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During Ted Balbach's Tenure as Research Director**

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Monetary Economic Research at the St. Louis Fed During Ted Balbach's Tenure as Research Director

Michael D. Bordo and Anna J. Schwartz

Ted Balbach served as research director at the Federal Reserve Bank of St. Louis from 1975 to 1992. This paper lauds his contributions during that time, including the expanded influence of the *Review*, enhanced databases and data publications, and a visiting scholar program that attracted leading economists from around the world. Balbach is remembered fondly as a visionary leader and gracious mentor.

Federal Reserve Bank of St. Louis *Review*, September/October 2008, 90(5), pp. 499-504.

BACKGROUND

The monetarist movement took shape in the 1960s. The name gained usage and became trite. Basically, its adherents believed in the quantity theory of money, but in 1968 Karl Brunner named them monetarists. In today's terminology, the movement would be viewed as a network of young economists who shared the belief that the quantity of money was an important variable with explanatory power for the price level and cyclical fluctuations in economic activity.¹

Graduate students in economics became members of a club that had two branches. One consisted of students of Brunner at UCLA. Ted Balbach was a member of this branch. The other branch centered on students of Milton Friedman, particularly members of the Money Workshop at

the University of Chicago and also some who worked on the money and business cycle project at the New York headquarters of the National Bureau of Economic Research.

The two branches shared a common interest in two organizations that bridged their separate memberships. One was the Shadow Open Market Committee (SOMC), formed in 1973 under the aegis of Brunner and Allan Meltzer to advocate improved monetary policy, particularly urging the Fed to act decisively to reduce inflation, which had been accelerating since 1965 absent persistent action to tighten. Members of the SOMC, presumably individuals with monetarist leanings, came from wider backgrounds than those of the two branches. The other organization that bridged the membership of the two branches was the Federal Reserve Bank of St. Louis, which was distinguished as the first bank in the System to be headed by a president who expressed monetarist views and that had a research program (headed by Homer Jones) that featured topics of importance to monetarists. After he retired as research director of the St. Louis Fed, Jones joined the SOMC.

¹ Other elements of monetarism included (i) the view that inflation was everywhere and always a monetary phenomenon; (ii) that the Phillips curve was vertical; (iii) the importance of monetary rules, such as Friedman's constant monetary growth rule, instead of discretion; (iv) a critique of fine tuning; and (v) the dominance of monetary over fiscal policy (Friedman, 1960, 1968; Brunner, 1968; and Stein, 1976).

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One example of the links between Ted at the St. Louis Fed and the SOMC is that the St. Louis commercial bank that employed Ted's wife, Rachel, paid the expenses for her semiannual trip to New York to attend SOMC meetings and report the issues that had been discussed.

We have now set the stage for Ted Balbach's appointment as the St. Louis Fed director of research in 1975. The backdrop was the struggle by leaders of the monetarist movement to uphold propositions about the relation between money and economic variables such as income, prices, and interest rates that Keynesians of that time and earlier denied. Mainstream views (especially in the Federal Reserve System) were predominantly those of Keynesians.

In the period before 1975, research activities at St. Louis had a significant influence on the debates between monetarists and Keynesians. It was exciting for monetarists to score a victory by a St. Louis research product proving a point over a contrary Keynesian position. One such episode occurred in the dispute about the importance of fiscal policy versus monetary policy for economic stabilization. The Keynesian stand was that both mattered. The monetarist position was that only money mattered. The 1968 St. Louis Fed study by Leonall Andersen and Jerry Jordan provided strong support for the monetarist position. According to their data, the response of economic activity from 1952 to 1968 was larger, more predictable, and faster for money than for the fiscal variables of budget cuts or tax changes. The result brought joy to the monetarist camp, although Keynesians were unimpressed by a single-equation triumph—only the result of a multi-equation general equilibrium model could provide credible evidence.

By the time Ted Balbach began managing research, the conflict with Keynesians had lost some of its adversarial ardor in the academic world (although perhaps less so in the Fed). And by the 1980s the Keynesian approach began to shift, becoming more inclusive of monetarist views, especially with regard to inflation as fundamentally a monetary phenomenon. Thereafter, research at St. Louis could concentrate on scholarly issues unrelated to the divisiveness of the earlier conflict.

RESEARCH AT THE ST. LOUIS FED

1967 to 1975

Ted Balbach extended the research program begun by Homer Jones. Leonall Andersen and Jerry Jordan served as research directors between Homer's retirement in 1972 and Ted's appointment in 1975. The chief accomplishments in this period were these: First, the Federal Reserve Bank of St. Louis *Review* developed into a major publication that influenced policymakers and economists in the Fed and other central banks and led notable academics to write for it (see the names listed in the next subsection). Second, a special feature of the *Review* was the attention paid to measurement of the monetary base and other aggregates and also to problems created by System policies, such as lagged reserve requirements for member banks. Data series on monetary aggregates and other variables became essential for serious research on money and the macroeconomy. Third, establishment of a visiting scholars program exposed the bank staff to and allowed them to be influenced by ideas from academia and other central banks and also spread the message of the St. Louis Fed to a wider audience.

The *Review*. The *Review* contained articles on various aspects of monetary economics: monetary policy, money stock determinants, the transmission mechanism, international money, the demand for money, inflation, gold and the balance of payments, monetarism, and monetary versus fiscal policy. The key authors in this period were research staff members: Leonall Andersen, Norm Bowsher, Albert Burger, Keith Carlson, Alton Gilbert, Jerry Jordan, Dennis Karnosky, Michael Keran, Cliff Luttrell, Charlotte Ruebling, Roger Spencer, James Turley, and Ted Balbach.

In addition to articles written by the research staff, several important articles were contributed by scholars in the monetarist camp, including Karl Brunner, David Fand, Milton Friedman, Phil Gramm, Harry Johnson, James Meigs, Allan Meltzer, and Bob Rasche; other important scholars also wrote for the *Review*, giving it a broader coverage. These included Gerry Dwyer, William Gibson, Patric Hendershott, Lawrence Klein, John

Pippenger, Ronald Teigen, Murray Weidenbaum, and William Yohe. The views of senior Fed officials, including Andrew Brimmer, Arthur Burns, Darryl Francis, and Robert Solomon, appeared in various issues.

Data. The public distribution of financial data began on Homer Jones's watch. He first developed the weekly *U.S. Financial Data*, which showed the levels of selected monetary aggregates and their growth rates over various ranges (the famous triangles) as well as other financial data. Jones then started the monthly *Monetary Trends* and *National Economic Trends* publications. The data therein were widely used by the public and within the Federal Reserve System for policy analysis (Poole, 2006).

Visiting Scholars. A visiting scholars program was introduced in the few years before 1975. Many leading academics in the monetarist camp visited the Bank, lectured, and, as noted above, published articles in the *Review*. These included Karl Brunner, Milton Friedman, and Allan Meltzer. A number of scholars from Germany also visited the Bank in these years, including Wolfgang Schmitz, Dieter Hoffman, and Manfred Willms. Scholars from Mexico, Spain, and England also visited. This program preceded the future development of formal links to the hard currency central banks of Switzerland and Austria.

1975 to 1992: Ted Balbach's Term

On Ted's watch all aspects of the program inherited from Homer Jones were greatly expanded, and he added a number of programs of his own design.

The Review. The scope of the *Review* broadened greatly under Ted's tutelage. The key monetarist themes remained and were extended. Articles investigated the money supply, money demand, monetarism, inflation, the transmission mechanism of monetary policy, international money, and the balance of payments and exchange rates. These article explored new subjects reflecting changes in the United States and global economies and discoveries of monetary and macroeconomic research. These included fiscal deficits, real interest rates, energy, supply shocks,

productivity, economic growth, financial markets, financial innovation, forward exchange markets, real exchange rates, bank failures, rational expectations, tax reform, protectionism, payments system risk, the gold standard, Bretton Woods, and globalization.

Reflecting an expansion of the Research Department, the list of research staff authors expanded. Among new authors were Rae Balbach, Dallas Batten, Michael Belongia, Donald Brown, James Bullard, Alison Butler, Claudia Campbell, Cletus Coughlin, Michael Dueker, Michelle Garfinkel, Rik Hafer, Scott Hein, Steve Holland, Nancy Jianakopolos, Donald Kemp, Kevin Kliesen, Richard Lang, Douglas Mudd, Christopher Neely, Philip Nuetzel, Mack Ott, Michael Pakko, David Resler, Steve Russell, Gary Santoni, Neil Stevens, Courtenay Stone, Jack Tatom, Daniel Thornton, Michael Trebing, Jai-Hoon Yang, and Adam Zaretsky.

Leading academics also contributed important articles, many of them delivered as the Homer Jones Memorial Lecture, a series inaugurated by Ted in 1987. Among the lecturers were Karl Brunner, David Laidler, Allan Meltzer, Anna Schwartz, and Beryl Sprinkel. Many visiting scholars (see Table 1) contributed *Review* articles on diverse subjects.

The *Review*, which was widely and freely disseminated around the world, influenced readers behind the Iron Curtain in the 1970s. According to Jerry Jordan, Václav Havel cited the importance of the *Review*, because it was free and uncensored, in influencing the development of his free-market views hence contributing to the Velvet Revolution in Czechoslovakia.

Ted started the Annual Economic Policy Conference in 1976. This annual series of conferences brought leading economists from around the United States and world to discuss pressing topics of the day in economic policy. The seventeen conference subjects selected during Ted's tenure had such titles as *Financing Economic Growth: The Problems of Capital Formation; Stabilization Policies; The Supply-Side Effects of Economic Policy; The Monetary versus Fiscal Policy Debate; and How Open Is the U.S. Economy?* Many of the conferences were published in the

Table 1**Visiting Scholars During Ted Balbach's Tenure**

Byung Chan Ahn, <i>Bank of Korea</i>	Fernando Méndez Ibisate, <i>Universidad Complutense de Madrid</i>
Rachel Balbach, <i>Boatman's Bank</i>	Laurence H. Meyer, <i>Washington University in St. Louis</i>
Peter Bofinger, <i>Landeszentralbank, Baden-Württemberg</i>	Dewet Moser, <i>Swiss National Bank</i>
Michael D. Bordo, <i>University of South Carolina; Rutgers University</i>	Manfred J.M. Neumann, <i>University of Bonn</i>
K. Alec Chrystal, <i>City University of London</i>	Seonghwan Oh, <i>University of California–Los Angeles</i>
Alex Cukierman, <i>Tel Aviv University</i>	Sanghyun Park, <i>Federal Reserve Bank of New York</i>
Lawrence S. Davidson, <i>Indiana University</i>	Alex Pollock, <i>American Enterprise Institute for Public Policy Research</i>
José Luis De Molina, <i>Banco de España</i>	Dieter Proske, <i>Austrian National Bank</i>
Kevin Dowd, <i>University of Nottingham</i>	Carlos Quiroz, <i>Banco Central do Brasil</i>
Dean S. Dutton, <i>Brigham Young University</i>	Robert H. Rasche, <i>Michigan State University</i>
Gerald P. Dwyer Jr., <i>Clemson University</i>	Ronald A. Ratti, <i>University of Missouri–Columbia</i>
Salam K. Fayyad, <i>Yarmouk University</i> (current Prime Minister of the Palestinian Authority)	Tobias Rötheli, <i>Swiss National Bank</i>
Steven M. Fazzari, <i>Washington University in St. Louis</i>	Zalman F. Shiffer, <i>Bank of Israel</i>
Robert Fluri, <i>Swiss National Bank</i>	Courtenay C. Stone, <i>California State University–Northridge</i>
Joel Fried, <i>University of Western Ontario</i>	Philip Stork, <i>Maastricht University</i>
Werner Hermann, <i>Swiss National Bank</i>	Paul T.W.M. Veugelers, <i>Erasmus University Rotterdam</i>
Donald Hooks, <i>University of Alabama</i>	Jürgen von Hagen, <i>University of Bonn</i>
George Hubmer, <i>Austrian National Bank</i>	Patrick J. Welch, <i>Saint Louis University</i>
Dennis W. Jansen, <i>Texas A&M University</i>	David C. Wheelock, <i>University of Texas, Austin</i>
John W. Keating, <i>Washington University in St. Louis</i>	Geoffrey Wood, <i>City University of London</i>
Byun Ki-Sook, <i>Bank of Korea</i>	Piyu Yue, <i>University of Texas</i>
Levis A. Kochin, <i>University of Washington</i>	Mathias Zurlinden, <i>Swiss National Bank</i>
Kees G. Koedijk, <i>Erasmus University Rotterdam; Maastricht University</i>	
Clemens J.M. Kool, <i>Erasmus University Rotterdam; Maastricht University; Utrecht University</i>	

Review, a few in a book series by Kluwer. The authors included such luminaries as Alan Blinder, Richard Cooper, Jacob Frenkel, Ben Friedman, Ben McCallum, Rick Mishkin, Bill Poole, Larry Summers, and John Taylor.

Data. Under Ted, databases and data publications were expanded. He started *International Economic Trends* in 1978 and the St. Louis Fed's online database FRED (Federal Reserve Economic Data) in 1991. The latter has been greatly expanded over the years and is very widely used.

Visiting Scholar Program. The visiting scholar program burgeoned under Ted. Over 40 scholars from around the world were numbered among the visitors to the Bank. (See Table 1.) Most stayed at the Bank for six months to a year, interacting with the staff and writing articles for the *Review*.

Other Activities. As noted, Ted designed annual policy conferences beginning in 1976, in collaboration with the Center for American Business and Enterprise at Washington University.

He also instituted the annual Homer Jones Memorial Lecture Series mentioned earlier, with the support of local universities and the local National Association for Business Economics.

Ted also engaged in considerable outreach activities with other “monetarist” central banks. He started a formal exchange program with the Swiss and Austrian national central banks as well as an ongoing informal collaboration with the Bundesbank and the Bank of England. Numerous researchers from these central banks came to St. Louis. In return, a number of the Bank’s staff economists were sent to various central banks for extended visits.

Ted usually attended the Konstanz (started in 1970) and Carnegie Rochester (started in 1973) conferences. Sometimes he delegated other researchers to attend these conferences. Ted also sent staff economists to New York and Washington to get firsthand knowledge about how the Open Market Desk worked and to interact with people at the Board. Some of the senior staff were allowed to attend Federal Open Market Committee meetings.

Other Contributions by Ted Balbach²

Ted contributed to research at St. Louis in a number of intangible ways and strengthened its position as the premier Research Department of the Reserve Banks of the Federal Reserve System. He was an excellent mentor to the staff and visiting scholars. His role was to encourage research and prod people to do it better in a timely manner. His most important and persistent demand from researchers was presentation and tests of hypotheses with clarity and simplification. He stressed the importance of communication, especially to policymakers and financial market participants. Ted read and commented on every article published in the *Review*.

CONCLUSION

The present status of the *Review* is a tribute to Ted’s vision of what it could become. All in all,

² For help with this and the preceding section, we thank Jack Tatom, Dave Wheelock, and Bob Rasche.

while Balbach was in charge, the *Review* was a stimulating publication. It is fitting that we honor him for his service.

Ted was the counselor to four presidents of the Federal Reserve Bank of St. Louis (Francis, Roos, Roberts, and Melzer), the latter three having little monetary policy background. He inspired the presidents he served to uphold the principles of price stability and, toward this objective, the control of monetary aggregates.³ In the era of the Great Inflation and its aftermath, his defense of these principles was not the standard view it has become since.

In the debriefings to the staff after FOMC meetings that Ted attended, he reviewed the discussion in detail. According to those present, he had an excellent and often very humorous grasp on the issues, including the dynamics of the discussion and the inconsistencies in the remarks and votes of the participants.

Ted was a networker par excellence. He knew everybody and everything that was going on in the world of monetarism and monetary policy in the United States and Europe. He facilitated useful communication in the profession. Were he of this generation, he would be an avid user of Facebook and YouTube.

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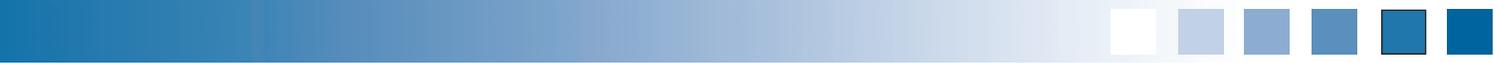
³ According to Jerry Jordan, the Board of Governors brought these men (who had no prior monetarist leanings) to St. Louis in an attempt to counteract its monetarist orientation. Ted, according to Jordan, instructed them well and convinced them of the importance of “sound money.”

Bordo and Schwartz

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Oil and the U.S. Macroeconomy: An Update and a Simple Forecasting Exercise

Kevin L. Kliesen

Some analysts and economists recently warned that the U.S. economy faces a much higher risk of recession should the price of oil rise to \$100 per barrel or more. In February 2008, spot crude oil prices closed above \$100 per barrel for the first time ever, and since then they have climbed even higher. Meanwhile, according to some surveys of economists, it is highly probable that a recession began in the United States in late 2007 or early 2008. Although the findings in this paper are consistent with the view that the U.S. economy has become much less sensitive to large changes in oil prices, a simple forecasting exercise using Hamilton's model augmented with the first principal component of 85 macroeconomic variables reveals that a permanent increase in the price of crude oil to \$150 per barrel by the end of 2008 could have a significant negative effect on the growth rate of real gross domestic product in the short run. Moreover, the model also predicts that such an increase in oil prices would produce much higher overall and core inflation rates in 2009 than most policymakers expect. (JEL E37, E66, Q43)

Federal Reserve Bank of St. Louis *Review*, September/October 2008, 90(5), pp. 505-16.

In December 2001, the spot price of West Texas Intermediate (WTI) crude oil averaged \$19.33 per barrel. Shortly thereafter, oil prices started to trend higher. After a brief decline from \$74 per barrel in July 2006 to about \$55 per barrel in January 2007, oil prices then resumed their upward trajectory. They surpassed \$90 per barrel in October 2007. Meanwhile, participants and traders in the crude oil futures market did not foresee the sharp rise in prices. However, some economists and energy analysts correctly expected the price of crude oil to eventually rise to \$100 per barrel or more, and crude oil prices eventually closed above \$100 per barrel on February 19 this year for the first time ever.¹ Some of these analysts also predicted that \$100-per-barrel crude oil would cause the

U.S. economy to fall into a recession. Since then, spot WTI prices have risen to more than \$130 per barrel, and officials from the Organization of the Petroleum Exporting Countries and some financial market participants have recently predicted that oil prices could eventually reach \$200 per barrel.²

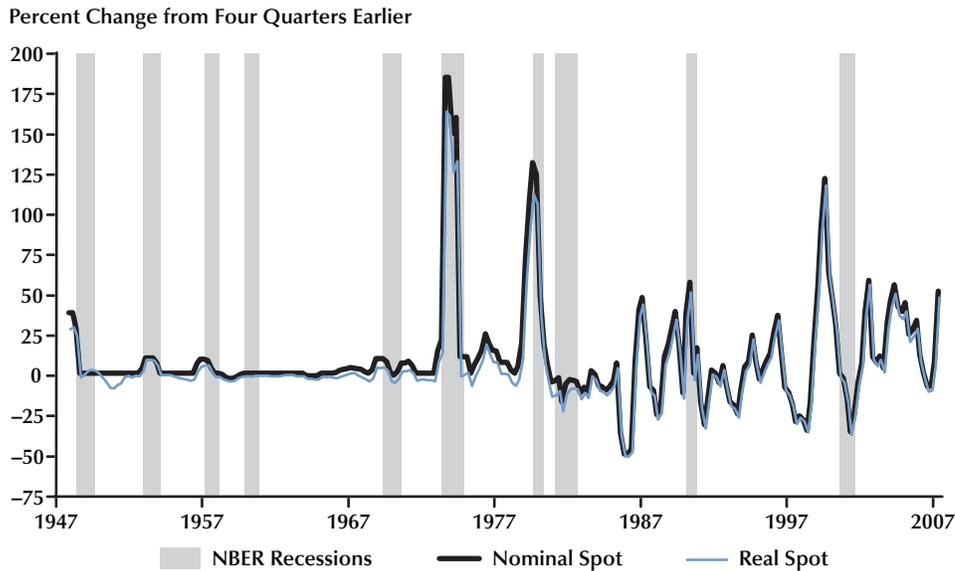
Some recent research suggests that the economy responds differently to an oil price shock, depending on the initial prevailing macroeconomic conditions and, moreover, whether the oil price increase is (i) moderate and steady, as occurred from 2003 to 2006, or (ii) rapid and large, as occurred since 2007. Moreover, small time-series models may capture the aggregate economic effects of large oil price increases over relatively

¹ See Greenspan (2007), King and Chazan (2007), and Verleger (2007).

² See Hoyos (2008). Alternatively, Brown, Virmani, and Alm (2008) contend that oil prices are not likely to remain above \$100 per barrel (in 2008 dollars) unless there is a significant supply shock.

Kevin L. Kliesen is an associate economist in the Research Division of the Federal Reserve Bank of St. Louis. The author thanks Cletus C. Coughlin and Yi Wen for comments. Joshua A. Byrge provided research assistance.

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Figure 1**Real and Nominal Changes in Spot Oil Prices**

NOTE: NBER, National Bureau of Economic Research.

short periods better than large structural models (Huntington, 2005). Using an augmented model proposed by Hamilton (2003), this article will show that a permanent increase in the spot price of crude oil to either \$100 or \$150 per barrel would cause a modest slowing in real GDP growth and its major components relative to a baseline forecast without oil prices. This result could be important given the relatively weak growth over the first half of 2008. Moreover, this model also predicts that an increase in the spot price of crude oil to \$150 per barrel will cause both overall and core inflation rates to rise to 4 percent in 2009. This inflation forecast is well above the expectations of Federal Reserve policymakers in early 2008.

OIL AND MACROECONOMIC ACTIVITY: A SHORT REVIEW

Figure 1 shows that nearly all post-World War II recessions in the United States were preceded by, or accompanied by, an increase in oil

prices.³ Accordingly, oil price shocks tend to be viewed with alarm by forecasters, macroeconomists, financial market participants, and public policymakers.⁴ An oil price shock is typically a large, unexpected increase in the relative price of energy that affects the economic decisions of firms and households.⁵ Moreover, higher oil prices engender direct and indirect (second-order) effects that vary in magnitude across time. In the short run, the price elasticities of the supply and demand for oil are likely very low because firms and consumers find it difficult to change their energy consumption habits immediately and new sources of oil or alternative sources of energy are

³ The behavior of oil prices was decidedly different before the 1970s. According to Hamilton (1985), changes in U.S. crude oil prices prior to the 1970s were influenced importantly by decisions of the Texas Railroad Commission, a state regulatory agency that actively sought to control the production of Texas crude oil. As a result, domestic oil prices were remarkably stable during this period.

⁴ See Bernanke (2004).

⁵ See Jones, Leiby, and Paik (2004) and Hamilton (2005) for a survey of the oil-macroeconomy literature.

not immediately available. Over the longer term, these price elasticities increase. Higher prices not only spur producers to seek new sources of crude oil, but also provide important incentives to conserve energy and increase the production of alternative energy sources.

An oil price increase may lower real gross domestic product (GDP) growth through other channels. First, higher prices raise uncertainty about future oil prices and thus cause delays in business investment (e.g., Bernanke, 1983, and Pindyck, 1991). Guo and Kliesen (2005), for example, find that increased oil price volatility from 1984 to 2004 had a significant effect on key measures of U.S. macroeconomic activity, such as business capital spending. Second, oil price changes induce resource reallocation, and such reallocation is costly (e.g., Lilien, 1982, Davis and Haltiwanger, 2001, and Lee and Ni, 2002). Not surprisingly, the large, sustained increase in oil prices since 2007 that has pushed the national average price of gasoline past \$4 per gallon has precipitated some potentially long-term resource reallocation in the automotive industry. Currently, automotive manufacturers are actively engaged in the design and production of hybrid vehicles or vehicles that run on biofuels or alternative fuels, such as hydrogen. This entails various changes: for example, the design of new components, including lithium batteries and drive trains, and the training of automotive technicians accustomed to working solely on internal combustion engines.

The link between oil price changes and economic activity is complicated by other factors, such as economic growth and the influence of domestic monetary policymakers.⁶ For example, Huntington (2005) argues that oil price shocks that occur after a period of low inflation and low interest rates are less likely to cause a recession or a significant slowing of real GDP than if the prior economic conditions were high inflation and high interest rates. According to Barsky and Kilian (2004), the link between higher oil prices and weaker economic growth is complicated by the endogeneity of oil prices. This view holds

that demand shocks, rather than supply shocks, have been the dominant factors explaining higher oil prices. In a similar vein, Aguiar-Conraria and Wen (2007) study the demand channel of oil shocks during the 1970s.

Estimates of the short-run macroeconomic effects of higher oil prices on real GDP growth vary. According to a 2005 survey of several macroeconomic models reported by Huntington, a \$10-per-barrel increase in the price of oil is expected to reduce output in the United States by about 0.25 percentage points in the first year and about 0.5 percentage points in the second year (relative to a baseline forecast).⁷ A study published by the International Monetary Fund (IMF) in December 2000 (Robinson et al.) showed that a permanent \$5-per-barrel increase in the price of oil would reduce world real GDP growth by about 0.25 percentage points per year over the first four years; the effect on U.S. real GDP growth over the same period was slightly larger than 0.3 percentage points per year.⁸ Similar results were found for models used by the Federal Reserve (MULTIMOD), the Organisation for Economic Co-operation and Development (INTERLINK), and the Brookings Institution (McKibbin-Sachs Global model).

The Effects of Oil Price Changes on Output and Inflation Since 1970

A rough approximation of the potential effects of higher oil prices on real GDP growth and inflation can be derived with the simple model used by Hamilton (2003):

$$(1) \Delta \ln(y_t) = \alpha + \sum_{i=1}^4 [\beta_i \Delta \ln(y_{t-i}) + \delta_i \Delta \ln(x_{t-i})] + e_t.$$

In this analysis, y_t is a measure of the log change in real GDP at an annual rate.⁹ The oil

⁶ Regarding the latter, see, among others, Bernanke et al. (1997), Leduc and Sill (2004), and Hamilton and Herrera (2004).

⁷ These models assume a constant price elasticity in the short term because of the limited ability to substitute away from oil as an energy source.

⁸ The IMF used the average price of Brent (United Kingdom), Dubai, and WTI grades. In November 2000, this reference price averaged about \$32 per barrel according to the IMF.

⁹ Hamilton originally used the log change in real GDP at a quarterly rate.

price change, x_t , is the price of crude oil transformed according to Hamilton (2003).¹⁰ Hamilton showed that an asymmetric measure of oil prices helps explain real GDP growth. He also showed that the sum of the coefficients on the lagged values of the net oil price (NOP) measure was highly significant, even though some of the individual coefficients were not. Hamilton's measure of the NOP is constructed as follows: The current-quarter price of oil is compared with the maximum price over the previous 12 quarters. If the percentage difference is positive, that observation is used; but if the percentage difference is negative, that month's observation is set to zero. For example, in the fourth quarter of 2007 (December 2007), the spot price of WTI crude oil was \$91.73 per barrel. Over the previous 12 quarters (2004:Q4–2007:Q3), the maximum crude oil price was \$79.93 per barrel, a difference of 14.8 percent. If the price of WTI was \$79.93 per barrel or less in 2007:Q4 (producing a zero or negative percentage change), the observation for that quarter would have been set to equal zero. Thus, in the Hamilton framework, only energy price *increases* matter; energy price decreases do not matter.

Table 1 shows regression results of the above equation and three alternative specifications. The sample period is 1970:Q1–2007:Q4. The analysis begins in 1970:Q1 because, as is evident from the discussion of Figure 1, oil prices were relatively stable before 1970. Accordingly, a large percentage of observations for the Hamilton NOP variable are zeroes before 1970. Second, all of the major oil price shocks have occurred since 1973.

Regression (1) in Table 1 reports results from a model that predicts future real GDP growth using lagged growth rates. Although this simple AR(4) model is commonly used to predict future GDP growth, the adjusted R^2 is quite low, 0.06. Regression (2) is equivalent to equation (1) at the beginning of this section. Adding the NOP variable doubles the explanatory power of the model, as the adjusted R^2 rises to 0.12. Interestingly, adding

the NOP variable renders insignificant the first and second lags of real GDP growth, which were significant in regression (1).

In Table 1, regressions (3) and (4) extend Hamilton's model by adding the Chicago Fed National Activity Index (CFNAI), z_t :

$$(2) \quad \Delta \ln(y_t) = \alpha + \sum_{i=1}^4 [\beta_i \Delta \ln(y_{t-i}) + \delta_i \Delta \ln(x_{t-i})] + \sum_{i=0}^1 \gamma_i z_{t-i} + e_t.$$

The CFNAI is the first principal component, or common factor, of 85 monthly indicators of real economic activity.¹¹ Much empirical research has shown that principal components can significantly improve the forecasting performance of major macroeconomic variables such as real GDP growth and inflation.¹² This result is reinforced in regressions (3) and (4) in Table 1. Adding the contemporaneous and lagged value of the CFNAI (z_t and z_{t-1}) to both the AR(4) model and Hamilton's equation (equation (2)) shows that the CFNAI is highly significant.¹³ In addition, the first and second lags of NOP are now also highly significant. As a result, the explanatory power of regressions (3) and (4) is significantly larger than for regressions (1) and (2). Adding the CFNAI reduces the sum of the NOP coefficients from -0.19 in regression (2) to -0.09 in regression (4).

A further extension of Hamilton's analysis can be seen in Table 2. In this case, the analysis examines whether the NOP variable helps to predict the growth of real GDP—and, separately, its major components—and inflation (log change) using four separate price measures. The inflation series are based on the overall price indices measured by the consumer price index (CPI) and the

¹⁰ This analysis uses the spot price of WTI crude oil. Hamilton (2003) used the producer price index for crude petroleum. The quarterly value is not the *average* of the monthly observations (e.g., January, February, and March), but instead it is the last *month* of the quarter (March, June, September, December).

¹¹ See the "CFNAI Background Release" (www.chicagofed.org/economic_research_and_data/files/cfnai_background.pdf) and "CFNAI Technical Report" (www.chicagofed.org/economic_research_and_data/files/cfnai_technical_report.pdf) on the Federal Reserve Bank of Chicago web site.

¹² See Gavin and Kliesen (2008) and references cited therein.

¹³ The second, third, and fourth lags of CFNAI were dropped because they were not significant.

Table 1

Predicting Real GDP Growth (y_t) Using Lagged Real GDP Growth, Oil Prices (x_t), and the Chicago Fed National Activity Index, z_t

	(1)	(2)	(3)	(4)
Constant	1.90*** (0.45)	2.91*** (0.52)	4.84*** (0.45)	5.33*** (0.48)
y_{t-1}	0.22*** (0.08)	0.14 (0.08)	-0.26*** (0.08)	-0.31*** (0.08)
y_{t-2}	0.14* (0.08)	0.08 (0.08)	-0.13** (0.06)	-0.15** (0.06)
y_{t-3}	0.00 (0.08)	-0.01 (0.08)	-0.17*** (0.06)	-0.16*** (0.06)
y_{t-4}	0.01 (0.08)	0.00 (0.08)	-0.06 (0.06)	-0.06 (0.06)
x_{t-1}		-0.04 (0.03)		-0.04** (0.02)
x_{t-2}		-0.07** (0.03)		-0.06*** (0.02)
x_{t-3}		-0.03 (0.03)		0.01 (0.02)
x_{t-4}		-0.05* (0.03)		0.00 (0.02)
z_t			2.62*** (0.28)	2.48*** (0.29)
z_{t-1}			1.33*** (0.40)	1.53*** (0.40)
Adj. R^2	0.06	0.12	0.55	0.58
DW	2.00	2.00	1.99	2.03

NOTE: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. DW, Durbin-Watson. The sample period is 1970:Q1–2007:Q4. Standard errors are shown in parentheses.

personal consumption expenditures (PCE) price index (PCEPI), as well as their respective “core” measures that exclude food and energy prices. The empirical results reported in Table 2 are based on equation (2) above. However, instead of reporting each of the coefficients (and their statistical significance) of the independent variables (including the CFNAI terms), Table 2 reports only the sum of the coefficients on the lagged NOP terms for each expenditure category. The GDP expenditure categories and price variables thus become, separately, the y_t terms. Each row in Table 2 also shows an F -statistic to determine the significance of the sum of the coefficients on

NOP variables. In addition to the entire sample period (from 1970:Q1–2007:Q4), Table 2 also shows results for three subperiods: 1970:Q1–1982:Q4, 1983:Q1–1994:Q4, and 1995:Q1–2007:Q4. The partition of the second and third periods reflects, respectively, the onset of the Great Moderation and the acceleration in trend productivity growth.¹⁴

Effects on Output. Table 2 shows that energy price increases significantly help to predict real GDP growth and most of its components. However, the size of this effect varies across

¹⁴ See Anderson and Kliesen (2006).

Table 2

**Do Changes in Oil Prices Matter for the Real Economy?
Subset F-Test on Lags of Hamilton's 12-Quarter Oil Shock Variable**

Variable	1970-2007			1970-1982			1983-1994			1995-2007		
	Sum of NOP coefficients	F-statistic	p-Value	Sum of NOP coefficients	F-statistic	p-Value	Sum of NOP coefficients	F-statistic	p-Value	Sum of NOP coefficients	F-statistic	p-Value
Expenditures												
Real GDP	-0.0917	872.4***	0.0000	-0.0603	269.5***	0.0000	-0.0047	193.4***	0.0000	-0.1327	224.8***	0.0000
PCE	-0.0668	941.6***	0.0000	-0.0287	344.6***	0.0000	-0.1869	133.0***	0.0000	-0.1074	263.8***	0.0000
Fixed investment	-0.1375	146.2***	0.0000	-0.1673	71.0***	0.0000	0.0301	9.0***	0.0048	-0.2649	30.1***	0.0000
Business investment	-0.0186	97.7***	0.0000	-0.0080	54.1***	0.0000	0.1368	4.5**	0.0401	-0.1686	22.9***	0.0000
Structures	-0.0106	34.5***	0.0000	-0.0452	28.9***	0.0000	-0.2054	3.4*	0.0720	0.0601	4.1**	0.0493
Equipment and software	-0.0322	79.0***	0.0000	-0.0170	55.3***	0.0000	0.3017	2.0	0.1615	-0.3281	23.1***	0.0000
Residential	-0.2304	38.3***	0.0000	-0.3473	12.2***	0.0012	-0.1667	8.0***	0.0076	-0.1540	11.6***	0.0015
Exports	0.2732	20.5***	0.0000	0.3967	4.3**	0.0448	0.3828	3.5*	0.0709	0.0412	8.9***	0.0048
Imports	-0.2704	54.7***	0.0000	-0.3738	17.9***	0.0001	0.4623	1.7	0.2022	-0.4657	43.4***	0.0000
Prices												
CPI	0.0386	1,028.7***	0.0000	0.0405	459.4***	0.0000	0.0227	121.9***	0.0000	0.1830	97.4***	0.0000
Core CPI	0.0887	1,868.2***	0.0000	0.1166	455.7***	0.0000	0.0231	630.3***	0.0000	0.0019	2,338.6***	0.0000
PCEPI	0.0334	1,556.6***	0.0000	0.0555	458.1***	0.0000	-0.0383	271.4***	0.0000	0.0721	184.6***	0.0000
Core PCEPI	0.0653	3,170.7***	0.0000	0.0934	920.4***	0.0000	-0.0169	414.1***	0.0000	0.0150	1,720.4***	0.0000

NOTE: GDP components are measured in 2000 chain-weighted dollars. The regressions are of the form

$$\Delta \ln(y_t) = \alpha + \sum_{i=1}^4 [\beta_i \Delta \ln(y_{t-i}) + \delta_i \Delta \ln(x_{t-i})] + \sum_{i=0}^3 [\gamma_i \Delta \ln(z_{t-i})] + e_t,$$

where z_t is the Chicago Fed National Activity Index, x_t is domestic crude petroleum production transformed according to Hamilton (2003), and y_t are the dependent variables above. For the reported p values, ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

indicators and across time. Over the entire sample period the sum of the energy coefficients on real GDP growth was highly significant, though modest (−0.09). The first row of Table 2 indicates that the oil price increases had their largest effect on real GDP growth (−0.13) over the final period. This is perhaps surprising, given the acceleration in productivity growth and the continued drop in energy usage per unit of GDP. This result may reflect the relatively sharp, unexpected increase in energy prices that have occurred since then. The effects of energy price increases on real GDP growth were much smaller during the Great Inflation period (−0.06). The effects of higher energy prices on real GDP growth were even smaller in the subsequent period (−0.005).

Table 2 reveals other interesting findings. First, during the Great Inflation, the largest (negative) effects of oil price increases were on real residential fixed investment and imports; however, the effect on real consumer spending (PCE) was relatively small during this period. Second, the smallest effect of oil price increases on the components of real GDP occurred from 1983 to 1994. The notable exception was real consumer spending. During this period (1983-94), the sum of the NOP coefficients was −0.19, substantially larger than both the previous and following periods. Moreover, in the cases of real fixed investment in business equipment and software and real imports, the sign not only became positive during the 1983-94 period, but the significance of oil price increases disappeared altogether. Third, since 1995, the sensitivity of real equipment and software investment has increased significantly. This is consistent with the literature reports cited earlier, in which increasing oil prices had a sizable influence on business capital spending. In fact, the coefficient is about equal in magnitude to that of the second period, but the sign is changed. In addition, higher oil prices now help to predict business investment in structures. However, this change could reflect the fact that the share of nominal fixed investment in drilling and mining activity as a percent of nominal non-residential fixed investment increased from about 1.75 percent in 1995 to 8 percent in 2007. Finally, although the effect of oil price increases on real

PCE since 1995 has diminished somewhat compared with the 1983-94 period (from −0.19 to −0.11), the sum of the coefficients is more significant compared with the 1970-82 period.

Effects on Consumer Price Inflation. The last four rows of Table 2 show the results of equation (2) as applied to the four price series previously mentioned.¹⁵ Since 1970, the sum of the coefficients on oil price increases, which have the expected positive sign and are highly significant, are essentially the same for both the total CPI and the total PCEPI (0.04). The sums of the coefficients on the core price indices are also roughly equal to each other, but the sums of the coefficients are larger, and even more significant, than for the total price measures. It appears that the latter effect stems from the Great Inflation period. Since 1983, the effects of higher oil prices on core inflation have been much more modest and considerably smaller than those on the total price measures. The results in Table 2 provide some evidence for the decision by the Federal Open Market Committee to place somewhat more emphasis on core PCEPI inflation during the run-up in oil prices over the past several years.

A Simple Forecasting Exercise

Results from Tables 1 and 2 suggest that past oil price increases are statistically significant predictors of economic activity and inflation in the current quarter. This section provides some evidence that Hamilton's NOP variable helps to forecast the growth of economic activity and inflation one quarter ahead. In this experiment, the baseline forecast uses an AR(4) model augmented with the CFNAI; this is a one-period-ahead version of regression (3) in Table 1—that is, excluding oil prices. The unrestricted model adds Hamilton's NOP series as an explanatory

¹⁵ A version of Table 1 was estimated for the PCEPI and core PCEPI series. That is, inflation was regressed on (i) four lags of inflation, (ii) four lags of Hamilton's NOP measure, and (iii) the contemporaneous and lagged value of the CFNAI. In results not published here, the adjusted R^2 for PCEPI inflation in (i) is 0.76. Adding the CFNAI increased the adjusted R^2 to 0.78; the adjusted R^2 for the AR(4) for core PCEPI is 0.82; and adding the CFNAI boosted the adjusted R^2 to 0.83. Adding Hamilton's NOP to the latter model raised adjusted R^2 to 0.86. These results are available on request.

Table 3
Evaluating Forecasts With and Without Oil Price Increases

Variable	Base	+WTI	+PPI
Expenditures			
Real GDP	1.60	1.56	1.57
PCE	1.55	1.41	1.47
Fixed investment	5.21	5.28	5.38
Business investment	5.60	5.69	5.94
Structures	8.83	8.86	9.45
Equipment and software	5.98	6.00	6.05
Residential	9.27	9.48	10.03
Exports	7.13	7.35	7.30
Imports	5.31	4.69	4.96
Prices			
CPI	2.03	2.01	2.03
Core CPI	0.63	0.81	0.91
PCEPI	1.47	1.46	1.48
Core PCEPI	0.51	0.61	0.59

NOTE: Data are presented as root mean square forecast errors in percent. The base forecast is an AR(4) model augmented with the contemporaneous and first lag of the CFNAI. The alternative models are augmented with either the spot price of West Texas Intermediate (WTI) or the PPI for domestic crude petroleum production. Both oil prices are transformed according to Hamilton (2003). The augmented model is regression (4) from Table 1. The base and alternative models are estimated for the period 1970:Q1–2001:Q4. Then, one-step-ahead pseudo-forecasts are estimated for 2002:Q1–2007:Q4. Forecast errors in bold indicate that the forecast errors from the augmented model are significantly different from the base model according to the Clark-McCracken test.

variable (regression (4) in Table 1). The analysis continues to use the spot price of WTI as before, but now includes the producer price index (PPI) for domestic crude petroleum as an alternative measure of oil prices.¹⁶ Again, each of these oil price series is modified according to the Hamilton specification. First, the restricted model (without energy) is estimated from 1970:Q1 to 2001:Q4. The model is estimated for each of the output and price series listed in Table 2. Next, one-step-ahead pseudo-out-of-sample forecasts (with and without energy) are computed from 2002:Q1 to 2007:Q4. Table 3 presents the root mean square errors (RMSEs) from this forecasting exercise.

The value of any forecast to the practitioner or the policymaker is its accuracy. A standard test of forecast accuracy is the one proposed by

Diebold and Mariano (1995; DM). However, as Clark and McCracken (2001; CM) point out, the DM test is not appropriate for nested models such as those used here. In Table 3, the null hypothesis is that the baseline forecasts (without NOP) and the augmented forecast (with NOP) have the same predictive power. Based on the CM test statistic, Table 3 shows that spot oil price increases can help improve the baseline, one-quarter-ahead forecast for the growth of real GDP, real PCE, and real imports. However, this is not the case for the PPI measure of oil prices. In all other series listed in Table 3, the PPI measure of oil prices—which is the series Hamilton used—does not improve the baseline forecast. However, Table 3 shows that adding the WTI spot oil price increase to the price equations marginally improves the RMSEs of the forecasts for overall CPI and PCE inflation. For example, adding the spot WTI to the CPI

¹⁶ The PPI series is the oil price series used in Hamilton's analysis.

inflation forecasting equation reduces the RMSE from 2.03 (baseline) to 2.01. Notably, the RMSE for the PCEPI inflation forecasts are much smaller than those for the CPI series.

Alternative scenarios of economic growth and inflation over the near term matter most for conducting monetary policy. Accordingly, the analysis is now extended to gauge the potential effects of higher oil prices on economic growth and inflation in 2008 and 2009. First, the model for each variable is estimated for the 1970:Q1–2007:Q4 period. Next, the model is used to forecast out-of-sample growth rates for the 2008:Q1–2009:Q4 period. The baseline forecast is the same AR(4) model augmented with the CFNAI.¹⁷ The baseline forecast is augmented with two separate scenarios for the spot price of WTI to gauge the effects of higher oil prices through 2009. In the first scenario, the spot price of WTI averages \$100 per barrel for the four quarters of 2008 and remains at that level through 2009:Q4. In the second scenario, the spot price of WTI increases from \$100 per barrel in 2008:Q1 to \$150 per barrel in 2009:Q1 and then remains at that level until 2009:Q4.¹⁸ Finally, these forecasts are compared with the forecasts released by the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters (SPF) on February 12, 2008. One drawback to the SPF is that the quarterly forecast horizon extends only to 2009:Q1.

Huntington (2005), in a study that compares different types of macroeconomic models, argues that small time-series models may capture the aggregate economic effects of large oil price increases that occur over relatively short periods—like those that have occurred since 2007. He argues that structural models are better able to capture the economic impacts of a gradual increase in oil prices. Table 4 shows out-of-sample forecasts using Hamilton's augmented model. Forecasted annual average growth rates for 2008 and 2009 are shown for real GDP, real PCE, real business fixed investment, and PCEPI and core PCEPI

inflation.¹⁹ As shown, the baseline forecast for real GDP growth in 2008 (2.4 percent) is modestly more optimistic than the SPF forecast (1.9 percent). The baseline forecast incorporating the assumption of \$100 per barrel oil in 2008—a modest step up from its average of \$91.73 per barrel in the fourth quarter of 2007—lowers the forecast for real GDP growth in 2008 by slightly less than 0.25 percentage points to about 2.25 percent.²⁰

Table 4 suggests that an additional \$50-per-barrel increase in oil prices reduces the forecast for real GDP growth in 2008 by about another 0.25 percentage points, so that \$150-per-barrel oil cuts the forecast for real GDP growth in 2008 by 0.5 percentage points from its baseline forecast (2.4 percent). The model thus predicts that each \$10-per-barrel permanent increase in spot oil prices reduces real GDP growth by 0.1 percentage points within one year, and even less after two years. Recall that Huntington (2005) found that each \$10-per-barrel increase in crude oil reduced real GDP growth by about 0.25 percentage points.

For 2009, the baseline model predicts that real GDP will increase 3.1 percent.²¹ The predicted growth for real GDP in 2009 with either of the two oil price scenarios differs little from the baseline forecast. In either case, the unrestricted Hamilton model does not predict long-lasting effects on real GDP growth from an increase in oil prices. Hence, once oil prices stabilize, and the drag from higher oil prices ends, the model predicts that real GDP will converge to trend-like growth relatively quickly. This is a common characteristic of most forecasting models.

Forecasts for the remaining variables in Table 4 are generally consistent with the findings from Tables 2 and 3: Higher oil prices have their largest effects on real consumer expenditures. In

¹⁹ The data series were last updated on February 28, 2008.

²⁰ Growth rates for the year are forecast averages for the four quarters of each year.

²¹ The February 10, 2008, Blue Chip Economic Indicators reported that the Blue Chip Consensus predicts that real GDP would increase by 2.6 percent in 2009. A consensus forecast published by the National Association for Business Economics on February 25, 2008, predicted that real GDP would increase by 2.9 percent in 2009.

¹⁷ An AR(4) model is used to estimate the out-of-sample values for the CFNAI.

¹⁸ Spot WTI is assumed to rise 10.75 percent per quarter from 2008:Q1 to 2009:Q1, reaching a level of \$150.44 per barrel.

Table 4
Forecasts of Real Output and Expenditure Growth and Price Inflation
Averages of Quarterly Data at Annual Rates

Indicator	2007	2008	2009
Real GDP	(Actual)		
SPF	2.5	1.9	NA
Baseline		2.4	3.1
Baseline + \$100 oil		2.2	3.2
Baseline + \$150 oil		1.9	3.0
Real PCE			
SPF	2.5	1.9	NA
Baseline		3.1	3.4
Baseline + \$100 oil		2.8	3.6
Baseline + \$150 oil		2.6	3.0
Business fixed investment			
SPF	7.3	2.1	NA
Baseline		2.7	4.4
Baseline + \$100 oil		2.7	4.5
Baseline + \$150 oil		2.5	4.4
PCEPI			
SPF	3.4	2.5	NA
Baseline		3.2	3.2
Baseline + \$100 oil		3.6	3.3
Baseline + \$150 oil		3.7	4.0
Core PCEPI			
SPF	2.1	2.1	NA
Baseline		2.3	2.5
Baseline + \$100 oil		3.0	2.7
Baseline + \$150 oil		3.3	4.1

NOTE: The baseline forecast is an AR(4) plus the CFNAI. The forecast horizon for the Survey of Professional Forecasters is 2008:Q1–2009:Q1.

2008, \$100-per-barrel oil is predicted to reduce the growth of real PCE by 0.3 percentage points, while an increase to \$150 per barrel produces an additional decline of about 0.25 percentage points relative to the baseline forecast. Comparing the baseline forecast for real PCE growth in 2009 with the forecast that assumes \$150-per-barrel oil suggests that higher oil prices will have modestly more persistent negative effects on real consumption spending: 3.4 percent (baseline) versus 3.0 percent (\$150 per barrel) than on real GDP

growth. Table 4 also suggests that higher oil prices will have considerably more modest short-run effects on business capital spending (business fixed investment), but the effects will not be as persistent as predicted for real consumer spending. Nevertheless, these results are generally, but perhaps weakly, consistent with the literature that finds significant negative effects on business capital spending from higher oil prices.

Perhaps the most interesting findings are those associated with the inflation forecasts. First,

the baseline forecasts predict modestly higher overall and core inflation for 2008 than does the SPF forecast. Second, the model predicts a considerable acceleration in PCEPI inflation rates in 2008 and 2009 should oil prices increase to \$100 or \$150 per barrel. Perhaps most worrisome is that the augmented Hamilton model predicts that a permanent increase in crude oil prices to \$150 per barrel will lead to overall and core inflation rates of 4 percent (or slightly above) in 2009. If this model is correct, the prospect of crude oil prices rising to \$150 per barrel could produce a significant acceleration in inflation in 2009.

CONCLUSION

The analysis in this paper has used a version of Hamilton's model to gauge the effects of higher oil prices on real GDP growth and inflation. One finding of this study is that the model's explanatory power is dramatically improved by adding the Chicago Fed National Activity Index as an explanatory variable. This addition, however, does not diminish another finding—consistent with those in the literature—that oil price increases do matter. Second, oil prices matter more for some GDP components than others, such as real consumer spending. The model also predicts significantly negative effects on business capital spending. Moreover, this sensitivity seems to have increased considerably since 1995 compared with the period from 1970 to 1995.

To gauge the predictive power of these findings, a simple forecasting exercise using Hamilton's model augmented with the CFNAI shows that the estimated negative effects of \$100-per-barrel oil on real GDP growth are significant but would wane by the end of 2008. An additional \$50-per-barrel increase in the price of crude oil would cut real GDP growth by about 0.25 percentage points in 2008, but by only 0.1 percentage points in 2009 (both relative to a baseline forecast that excludes oil prices). Statistically, real consumption expenditures would experience similarly large but more persistent negative growth. The augmented Hamilton model predicts much more modest—and less persistent—effects on the

growth of real business fixed investment. Finally, the model predicts that a permanent increase in crude oil prices to \$150 per barrel would cause overall and core PCEPI inflation to rise to 4 percent in 2009. This result, if correct, suggests that policymakers may need to be quite vigilant should oil prices rise to limits heretofore thought unlikely by most analysts.

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Banking Crisis Solutions Old and New

Alistair Milne and Geoffrey Wood

In 2007 Britain experienced its first run on a bank of any macroeconomic significance since 1866. This was not dealt with by the method that had maintained banking stability for so long: letting the bank fail but supplying abundant liquidity to the markets to prevent contagion. In this paper the authors examine why that traditional solution was not used and propose changes to Britain's deposit insurance system, to its bank insolvency regime, and in arrangements to allow customers access to banking services should their bank be closed—so that the traditional approach can once more be used to mitigate moral hazard. (JEL E58, G21, G28)

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In the autumn of 2007 Britain experienced its first bank run of any significance since the reign of Queen Victoria.¹ The run was on a bank called Northern Rock. This was extraordinary; by the early 1870s, the Bank of England had developed techniques to prevent such events. Further, it was the announcement of support for the troubled institution that triggered the *retail* run. (We emphasize “retail” because the bank had already been experiencing great difficulty in obtaining wholesale funding.) That run was halted only when the Chancellor of the Exchequer (as Britain's minister of finance is known), then Alistair Darling, announced that he would commit taxpayers' funds to guarantee every deposit at Northern Rock.

This paper has two aims: first, to address the question of why the United Kingdom's traditional techniques for maintenance of banking stability failed—if they did fail—on this occasion; and

second, to consider how these techniques may need to be changed or supplemented to prevent any similar problems in the United Kingdom.

CHRONOLOGY OF EVENTS

Northern Rock was created by the merger of two “building societies,” the Northern Counties and the Rock, on July 1, 1965. Building societies were mutual organizations, owned by their depositors and their borrowers. Their deposits came primarily from retail customers, and their major (essentially sole) lending activity was to individuals to buy residences. In the 1990s these organizations were allowed to demutualize and “convert” (in the terminology of the time) to banks. Most large societies converted, and Northern Rock was among them. It demutualized on October 1, 1997.

Many of these demutualized societies were taken over by or merged with existing banks. Northern Rock remained independent. Two other features of its post-demutualization behavior were

¹ There were runs on some “fringe banks” in the secondary banking crisis of 1973-74. See Reid (1976) for details.

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distinctive. First, it grew very rapidly. At the end of 1997, its assets (on a consolidated basis) stood at £15.8 billion. By the end of 2006, its assets had reached £101.0 billion. Even so, at the end of the second quarter of 2007, its loans were only 8 percent (by value) of the stock of mortgage debt in the United Kingdom and therefore only about 5 percent of total bank lending, and its deposits about 2 percent of sterling bank deposits. It was certainly not an enormous institution. The second feature relates to its activity. On the asset side of the balance sheet it remained close to the traditional building society model: It stayed concentrated on mortgage lending to individuals wishing to buy their own homes. There were, however, dramatic changes in the structure of its liabilities. It adopted an “originate to distribute” model of funding (the originated mortgages would be sold in wholesale markets).

The resulting dependence on wholesale markets for the large majority of its funding was what most distinguished Northern Rock from other U.K. banks. Retail deposits (and other classes of retail funds) did grow, but not nearly as rapidly as wholesale funds, so retail funds fell as a proportion of total liabilities and equity, from 62.7 percent at year-end 1997 to 22.4 percent at year-end 2006. But on August 9, 2007, there was a sharp dislocation in the market for Northern Rock’s funding, with the start of a major repricing of credit risk in global financial markets.

INSTITUTIONAL CONTEXT

This section briefly describes the institutional setting within which the problems were addressed. The structure of regulation is considered first and is followed by a discussion of the way in which the Bank of England conducted its money market operations.

The Bank of England had been given operational independence to set interest rates to achieve an inflation target determined by the Chancellor of the Exchequer by the Bank of England Act 1998. As part of that change, it lost responsibility for bank supervision to the Financial Services Authority (FSA), a new agency created at the

same time and charged with the task of supervising the entire financial sector. Notably, although the FSA had the duty of supervising individual banks, the Bank of England retained responsibility for stability of the financial system as a whole. The Treasury also shared responsibility for stability and supervision: If any risks had to be taken with taxpayers’ money, the Treasury had the money and the right to use it. The three institutions together are known as the Tripartite Authorities.

Another factor was important at that time. The way in which money market operations were conducted also had changed recently. A new operating procedure had been devised because of concern over the volatility of short-term sterling rates. Banks were allowed to specify for each reserve maintenance period the amount of cash they wanted from the Bank of England at the Bank’s policy rate. If they found they needed less than the specified amount, they could redeposit the cash at the Bank at a rate below the policy rate; if they needed more, they could get it at a rate above the policy rate. The new regulatory system and the new money market procedures both seemed to have worked smoothly before the Northern Rock episode, but this was their first test under stress.

THE MARKET FREEZE

Soon after interbank and other financial markets froze on August 9, it became clear that Northern Rock would face severe problems if the markets remained frozen for long. The then-chairman and the then-chief executive of Northern Rock first discussed these problems with each other on Friday, August 10.² That same day the FSA contacted the businesses that it believed

² See question 391 (Q 391) in the following source: House of Commons Treasury Committee (2008b): *The run on the Rock, Fifth Report of Session 2007-08*, volume II. “Q 391” here refers to question 391 in this publication. In this and subsequent footnotes, referenced questions follow the same format. Multiple questions are referenced by “Qq.” Access www.parliament.the-stationery-office.co.uk/pa/cm200708/cmselect/cmtreasy/56/56ii.pdf for the complete text of questions (and answers) cited herein. For additional documentation, see House of Commons Treasury Committee (2008a).

might be at risk from the freezing of financial markets. One of these was Northern Rock.³ Northern Rock replied to the FSA on the next working day, Monday, August 13. Thereafter, the FSA and Northern Rock were in twice-daily telephone contact.⁴

Between August 10 and mid-September, Northern Rock and the Tripartite Authorities pursued a threefold strategy to extricate Northern Rock from its difficulties. The three options (discussed in detail in the following text) were as follows:

- Northern Rock could resolve its liquidity problems through its own actions in short-term money markets and by securitizing its debt⁵;
- Northern Rock could obtain the “safe haven” of a takeover by a major retail bank⁶; and
- Northern Rock could receive a support facility from the Bank of England guaranteed by the government.

THE FIGHT TO SAVE NORTHERN ROCK

Did the Bank of England Provide Sufficient Liquidity Assistance?

Northern Rock’s resolution of its liquidity problems through its own actions would have required that short-term funds be available in money markets at rates in line with adjustable mortgage rates and other short-term interest rates (i.e., in an environment in which there was no general shortage of bank liquidity). Some commentators have suggested that failure by the Bank to provide sufficient assistance to the money markets forced Northern Rock to turn to the Bank for a support facility. In August 2007, the Bank of England was approached by banks arguing that

the Bank should provide additional liquidity at the regular (no penalty) rate. The Bank refused such assistance.

The commercial banks raised their reserve requirements by 6 percent in the maintenance period starting September 6, 2007. On September 5—before the start of the September 6 maintenance period—the Bank of England announced that if the secured overnight rate had not fallen from its higher-than-usual level above Bank rate, the Bank would have been prepared to offer additional reserves, amounting to 25 percent of the requested reserves target, before the end of the “maintenance period.”⁷ (This period is approximately one month; it runs from one monthly meeting of the Bank’s Monetary Policy Committee to the next.) On September 13, this criterion was met and additional reserves were provided. An additional fine-tuning operation occurred on September 18 after the run on Northern Rock; the Bank again offered £4.4 billion, or 25 percent of the reserves target.

Would provision of this extra liquidity at the time the banks first requested it have saved Northern Rock? It seems very unlikely that any such general lending operation would have been of a sufficient scale to ensure that Northern Rock received the liquidity it required. Banks would have wanted to ensure that they were themselves secure; and even when thus satisfied, there would have been reluctance to lend any extra funds to a bank about which many by then had doubts. It seems likely that only lending by the Bank specifically targeted on Northern Rock would have helped, and that approach was not initially considered.

Would a Safe Haven Be Found?

On August 16, Northern Rock began its pursuit of a “safe haven,” acting “behind the scenes” and with its advisers to seek an offer for the company.⁸ Two institutions showed interest in acquiring Northern Rock. One showed only “a slight expression of interest...that never came to anything.”⁹

³ Q 1523.

⁴ Q 568.

⁵ Qq 108, 200, 611.

⁶ Q 613.

⁷ Q 613.

⁸ Qq 571, 732.

⁹ Qq 749, 754.

The second institution, a major High Street retail bank,¹⁰ showed “more specific interest” for a period of two or three days, but no firm offer was made.¹¹ Northern Rock ceased its pursuit of a safe haven on Monday, September 10.¹²

This option failed for two main reasons. The bidder (the second institution) wanted liquidity support in the form of a loan; there was, in the words of the Governor of the Bank of England, a request to “borrow about £30 billion without a penalty rate for two years.”¹³ Both the Chancellor of the Exchequer and the Governor indicated that they were reluctant to let the Bank act as a commercial lender to a going concern.¹⁴

The Chancellor of the Exchequer and the Governor also agreed that a legal barrier prevented the provision of financial support. If such lending were to be made available to one High Street bank, it would have been necessary to have offered a matching facility to other potential bidders.¹⁵ In addition, the Governor emphasized the legal difficulties faced in current circumstances in accomplishing a rapid takeover of a bank that is a quoted company (a company whose shares are traded on the London stock exchange): “...any change of ownership of a quoted company—and Northern Rock is a quoted company—cannot be managed except through a long and prolonged timetable set out in the Takeover Code.”¹⁶

Before the run the FSA, the Governor of the Bank of England, and the Chancellor of the Exchequer all favored a solution to Northern Rock’s problems through a private sector takeover. The Chancellor of the Exchequer stated that a merger “would have been by far the best option.”¹⁷ But a rapid takeover was not possible, and there was no time for one to proceed at the normal pace.

¹⁰ Q 588.

¹¹ Q 754.

¹² Qq 571, 577.

¹³ Q 1665.

¹⁴ Qq 789, 1665.

¹⁵ Qq 1665, 789.

¹⁶ Q 5.

¹⁷ Qq 257, 3, 790.

Why a Bank of England Support Operation?

By Monday, September 10, it was evident that a Bank of England support operation for Northern Rock would be necessary for Northern Rock to avoid defaulting on its short-term borrowing. By the following day, it was apparent that that operation would need to be publicly announced.¹⁸ Stock exchange rules required this announcement—it was an undeniably “material event”—and the announcement was made at 7 a.m. on Friday, September 14:

The Chancellor of the Exchequer has today authorised the Bank of England to provide a liquidity support facility to Northern Rock against appropriate collateral and at an interest rate premium. This liquidity facility will be available to help Northern Rock to fund its operations during the current period of turbulence in financial markets while Northern Rock works to secure an orderly resolution to its current liquidity problems...The FSA judges that Northern Rock is solvent, exceeds its regulatory capital requirement and has a good quality loan book.¹⁹

But before the provision of emergency liquidity assistance by the Bank of England to Northern Rock could be announced formally, the outlines of the operation were reported by the BBC News the previous evening. This was followed by a retail run on Northern Rock. Some have blamed the BBC announcements for this run, but doing so neglects the fact that announcements of official support for banks often trigger runs. Regardless of the cause of the run, the speed and extent of withdrawals meant that the Bank of England’s emergency facility, which had been envisaged as a “backstop” that would allow Northern Rock time to raise lower-cost short-term funds in wholesale markets, had to be called upon almost immediately.²⁰

The momentum of the run on Northern Rock retail deposits was due to two factors. First, depos-

¹⁸ Q 1620.

¹⁹ Bank of England (2007).

²⁰ Q 529.

itors became aware that, if the run continued, Northern Rock would eventually cease to be a going concern.²¹ Second, public awareness that deposits above £2,000 were not guaranteed in full increased; this fact was something of which many depositors may previously have been unaware.²² The Governor of the Bank of England said that, in these circumstances, the only way to halt the run was to provide a government guarantee of deposits in Northern Rock.²³ The Chancellor of the Exchequer “became convinced” on Sunday, September 16, that action along these lines was necessary.²⁴ The announcement of a government guarantee late on Monday, September 17, had the desired effect. The run was halted.²⁵

A Lender-of-Last-Resort Operation?

The decision to provide support to Northern Rock has been described as a “lender of last resort” operation, but it was certainly not what we would term a classic lender-of-last-resort operation. That procedure evolved in Britain in the nineteenth century to prevent a general loss of confidence in the safety of bank deposits (i.e., to prevent a general run from banks to cash).

The concept of a lender of last resort was described in its essentials, and named, by Francis Baring in 1797 in his comment on financial consequences of the 1793 declaration of war between France and Britain²⁶:

That dreadful calamity is usually preceded by some indication which enables the commercial and monied men to make preparation. On this occasion the short notice rendered the least degree of general preparation impossible. The foreign market was either shut, or rendered more difficult of access to the merchant. Of course he would not purchase from the manu-

facturers;...the manufacturers in their distress applied to the Bankers in the country for relief; but as the want of money became general, and that want increased gradually by a general alarm, the country Banks required the payment of old debts...In this predicament the country at large could have no other resource but London; and after having exhausted the bankers, that resource finally terminated in the Bank of England. In such cases the Bank are not an intermediary body, or power; there is no resource on their refusal, for they are the *dernier resort*.²⁷

Shortly after Francis Baring’s 1797 use of the term “dernier resort,” Henry Thornton (1802) provided a statement of what it was, why it was necessary, and how it should operate. Quite remarkably, this statement was essentially a complete description of the lender-of-last-resort role as it was performed until the beginning of this century. Thornton’s statement was made in a particular institutional context, and for clarity’s sake this context is further detailed here.²⁸

All banks in England (except the Bank of England) were constrained to be partnerships of six or fewer members. The joint stock form was not generally allowed until 1826 and limited liability not until 1858. Failures were common despite the risk aversion on the part of bankers that unlimited liability surely brought. It is here that the Bank of England comes into play:

If any bank fails, a general run upon the neighbouring banks is apt to take place, which if not checked in the beginning by a pouring into the circulation of a very large quantity of gold, leads to very extensive mischief. (Thornton, 1802, p. 182)

²¹ Q 57.

²² Q 677.

²³ Qq 46, 57.

²⁴ Q 1760.

²⁵ Q 1760.

²⁶ A detailed description of the evolution of this classic lender of last resort can be found in Wood (2000).

²⁷ This quotation is from the Augustus Kelley 1967 publication (pp. 19-23), which is a reprint of the 1797 edition of Francis Baring’s *Observations on the Establishment of the Bank of England and on the Paper Circulation of the Country*. Baring, as well as importing the term, used it in a new, metaphorical way. In France it referred to the final court of appeal.

²⁸ Thornton’s writing in *Paper Credit* continually interwove analysis with factual examples. In an early essay on the book, Francis Horner (writing in the *Edinburgh Review*) observed that this made *Paper Credit* hard to read and to understand and, accordingly, as well as praising the book’s insights very highly, he summarized its analytical framework.

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And who was to “pour in” this gold? The Bank of England.

...If the Bank of England, in future seasons of alarm, should be disposed to extend its discounts in a greater degree than heretofore, then the threatened calamity may be averted. (Thornton, 1802, p. 188)

This approach, however, was not incompatible with allowing some individual institutions to fail:

It is by no means intended to imply that it would become the Bank of England to relieve every distress which the rashness of country banks may bring upon them: the Bank by doing this, might encourage their improvidence... The relief should neither be so prompt and liberal as to exempt those who misconduct their business from all the natural consequences of their fault, nor so scanty and slow as deeply to involve the general interests. (Thornton, 1802, p. 188)

The overriding concern should be with the system as a whole. The reason a “pouring into the circulation” (to use Thornton’s phrase) would stop a panic and thus protect the system was described with great clarity by Bagehot in 1873:

What is wanted and what is necessary to stop a panic is to diffuse the impression that though money may be dear, still money is to be had. If people could really be convinced that they would have money...Most likely they would cease to run in such a herd-like way for money. (pp. 64-65)

In the British banking system in place by the mid to late nineteenth century—a system based on gold but with the central bank as the monopoly supplier of notes—the responsibility for diffusing “...the impression that...[m]oney is to be had” clearly rested with the central bank.

This brief synopsis summarizes nineteenth-century theory on the subject of lender of last resort. Because the central bank was the sole permitted note issuer, it was the ultimate source of cash. If it did not, by acting as lender of last resort, supply that cash in a panic, the panic would continue, worsen, and bring about a widespread banking collapse along with a sharp monetary contraction.

What was nineteenth-century practice? A set of institutions (now gone) called discount houses that originated as bill brokers brought together those who wished to issue bills of exchange (an important means of trade finance) and investors who wished to purchase such bills. These brokers grew, built up their capital base, and ceased to be purely brokers, instead holding some bills on their own account. They then became “discount houses.” In part because of a degree of animosity between the banks and the Bank of England (due to the latter’s privileges), the banks preferred to place their surplus liquidity with the discount houses. These in turn had access to borrowing at the Bank of England by discounting bills there.

Within that setting, how did lender-of-last-resort practice develop? Sterling returned to its prewar gold parity in 1821. The first subsequent occasion for emergency assistance from the Bank was in 1825 after a substantial external drain of gold and resulting shortage of currency. A panic developed, and there were runs on banks. The type of bills the Bank would normally discount soon ran out and the panic continued. If a wave of bank failures was to be prevented, the banks would have had to borrow on the security of other types of assets. On December 14, the Bank of England suddenly deviated from its normal practice and made advances on government securities offered to it by the banks instead of limiting itself to discounting commercial bills. The panic was ended.

After several other episodes, the final step was taken in 1866, with the Overend, Gurney crisis. Overend, Gurney, and Co. originated with two eighteenth-century firms, the Gurney Bank (of Norwich) and the London firm of Richardson, Overend and Company. By the 1850s the combined firm was very large; its annual turnover of bills of exchange was equal in value to about half the national debt, and its balance sheet was ten times the size of the next-largest bank. It was floated during the stock market boom of 1865. By early 1866 the boom had ended. Many firms were failing. Bank rate had been raised from 3 percent in July 1865 to 7 percent in January 1866. After February, Bank rate started to ease, but on May 11, Overend, Gurney was declared insolvent.

As remarked in the June 1866 *Bankers' Magazine*, “a terror and anxiety took possession of men’s minds for the remainder of that and the whole following day.” The Bank of England briefly made matters worse by hesitating to lend even on government debt. The Bank Charter Act (which, among other things, restricted the note issue to the extent of the gold reserve plus a small fiduciary issue) was then suspended, and the panic gradually subsided.²⁹

The 1878 failure of the City of Glasgow Bank was much less dramatic. It had started respectably, was managed fraudulently, and failed. It was feared that the Bank Charter Act would have to be suspended again (see Pressnell, 1968), but no major problems appeared: “There was no run, or any semblance of a run; there was no local discredit” (Gregory, 1929). Other Scottish banks took up all the notes of the bank; Gregory conjectures that they acted to preserve confidence in their own note issues.

Then in 1890 came the (first) “Baring crisis.” Baring’s was a large bank of great reputation; in 1877, when U.K. Treasury bills were introduced, Bagehot praised them as being “as good as Baring’s.” Nevertheless, Baring’s became involved in a financial crisis in Argentina. The Argentinean government had difficulty paying the interest on its debt in April 1890; then the Argentinean national bank suspended interest payments on its debt. This precipitated a run on the Argentinean banking system, and there was revolution on July 26. Baring’s had lent heavily to Argentina. On November 8, it revealed the resulting difficulties to the Bank of England. The Bank (and the government) were horrified, fearing a run on London should Baring’s default. A hurried inspection of Baring’s suggested that the situation could be saved but that £10 million was needed to

finance current and imminent obligations. A consortium was organized, initially with £17 million of capital. By November 15 the news had leaked, and there was some switching of bills of exchange into cash. But there was no major panic and no run on London or on sterling. The impact on financial markets was small. Baring’s was liquidated and refloated as a limited company with additional capital and new (but still family) management.

Why the great difference among the first, second, and third episodes of bank failures? The Bank of England had both learned to act as lender of last resort and made clear that it stood ready so to act. The Bank had erred in 1866 by lending “...hesitatingly, reluctantly, and with misgiving... In fact, to make large advances in this faltering way is to incur the evil of making them without obtaining the advantage” (Bagehot, 1802, p. 188).

So the lesson learned in Britain was that a banking crisis could be stopped by prompt lender-of-last-resort action. However, this does *not* mean that a central bank is obliged to provide funds to any institution facing liquidity problems. Today, banks have many sources of funding that were not available in the nineteenth century. They now have access to both unsecured interbank markets and secured short-term sale and repurchase (repo) markets. This means that there is no need for the central bank to provide direct liquidity support to any bank able to access either interbank or repo markets. Today the obligation as lender of last resort can be fulfilled by providing liquidity to the money markets as a whole.

WHY DID THE TRIPARTITE AUTHORITIES PROVIDE SUPPORT AT ALL?

What range of possibilities was considered by the Tripartite Authorities immediately before the loan facility was granted to Northern Rock? The options—Northern Rock’s ability to refinance itself in the markets, finding a “safe haven,” or Bank of England support—all differed from the traditional response (whether termed “lender of

²⁹ Suspension of the Act freed the note issue from the constraint of the Bank’s gold reserves. This action has parallels in Italy later in the nineteenth century and again in East Asia in 1998. (For a brief discussion of that 1998 episode, see Wood, 1999.) There was also a parallel in the United States. The 1933 Banking Act (the Glass-Steagall Act) broadened the collateral the Fed could hold against Federal Reserve notes. While the gold requirement was left unchanged at 40 percent, the Act added government bonds to the list of eligible paper that could make up the remaining 60 percent (see Benston, 1990).

last resort” or “provision of liquidity to money markets”) in that they involved something that must be called, in one sense or another, a “rescue.”

The Authorities could have behaved as they had in the nineteenth century. They could have considered whether the troubled institution was of sufficient importance that its failure would have damaged the reputation of London, as they did in the Baring case in 1890, and if it failed that test it would have been allowed to sink or swim and liquidity would have been provided to the rest of the banking sector as needed to calm any subsequent panic.

The chosen option is well known—Northern Rock was not allowed to sink or swim. A determined attempt was made to keep the institution going and to find a rescuer for it. This approach certainly could not be justified by the size or reputation of Northern Rock. It was not a particularly large institution, and even its greatest admirer would not claim that it was a bank of international renown similar to that of Baring’s in 1890.³⁰ Why, then, did the Authorities act as they did?³¹

A Possible Interpretation

A range of factors probably influenced the decision. First, and most obvious, is that the problem was a shock—and one to previously untested regulatory and money market regimes. Also in play may have been some factors about which it is possible only to speculate at this time, although more data may become available in the future when the archives are opened (if written records of discussions were kept).

Gordon Brown had just become prime minister. Opinion polls suggested a subsequent sharp leap in the popularity of the ruling Labor government and there was much speculation that an

election would be called. Closing a bank (or nationalizing it) would probably have done little good for the government’s prospects of victory. A second consideration is that such action might not have reflected well, at least in the popular press, on the “Tripartite Arrangements” for financial stability, and these arrangements had been put in place when Gordon Brown was Chancellor of the Exchequer. Third, Northern Rock was headquartered in an area of strong Labor party support (Newcastle on Tyne) and where unemployment was above the national average. The political background was not favorable for the “sink or swim” option.

There are, however, also undeniably good economic reasons why the traditional course of refusing support to an individual institution and leaving it to sink or swim was not followed. These reasons are further explored before showing how these impediments can be removed, thus allowing a return to the traditional approach in any future bank failure, and thereby diminishing the problem identified by Thornton and now referred to as “moral hazard”:

It is by no means intended to imply that it would become the Bank of England to relieve every distress which the rashness of country banks may bring upon them: the Bank by doing this, might encourage their improvidence.

The first reason entails a technical aspect of the Bank’s money market operations and then, more fundamentally, the nature of interbank linkages and retail bank depositors in the twenty-first century.

Borrowing via the Standing Facility

As described previously, the current system of money market operations used by the Bank of England allows commercial banks to choose their own level of cash reserves according to their expected need in the month ahead. If their forecast is wrong, they can earn interest on the surplus or borrow more through the standing facility. The problem arises with the latter. Borrowing more—at the “penalty” rate above the basic rate—is seen as revealing a mistake by the borrowing bank. There was, therefore, no way for the Bank of

³⁰ In an article in *The Times* of January 22, 2008, Anatole Kaletsky made a similar contrast, presenting the sensible choices as either administration or nationalization, and condemning the chosen outcome as a device designed only to save the government’s reputation, and one that would be costly to the taxpayer.

³¹ On Monday, February 18, 2008, the government announced the latest development in the Northern Rock story. The bank was to be nationalized. It was in public ownership by Friday, February 22. The details of events leading up to this point are sparse and so are relegated to appendix 3 of the House of Commons report (HC 56-II, 2008b).

England to supply additional liquidity to Northern Rock through the standing facility, even if offered good and normally acceptable collateral, without giving the impression that Northern Rock had in some way blundered, thereby further eroding its ability to raise funding from the markets.

Under the money market system in use when the classic lender-of-last-resort system was developed, the discount houses were continually transacting with the Bank, frequently borrowing more than once per day. Hence, such borrowing was not considered abnormal and did nothing to cause alarm. In contrast, the new money market operating procedure, while perfectly capable of getting cash to banks at times of stress, did so in a way that highlighted the stress.

This fact suggests that it would be sensible to adopt arrangements where access to the standing facility at the 1 percent penalty rate is offered anonymously, since this would make it easier for banks individually and collectively to bridge an unexpected shortfall in liquidity.³² In the future, such an arrangement could help other institutions facing liquidity problems, but it would have been insufficient to prevent Northern Rock from defaulting on short-term obligations. Why? Northern Rock had such a large funding shortfall that it would not have had nearly enough eligible collateral (such as government bonds) to use for this type of borrowing. (At the time of Northern Rock's problems, the Bank of England did not accept mortgages or other loan assets, or even securitized mortgages, as collateral for access to the standing borrowing facility.) So it is clear that anonymous access to the standing facility, while possibly helpful in general, would not have resolved the liquidity problems at Northern Rock.

It can be argued that the Bank of England could still have provided support to Northern Rock through the standing facility by widening the range of eligible collateral. This solution, however, is problematic because other assets held by banks, such as retail or corporate loans, are illiquid and therefore very hard to value. Even when bank loans are made more liquid, through asset-

backed securitization, the tranches issued by the securitization vehicle are still not actively traded and are therefore very difficult to value. Thus, widening the range of eligible collateral would require very large "haircuts" (the margins by which the estimated value of the collateral must exceed the amount borrowed), which in turn would have further weakened Northern Rock's balance sheet. Northern Rock would have obtained liquidity but at the price of running out of capital.

Indeed, even with anonymity and widening of eligible collateral the standing borrowing facility would never be appropriate for the provision of funding on the scale required by Northern Rock: Its borrowing from the Bank of England eventually amounted to more than one-quarter of its total assets. A facility on such a scale far exceeds the normal needs of liquidity management and would necessitate careful assessment of the viability of the borrowing bank to ensure that it has sufficient financial resources for continued business viability and that it is not just borrowing to delay inevitable collapse. However it is arranged, the standing facility must be limited in magnitude.

Interbank Linkages

The nature and extent of interbank linkages create a problem with the sink-or-swim option. If a bank were to "sink" and go into liquidation, then its transactions, its assets, and its liabilities would be frozen. A court-appointed liquidator would try, by avoiding a "fire sale," to dispose of the assets at the best possible price, quite possibly taking some time to do so to minimize the loss for creditors. This process would cause immense problems for a modern banking system because it could leave many transactions uncompleted for months or even years. In an insolvency, repo borrowing (financing through an initial sale of a security and its later repurchase at a slightly higher price) is closed out, in a manner similar to over-the-counter derivative transactions, but unsecured borrowing, such as Northern Rock relied on because it lacked eligible collateral for repo financing, must be left to be finally resolved through the insolvency procedure.

³² Whether anonymity can be preserved when a large operation is ongoing is not as clear—the operation would almost certainly be noticed.

Retail Depositors

When “sink or swim” was the course of action, retail depositors differed in two ways from their modern-day counterparts. They were (relative to the population as a whole) more prosperous, and they did not rely to the same extent on bank transactions for day-to-day living—banking services were not as crucial to functioning in nineteenth-century society as they are now. In Britain today the politicians, who make the ultimate decision over bank closure, could not tolerate bank customers, especially poor ones, losing both money and access to banking services. Indeed, aside from any questions of protecting savings, loss of access to banking services would impede economic efficiency in many ways—for example, forcing reliance on cash and unwarrantedly destroying credit ratings. Britain does have a deposit insurance scheme supposedly intended to deal with these things, but, as argued below, it is significantly defective.

WHAT CAN BE DONE TO SOLVE BANKING CRISES?

We propose three aspects of the system for dealing with banking problems: (i) the deposit insurance fund, (ii) bank support, and (iii) prompt closure and payout.

Deposit Insurance

Deposit insurance is needed because it is impossible to avoid a commitment to protect depositors. This commitment cannot be avoided, for both political and economic reasons. The public expects that its money will be safe with any bank that has a banking license. Thus, in the event of a bank failure, it is politically damaging for the government of the day to allow small depositors to suffer losses. This is not quite inevitable; small depositors have on occasion lost money.³³ But it is difficult to avoid.

³³ Consider, for example, depositors in the Bank of Credit and Commerce International (BCCI). Depositors there had to rely on the deposit insurance fund. That case, however, was perhaps special since BCCI was closed because it was run fraudulently.

How large must a bank be in order to be politically “too big to fail”? One lesson of the Northern Rock situation is that the political necessity of supporting depositors seems to apply to much smaller banks today than it did in the past. A few years ago it was possible for covert financial support to be offered to a bank (in practice, this was then done indirectly, by persuading other banks to continue offering credit), and reports of concerned depositors queuing outside bank branches were not widely disseminated.³⁴ Thus, the provision of support to bridge a wholesale funding gap might have been enough on its own to prevent a liquidity crisis. Nowadays, in contrast, even a relatively small bank requires a clear commitment to protect depositors to maintain the stability of the deposit base.

There are also good economic reasons for protecting depositors in both large and small banks. In the case of large banks, this is necessary to protect against the economic consequences of a loss of a significant share of household wealth. As we discuss further below, it is also clear that this support cannot be simply in the form of a cash payout; large banks that are “too big to fail” must be maintained as going concerns in order not to lead to loss of essential lending and payment functions.³⁵ This obligation to support large banks in turn means that it is beneficial to protect depositors in smaller banks so that the smaller banks can compete effectively with the large banks that are perceived as “too big to fail.” The difference is that a small bank may be allowed to “fail,” provided depositors are promptly and fully compensated and arrangements, such as those described below, are made to ensure that these depositors continue to have access to banking services.

Deposit insurance cannot be avoided. Further, one of its benefits is that it is an explicit scheme because it can clearly state exactly who is protected and to what extent. This clarification then reduces the political pressure to provide a general

³⁴ Such depositor queues did take place at the time of the secondary banking crisis in the early 1970s but were not widely reported. This may be because the media of the day were more compliant.

³⁵ We emphasize that this does not mean that either management or shareholders are protected. It means simply that the operations of the bank are continued.

bailout of uninsured depositors, other creditors, and perhaps even of shareholders.

How should this scheme operate in practice? The protection should be 100 percent up to an appropriate limit; £35,000 per depositor per institution—the limit set in the government guarantee arrangements for U.K. bank depositors following the crisis at Northern Rock—is surely sufficiently large. This guarantee would be large enough to fully protect a little over 90 percent of depositors.

Premia should be paid by banks on a regular basis, in proportion to the amount of their insured deposit liabilities. Premia might have an element of risk sensitivity (e.g., according to the leverage of the bank). These premia should then be paid into the deposit insurance fund so that it has financial resources available to deal with a bank failure immediately. This requires maintaining the fund at an appropriate percentage level of total insured deposits (5 percent of total deposits seems appropriate, but it is worth considering the exact target level for the fund in light of the experience of other countries). In the event of a benign period, with no calls on the fund's resources, then the fund will become full and premia can be reduced to the level needed to maintain the ratio of fund assets to insured deposits. The fund itself should be invested in very safe assets such as government securities.

The deposit insurance fund must be further supported through a guaranteed first line of credit from the central government so that it can deal with a bank failure larger than the amount in the fund. In the event of such a call in which the fund is forced to use this line of credit, insured banks will then be required, after the event, to pay relatively high deposit insurance premia, and if necessary a special levy, to restore the fund within a reasonable time frame.

The deposit insurance fund requires the further explicit financial backing of the government in the form of an open-ended second line of credit—with the difference between the first and second lines of credit that there is no obligation on other insured institutions to repay this second line. Instead, once the crisis is resolved, the government will absorb this liability on its own books. We outline the reasons for this second line of

credit after the discussion of our bank closure proposals.

These funding arrangements, by building up assets in the fund and with lines of credit from the central government, avoid the principal problem of pure private sector deposit insurance: imposing relatively large contributions on banks when the economy is weak and banks' capital is under pressure. The remaining problem is determining how rapidly to build the fund to its desired level, both when it is first established and after any major call on the fund's resources. Some flexibility in the speed of repletion may be in order, depending on banks' abilities to provide the necessary funding.

Bank Support

We now turn to the second element of reform: clear but strictly limited procedures for the provision of financial support. As our previous discussion makes clear, offering bank support is not a lender-of-last-resort operation; it does not involve providing liquidity to the market as a whole to prevent a run for cash. However, it is also clear that the option of letting any bank in liquidity difficulties fail may create both inefficiency and systemic problems.

Inefficiency arises because the refusal to provide short-term liquidity to an institution that cannot obtain credit from the private sector threatens solvency. If the problem cannot be quickly resolved by private sector arrangements (e.g., a takeover or a recapitalization), then the resulting reorganization of the bank can lead to substantial loss of value. Systemic problems arise because the failure to provide short-term support can affect other financial institutions; such effects could be in the form of loss of confidence among uninsured depositors or increases in spreads in interbank markets.

Support to a troubled bank must be provided on strict terms. First, it must be provided against collateral—enough collateral and of sufficient quality—so that the risk of credit loss arising from the support operation is negligible. Unlike the situation with the standing facility, no strict rules are needed for collateral eligibility; this collateral could include loans or nonstandard securities,

but the valuation must be conservative. Second, it must be provided at a penalty cost above market rates for collateralized borrowing so that the provision of government liquidity is not a liquidity subsidy. Finally, the support must be strictly limited in duration, with a requirement for transfer of control from shareholders to the financial authorities after a defined period, which we believe should be about three months.

Prompt Closure and Payout

Our third provision in bank crisis resolution is the need for special procedures for intervention in a financial institution to resolve its financial distress and make a rapid payout to depositors. At present, this is not possible in the United Kingdom because closure follows standard U.K. corporate insolvency law: A creditor applies to put a business into administration, and the provider of liquidity support and the deposit insurance fund then have no preference over other creditors. A new legal framework is required.

This proposed framework requires that intervention in a bank, in which shareholders lose both ownership and control rights, must take place in either of the two following circumstances:

- when the maximum period of 3 months of support operation has passed or
- when net worth declines below some minimum level(s), short of balance-sheet insolvency; this might correspond to the usual Basel requirement on risk-weighted capitalization with intervention at the tier 1 level of 4 percent; but a simpler additional requirement might be to intervene based on unweighted leverage (equity as a proportion of total assets).

Different mechanisms that could be used for such intervention include the following:

- The bank could operate as a going concern, but with cash flow subsidy from the deposit insurance fund, with a view to preparing it for a private sector sale. Shareholders then could be reimbursed if the proceeds of this sale exceeded the amount needed to reimburse the fund.

- The bank could transfer deposits to another financial institution, together with cash from the deposit insurance fund. The bank assets could be reorganized or sold to pay out liability holders with the deposit insurance fund first in the queue and the shareholders last.³⁶
- The bank could transfer deposits, together with performing assets, to a “bridge bank” (requiring an injection of funds from the deposit insurance fund) and prepare this bank for sale. The deposit insurance fund would then acquire a claim on remaining nonperforming assets, with shareholders receiving payment only if these eventually realize more than the transfer from the deposit insurance fund.

If an effective prompt closure scheme is already in place, why do we believe there will be any need at all for bank support? We think this is still required because prompt closure (of the kind mandated, for example, by the U.S. Federal Deposit Insurance Corporation Improvement Act) is always based on accounting measures such as net worth. Where substantial off-balance-sheet problems exist (as was the case for Northern Rock), the first sign of difficulties is likely to be a withdrawal of wholesale funding, but it is not then necessarily appropriate for the authorities to move the bank directly into the closure regime.

The possibility of offering temporary bank support against collateral should be an alternative option to immediate closure. The authorities should have the right—but not the obligation—to provide this type of support (and they will not be likely to do so if the sums involved are so large as to suggest inevitable closure).

We do not consider in detail the arguments over whether this short-term support is to be publicly disclosed, but it is reasonable to maintain that disclosure should be on the same terms

³⁶ This order of priority follows U.S. practice. The virtue of that approach is that it has been tested and has worked. But if the deposit insurance fund were to come second-last in priority, preceding only shareholders, then it would have a powerful incentive to maximize the value realized for the business, and that is desirable from the point of view of achieving efficient use of the business's resources.

as other bank wholesale borrowing (i.e., the bank must disclose it has borrowed against collateral so that other debtholders are aware) but need not say that it is the government that has via the central bank provided this support. Of course, for large banks it would not be possible to keep the support quiet.

The merits and demerits of the various approaches to bank closure are not compared in this paper. We do, however, note that any resolution other than maintaining the bank as a going concern involves tricky technical problems of account transfer. This is no longer the nineteenth century, and bank rescue no longer means just a cash payout to depositors. Depositors need to be able to continue holding deposits and making and receiving payments. This means that salary and other payments will need to be rerouted and direct debits and other payment arrangements transferred. This, in turn, means that depositors need to have within a very short period (say 48 hours) either a clean transfer of all their banking arrangements to a new institution (either existing or *de novo*) or reorganization of the troubled institution (with all nonperforming assets removed) so that banking services then can be provided on an ongoing basis thereafter.

Transfer of accounts to a new institution is technically difficult. The various routing codes (sort codes in the United Kingdom) and bank account numbers must be updated. Payment arrangements must be transferred, and new payments cards may have to be issued. Even if the existing systems architecture of the bank is transferred to a new bridge bank (so that from the depositors' perspective they are dealing with the same institution as before), systems transfer problems arise with the nonperforming assets transferred out of the bank. Loan accounts still need to be monitored and repayments credited to these accounts. Staff will need to manage accounts in default. Given these requirements, it is clear that detailed consultation with the industry will be needed, perhaps through the U.K. Payments Council, to develop practical procedures.

CONCLUSION

This paper has shown how the highly unusual business model pursued by Northern Rock made it especially vulnerable to liquidity problems after repricing of credit risk in global markets during the summer of 2007. Britain was lucky in the resolution of the Northern Rock affair. Confusion in how official actions were announced undoubtedly created anxiety, but for all practical purposes the run was confined to Northern Rock. This fortunate result may have been a beneficial spillover from the government deposit guarantee that Northern Rock received, or perhaps it was due to a well-entrenched belief that British banks were safe.³⁷ Such luck cannot be relied on for the future.

We propose the following actions to make the British banking system robust once more.³⁸ First, there should be arrangements for prompt and orderly closure of a troubled bank—before it would otherwise be forced to close by either insolvency or illiquidity. Second, deposit insurance should be reformed so that whatever sum is guaranteed is completely guaranteed and can be accessed without any significant delay—by this, we mean essentially one business day. This requirement, of course, implies a cap on the guarantee at a fairly modest level. We have seen no arguments for raising the cap above the present level of £35,000; that amount would cover more than 90 percent of retail sterling bank deposits. Third, arrangements are needed so that customers retain access to all core banking services, either through speedy transfer of all accounts or the continued operation in some guise of the troubled bank.

With these reforms in place, Britain should be able to return once more to its classic, well-tested method of dealing with banking problems as first fully set out by Henry Thornton in 1802. These measures would preserve financial stability without encouraging bad, imprudent, or even

³⁷ The guarantee given to Northern Rock depositors was briefly extended to depositors at other banks, but there were few signs of other runs starting even before that was done.

³⁸ These proposals do not concern themselves with reform of regulatory and supervisory structures. Proposal for such changes, wholly compatible with the proposals in this paper and fully supported by its authors, are in the report of the Treasury Select Committee.

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reckless banking—and there is quite enough of that already around without encouraging it further. And so we hope that these or similar proposals are implemented soon.

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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

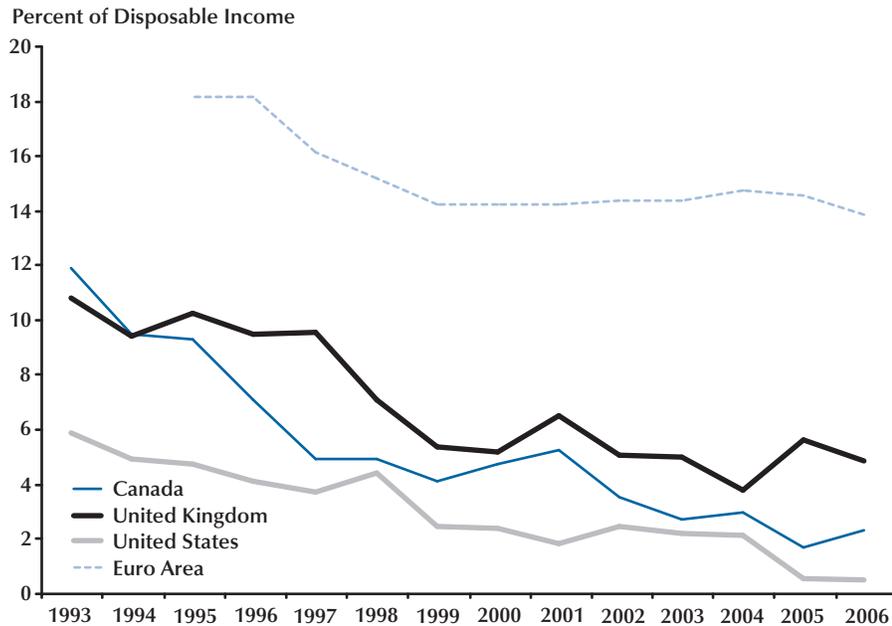
The beginnings of what is now referred to as the 2007-08 credit crunch appeared in early 2007 to be localized problems among lower-quality U.S. mortgage lenders. An increase in subprime mortgage defaults in February 2007 had caused some excitement in the markets, but this had settled by March. However, 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



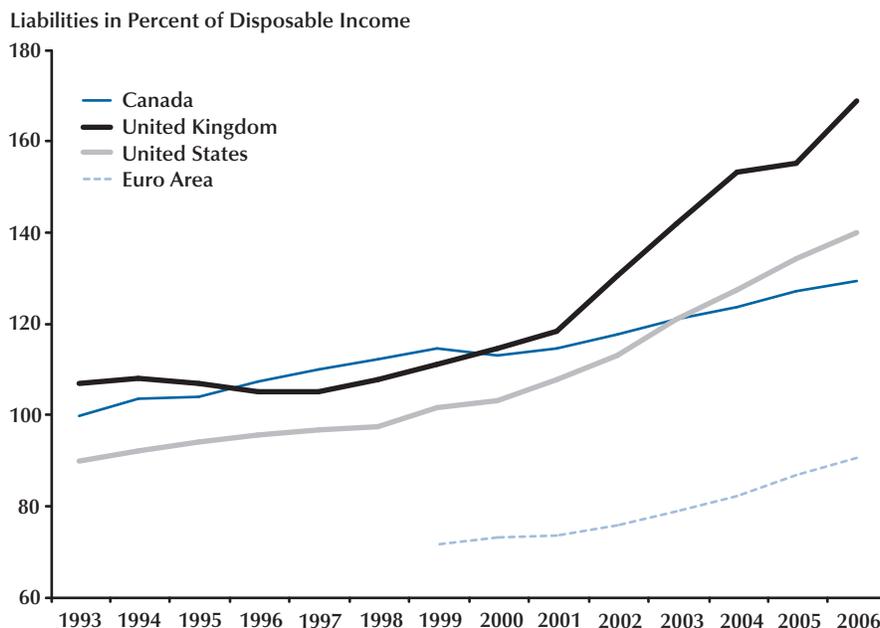
SOURCE: OECD Economic Outlook and ECB Monthly Bulletin.

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.

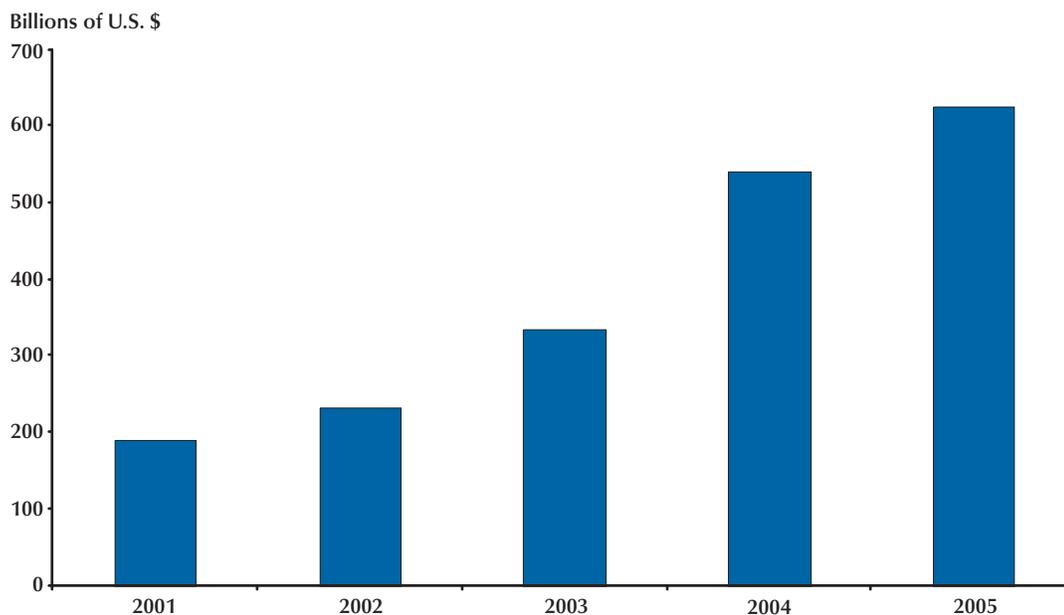
The main differences between a prime mortgage and a subprime mortgage from the borrower's perspective are higher up-front fees (such as application and appraisal fees), higher insurance costs, fines for late payment or delinquency, and higher interest rates. Therefore, the penalty for borrowing in the 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.

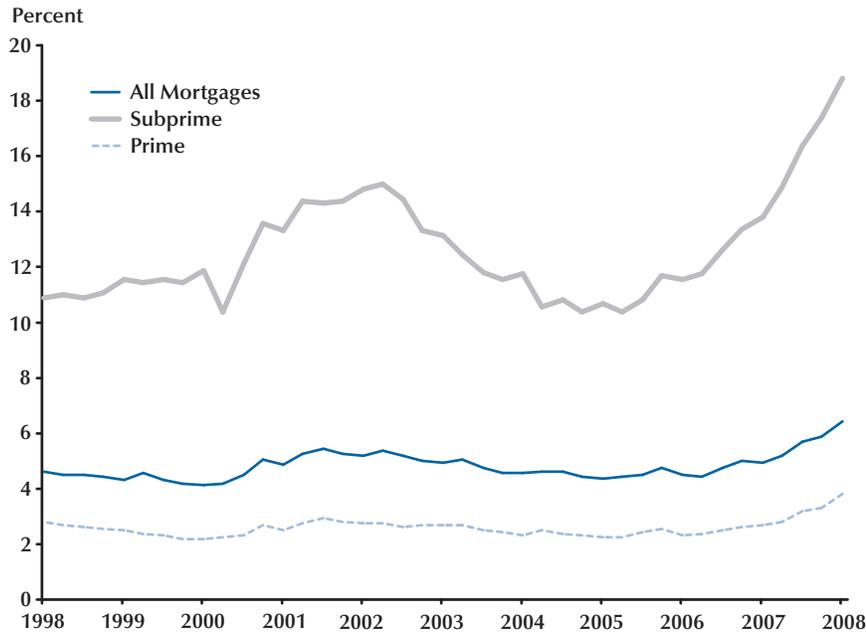
Why did subprime mortgages, which comprise a small proportion of total U.S. mortgages, transmit the credit crunch globally? The growth in the scale of subprime lending in the United States was compounded by the relative ease with which these loans could be originated and the returns that could be generated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



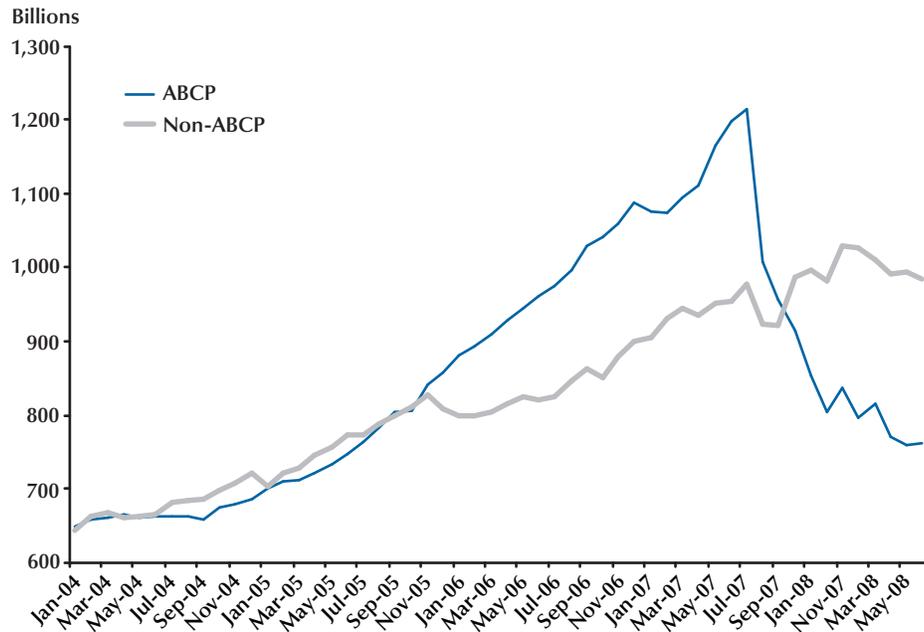
SOURCE: Mortgage Bankers Association/Haver Analytics.

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

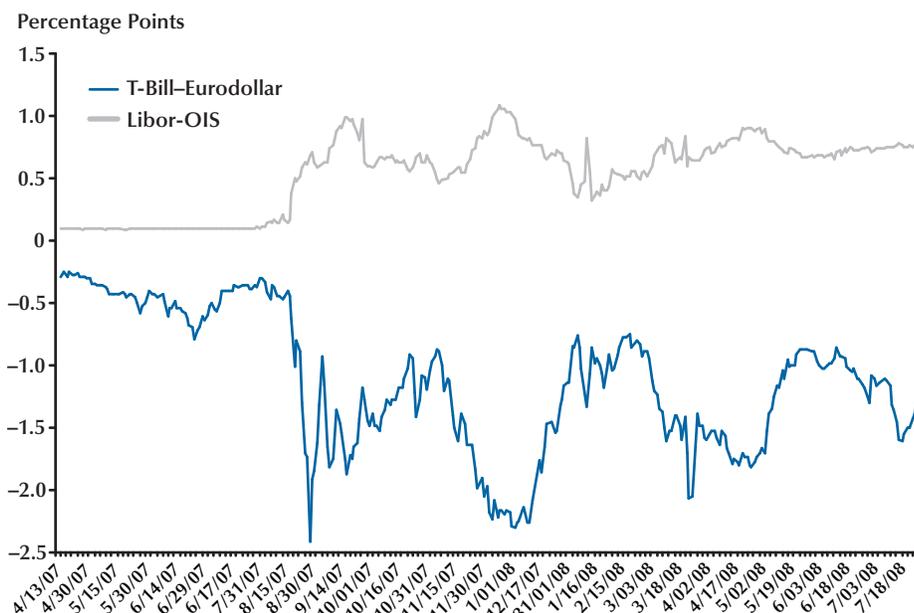
years. The ABCP needed to roll over periodically, usually monthly, but as investors were less willing to purchase short-term paper in the capital markets, these entities could not obtain the necessary short-term funding from these markets. Figure 5 shows that ABCP issuance peaked in July 2007 and fell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

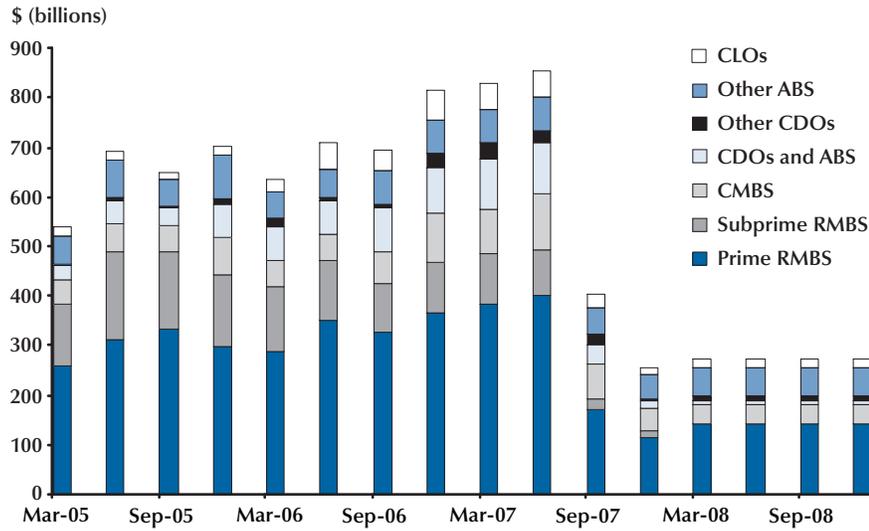
lend to other banks for fear of the scale of counterparty risk. If borrowing banks had unrevealed losses they might not repay the funds that they borrowed from other banks. The market response was demonstrated by two other interest rate spreads shown in Figure 6: the LIBOR-OIS spread (the London Interbank 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-

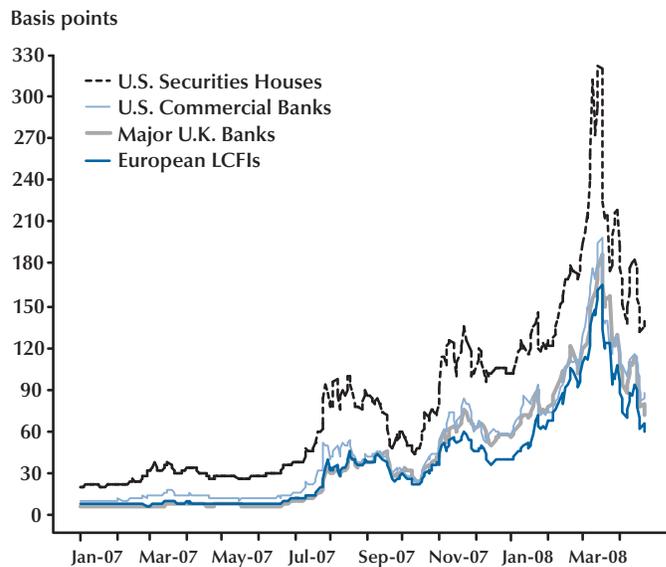
⁹ The LIBOR-OIS spread is the spread most often used by central banks to describe the increase in the cost of interbank lending, reflecting credit and liquidity risk. See Arain and Song (2008, p. 2) and Bank of England (2008, p. 15). LIBOR is set by the British Banker's Association in London. The LIBOR 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's 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

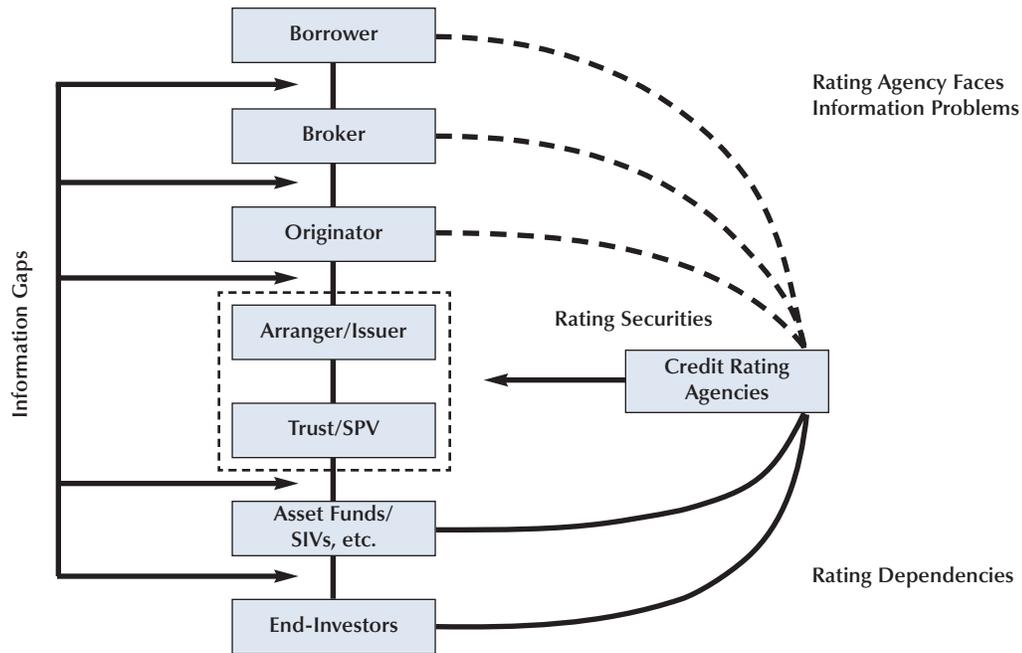
²⁷ Regulators were not sufficiently aware of the dangers offered by incentives set at the time, and some of the agents were outside their jurisdiction in any case.

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 (Buitier, 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. Buitier (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.

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.

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

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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