
- require creditors to establish escrow accounts for property taxes and homeowner’s insurance for all first-lien mortgage loans.

The regulation of the U.S. mortgage market is set to improve with the new rules, but setting of “gold standards” for originators to match products (e.g., alternative mortgages) offered by the GSEs or minimum borrower standards would also help. If sellers were required to offer the alternative and see that minimum standards were met, it would help ensure that the selling of mortgages does not revert to previous bad practice. Similar regulations should be created for non-U.S. banks operating in other places to prevent the problems spreading to other countries.

Regulation of Off-Balance-Sheet Vehicles and Banks’ Obligations to Them. A further question for regulators is the extent to which banks should be allowed to avoid regulation by using off-balance-sheet vehicles to conduct business in structured finance products. In the United States, the Financial and Accounting Standards Board is reconsidering FASB Statement 140, which allows banks to transfer assets and liabilities to SPVs. The difficulty here is that under Basel I rules for capital adequacy requirements, banks are required to hold 8 percent of their capital against loans, while off-balance-sheet vehicles of banks—the SIVs and conduits—are not. This arrangement offers banks a clear incentive to minimize the capital requirements by creating off-balance-sheet vehicles to hold assets and make

loans because the regulatory hurdle is lower for off-balance-sheet vehicles. Under Basel II rules this anomaly will be removed; banks and their off-balance-sheet entities will be treated in much the same way, removing the incentive for banks to arbitrage the capital requirements. It is unfortunate that these rules were not in place in Europe until January 1, 2007; by then the SPVs, SIVs, and conduits had created or bought large pools of securitized mortgage products.³⁷ The danger with the separation of on-balance-sheet activities from those of vehicles that are off-balance sheet is that it creates a false picture of bank stability. When these off-balance-sheet institutions need funds, they turn to banks for liquidity. Requiring banks to reveal the extent of their liquidity commitments to off-balance-sheet vehicles—and the scale of their activities should these entities need to be brought back onto the balance sheet—would resolve the problem. The banking system as a whole was strong enough to take these entities onto its balance sheet in 2007-08, but the effect on the demand for liquidity seriously affected the operation of the money markets.

The Financial Stability Forum of the Bank for International Settlements (a committee of global regulators and supervisors) has proposed in a report “Enhancing Market and Institutional Resilience” (Bank for International Settlements, 2008) that rules should be changed to make the holding of asset-backed securities and CDOs more costly for banks. This will be accomplished by the following means: (i) raising capital requirements, under the Basel II capital adequacy rules, for complex structured finance vehicles; (ii) introducing additional requirements for warehoused assets on banks’ balance sheets awaiting sale; and (iii) strengthening the capital requirements for liquidity buffers offered to conduits by banks. This step is a welcome development, but as Wyplosz (2008) has pointed out, intrinsically where risk-taking is concerned, regulation can help squeeze risk out of a segment of the market, but it typically reappears elsewhere. When banks

are regulated, non-bank vehicles emerge to assume the risk in an unregulated environment, and if regulation is imposed on them, new means will be discovered to avoid the regulations. Financial markets have strong incentives to innovate, so the regulators need to invest more effort into awareness of the areas in which risk is being taken in pursuit of high returns to keep in step with the financial institutions they are regulating. This should be done without stifling the financial intermediation process altogether. One way that regulators can offer incentives to the markets is to require them to hold the riskiest segments (the equity tranches) of their structured finance products on their own books (Buiters, 2008a, de la Dehesa, 2008). Regulators need to evaluate the bigger picture at a level beyond the financial institution, because it is the externalities of excessive risk-taking that matter. Regulators need to ask questions about an institution’s own assessment of the risk being carried, but they also need to consider the systemic risks that arise when the actions of an individual bank impinge on other banks or the markets.³⁸

Regulation of Ratings Agencies. A third concern is the regulation of rating agencies. Ratings agencies have been subject to a great deal of criticism because their primary purpose is to evaluate the risks of the products or entities that they rate. They seem to have done badly in rating structured finance products, and the agencies themselves are reviewing their processes. A major worry is the potential conflict of interest they face because rating agencies are well rewarded for rating structured finance products. Buiters (2008a) and Portes (2008) have suggested that Chinese walls within organizations are not enough to prevent these conflicts of interest; they argue that ratings agencies should be single-product firms selling one thing: ratings. Incentives are only one reason why ratings agencies have not done a good job, and why they may need to be regulated. Another side of the story

³⁷ Basel II is yet to be implemented in the United States; therefore U.S. banks are still able to arbitrage the regulations on capital while their European counterparts cannot.

³⁸ A narrow definition of the regulators’ range is to protect the taxpayer from excessive risk-taking by financial institutions. A broader definition covers protection of the financial system, including payments, settlements, and even the reputation of the financial industry (when it constitutes a major economic sector).

is the extent to which the ratings agencies had models appropriate for rating structured finance products. The modeling exercises involved are formidable but even taking this into account, Giovanni and Spaventa (2008) note that the models for structured finance products were calibrated using short spans of data over a benign period of moderation in financial markets and rising house prices.³⁹ They simply had not experienced turbulence or falling house prices to evaluate whether the models might prove unreliable. These problems were compounded when rating CDOs and CDOs-squared because these products were given too much benefit for combining lower tranche residential MBSs, when in fact the default risks were more highly correlated than the models assumed and were prone to a common shock—a fall in house prices. Fundamentally, is a rating metric suitable for sovereign bonds, investment, and sub-investment-grade corporate bonds, or project finance also suitable for structured financial products? The International Organization of Securities Commissions (IOSCO) has suggested that agencies should introduce new ratings for mortgage-backed or structured finance products because of the perception that they behave differently than other financial instruments in times of stress.

Whether regulation should be extended to ratings agencies is not a new topic of debate, but the recent experience will mean it has a new lease of life. With its influence through the presidency of the European Union in 2008, France has encouraged the European Commission to propose that ratings agencies be registered and subject to greater regulation if they wish to operate in Europe. This follows the recommendation of IOSCO and the Financial Stability Forum. Ratings agencies have long argued that they publish their opinions, underpinned by their reputations, and the use to which they are put is not something for which

they are answerable. In the United States the SEC confers a “nationally recognized statistical rating agency” status on certain qualifying ratings agencies, allowing their ratings to be used for regulatory purposes by others, but it stops short of regulating their methodologies. This deters entry into the ratings business because ratings have value to the purchaser when they can be used to reduce capital; conferring this status on some agencies and not others creates barriers to entry. Similarly, Basel II makes provision for credit ratings agencies to be used to evaluate bank capital, and the same argument applies. Whether regulation should be extended to ratings agencies is a question that needs to be addressed, since at present there is no regulation of their procedures. The Financial Stability Forum, through the IOSCO, offers a code of conduct fundamentals for credit rating agencies that it recommends but does not require agencies to adopt.

Regulation and Stress Testing. A fourth issue concerns the evaluations of risk by banks themselves. A number of early warnings had signaled difficulties ahead for financial institutions under certain risk scenarios; for example, in London the supervisory agency of the United Kingdom, the Financial Services Authority, had been concerned for some time about complexity and liquidity of financial markets, stating in January 2007 that “Financial markets have become increasingly complex since the last financial stability crisis, which implies that transmission mechanisms for shocks have also become more complicated and possibly more rapid...It is still important for market participants to consider how they would operate in an environment where liquidity is restricted (Financial Services Authority, 2007). The Bank of England was even more direct in its Financial Stability Report, stating “Financial institutions can become more dependent on sustained market liquidity both to allow them to distribute the risks they originate or securitise and to allow them to adjust their portfolio and hedges in the face of movements in market prices. If it becomes impossible or expensive to find counterparties, financial institutions could be left holding unplanned credit risk exposures in their ‘warehouses’ awaiting

³⁹ In simple terms the ratings agencies assessed the probabilities of default for individual mortgages, considered the correlations between individual loans, used these to assess the probability of default for the securitized products, and then rated the tranches accordingly. Where they failed to calculate defaults correctly was in assessing the proper weight to be attached to falling house prices on the defaults of individual loans, the interdependence between loan defaults, and the likelihood of falling house prices occurring.

distribution or find it difficult to close out positions” (Bank of England, 2007). In other countries, similar cautions were sounded but despite these early signals, most investment and commercial banks regarded themselves as adequately protected against *likely* shocks based on their own stress testing evaluations.⁴⁰ Banks did not appear to heed these warnings because they thought they were sound.

The use of stress testing assumes new significance under Basel II terms. If banks can demonstrate that they are robust to a battery of shocks that might conceivably happen, then they can reduce the capital they are required to hold. As with ratings agencies, however, the modeling process should be subject to investigation. Northern Rock in Britain had received approval for a Basel II waiver on the basis of its internal stress testing processes on July 27, 2007, just six weeks before the bank run. This did not stop that bank’s shortage of funds as markets seized up. The nature of the models used and the range of stress tests that they must meet need careful scrutiny. Mark-to-model methodologies do not necessarily correspond well with reality, and the weakness of the underlying assumptions of the models becomes apparent when a crisis occurs. It is likely that stress tests conducted by banks to determine their resilience to liquidity shortages will need to be respecified to account for longer-lasting liquidity crises of the type experienced during 2007-08. The difficulty here lies in preparing for the next crisis, not the last one. By definition the nature of any future shock (or combination of shocks) likely to trouble the financial system is difficult to predict, and should be part of an ongoing research agenda. When knowledge of the types of shocks is difficult to determine, requiring more capital to be held as a buffer is the obvious solution.

Fair Value Accounting. This raises a further issue: How should institutions determine the capital to be held against assets? This is a question of accounting as much as regulation. Since 1998 the Financial Accounting Standards Board (FASB) in the U.S. *Statement of Financial Accounting Standard* (SFAS) No. 133, has required fair value accounting for derivatives, and European institutions followed suit since 2005. There is a general vision to have all financial instruments accounted for at fair values, and while it has the advantage of presenting current valuations on assets and liabilities of banks rather than historic cost valuations, it also has some negative implications. The main concern is that as asset prices decline, fair value accounting book losses associated with illiquid assets are immediately revealed and banks are then required to reduce leverage in order to meet capital ratios under BIS rules. The banks may not intend to sell the assets but their low current valuation—and the more illiquid the asset the more difficult it is to determine the accuracy of current valuations—may enforce it. Forced sales can drive prices down creating a vicious circle. In the present conditions current value of residential MBSs and CDOs may not be fair value at all. Some of these points have been addressed by the FASB through its three levels approach in reporting valuations. Level 1 has a market value from market inputs, Level 2 has some market inputs, and level 3 has none. These do not eliminate subjectivity of fair value prices but they do reveal where assumptions affect asset valuations. Another approach has been to reflect the intention of the asset holder: Hence, an asset holder can report financial assets at historic cost if they intend to hold them to maturity, but report them at fair value if they are either “available for sale,” in which case any variation in fair value bypasses the income statement and is applied directly to the firm’s equity, or “due to be traded,” in which case the variation is included in an income statement. Many institutions use an intents model but investment banks are an exception. Investment banks argue that opponents of fair accounting cannot have it both ways. Fair accounting cannot be opposed during financial crises but adopted

⁴⁰ It is interesting to note that opinions differed between banks: Goldman’s bank-wide risk committee reportedly forced the sale of most mortgage derivatives, believing them to be too risky, and Barclays also sold a fair share of these assets. Citi, UBS, and Merrill Lynch retained large holdings on the balance sheets, and these have been the institutions most affected by write downs and credit losses. Bear Stearns shed the assets into subsidiaries—hedge funds which were off balance sheet—and marketed the shares in these funds aggressively.

at other times. There is a need for consistency. They also argue that when the current market valuation is low there will be a buyer at that price seeking value, and should the bank choose not to sell, it stands to gain if assets subsequently appreciate. The problem for commercial banks is that they must maintain capital ratios to comply with regulatory requirements, and therefore at times have little choice whether to hold or sell. This is particularly acute when many assets markets experience falling current valuations simultaneously.

It has been suggested that the lack of coordination between regulators has been detrimental to effective regulation in all these areas. In Europe in particular the different stance taken by national regulators did not ensure that financial institutions were well regulated. Similar problems had emerged in regulation in the United States, where a combination of federal and state-level regulation did not provide a consistent response to changing practices of financial institutions. Buitier (2008a) calls for a Europe-wide regulator to avoid the intercountry differences in the approach toward regulation of structured finance. International efforts to coordinate regulatory practice are bound to be helpful, coordinated by the Financial Stability Forum of the Bank for International Settlements. Goodhart (2008b) also endorses co-ordinated action within countries and across international borders and covers topics that have not been discussed in detail here. These include deposit insurance schemes; bank insolvency regimes often also referred to as “prompt corrective action”; and the inherent procyclicality of capital adequacy requirements under Basel II with the difficulties it creates when bank crises occur. Clearly, many changes will need to be implemented in regulation and supervision in light of the 2007-08 credit crunch.

CONCLUSION

This paper has argued that a number of factors provided conducive conditions for a credit crunch. First, there was a period of exceptional stability with very low long-term interest rates supported by the global savings glut flowing from emerging

industrialized economies. Second, financial innovation had developed well-understood financial products such as MBSs and introduced greater complexity, higher leverage, and weaker underlying assets based on subprime mortgages. Third, no one anticipated that house prices would fall nationwide in the United States—these conditions were not built into the models used to assess risk—but house prices did fall and when they did so defaults increased in the subprime sector, which proved a trigger for the crisis as investors reappraised the risks associated with the high-yielding residential MBSs and CDOs composed of these assets. Any number of other high-yield asset markets might have provided the trigger for the 2007-08 credit crunch, including hedge funds, private equity, and emerging market equities; it just happened to be the subprime crisis that occurred first. The failure of a number of banks then spurred a reaction in the markets for short-term paper and banks of all kinds withdrew from lending in money markets. The authorities decided to act to provide liquidity to the markets and funding liquidity for failing banks such as Northern Rock, Bear Stearns, and government-sponsored enterprises. Central banks handled the crisis well from the perspective of providing liquidity to the markets, but spreads remain larger than before the crunch. They did less well in providing funding liquidity for failing institutions and the consequences of these actions for the taxpayer that are unquantifiable at this stage. Finally, regulation and supervision needs to be enhanced in the face of rapid financial innovation—the scope of regulation will need to increase to ensure systemic risks are minimized in the future.

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