ECONOMIC ADVISORY PANEL MEETING

NOVEMBER 21, 2008

OVERVIEW OF U.S. ECONOMIC AND FINANCIAL MARKET DEVELOPMENTS

Discussion and Charts

Prepared by the staff of the
Research and Statistics Group

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Recent U.S. Economic and Financial Market Developments

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We last met in mid April of 2008, roughly two weeks prior to the late April meeting of the FOMC. The recently-released employment report for March indicated that nonfarm payroll employment had declined by 80,000, following a 76,000 decline in February, and that the unemployment rate had increased to 5.1% from 4.8% the previous month. (The cyclical low of the unemployment rate had been 4.5%, the average from 2006Q4 through 2007Q2.) At that time, growth over the first half of 2008 was expected to be about -1% (annual rate). Three key factors had led to the prospect of a mild downturn. First, oil prices (WTI) had risen from around $60 in April 2007 to an average of $112 in April 2008. This energy price shock was causing a pronounced slowing of growth of real disposable income and real personal consumption expenditures. Second, housing construction was still plunging while the rate of home price decline had steepened. Finally, the ongoing financial crisis had intensified with the collapse of Bear Stearns in mid March.

Nonetheless, growth was expected to rebound in the second half of 2008. After a somewhat sluggish response in the closing months of 2007, with the new year the FOMC undertook an aggressive easing of monetary policy, including a 75 basis point reduction (to 2 ¼%) of the federal funds rate at its March 18 meeting. In addition, the Federal Reserve had unveiled a number of new facilities designed to enhance financial market liquidity. These actions were beginning to have a beneficial effect on credit spreads. Similarly, the stock market was rising after having declined about 15% from its mid 2007 peak through mid March. In addition to the aggressive response of the monetary authorities, the fiscal authorities had quickly crafted and passed the Economic Stimulus Act of 2008 which provided roughly $100 billion of rebates checks to households and another $50 billion for bonus depreciation deductions for business investment placed in service in 2008.

Economic developments since April

Inflation.

From April through July, oil prices continued to move higher. WTI averaged $133/barrel in July, up 20% from an average of $112 in April. On a few days in mid July the spot price of WTI exceeded $145/barrel. Over that same period, the wholesale price of regular gasoline rose from $2.50/gallon to $3.40/gallon, a 36% increase. Many non-oil commodity prices also rose sharply over the first half of 2008. In particular, spot prices for foodstuffs rose 27% from the end of 2007 through July 2008. By July the three-month annualized percent change of the PCE deflator rose to nearly 8%, led by an 80% increase in the energy component and a 7 ½% increase in food prices. (Energy has a current weight of about 7.1% in the PCE deflator while food has a current-weight of about 13.9%.) **[Figures 1 & 2]**

The rate of increase of the core PCE deflator also moved higher over this period. **[Figure 1]** It was rising around 2% in April and May (3 month annualized percent change), but was up to around 3% in July and August. A conventional Phillips curve model of core PCE deflator inflation attributes the bulk of that increase to the more rapid rate of increase of import prices. This includes pass through of higher energy and other commodity prices as well as faster rates of price increase (or slower rates of price decline) for a broad range of goods. **[Figure 3]**

Since July, spot oil prices have moved steadily lower except for a brief hurricane-related up tick in September. For the first week of November the WTI spot price averaged $70.50/barrel, and at this writing that price is under $60. Non oil commodity prices have also plunged, with the CRB index down nearly 30% from its July peak. Over the three months ending in September the annualized rate of change of the energy component of the PCE deflator turned negative, with very steep declines expected in the fourth quarter. As a result, the three-month change in the

total PCE deflator slowed to 3% (annual rate) in September. For all of 2008Q4 we expect the PCE deflator to decline at a 1 ¾% annual rate, the largest quarterly decline since 1949.

Core inflation has also slowed in recent months. The three-month change in the core PCE deflator was back down to 2 ½% (annual rate) by September. Both core goods and core services have contributed roughly equally to the slowing. Prices of non-food, non-energy goods such as apparel and consumer durables have quickly changed course and are now falling again. The rate of increase of import prices for vehicles and parts and non-auto consumer goods has slowed sharply in recent months, reflecting both the weakness in demand and the waning impulse of the decline in the exchange value of the dollar since 2002. Indeed, the broad, trade-weighted dollar index has appreciated about 12% in nominal terms from its July low. **[Figure 4]** The rate of increase of core services prices has also slowed recently as the rate of increase of transportation services prices has slowed while the rate of increase of shelter prices continued to move lower.

As one might expect, shorter-dated (2 to 3 years) inflation expectations have moved up and down in line with the rate of increase of energy prices. **[Figure 5]** In contrast, longer-dated (5-10 years) inflation expectations have been relatively stable to slightly lower over this period. (Note that inflation expectations derived from financial markets have moved violently in recently weeks. This issue will be discussed in detail in the overview of financial market developments.)

Real Activity.

Growth of real GDP during the first half of 2008 turned out to be considerably stronger than anticipated, rising at an annual rate of 1.8%. **[Figure 6]** In contrast, prospects for the second half of 2008 are much worse than anticipated back in April. Real GDP is estimated to have declined 0.3% (annual rate) in 2008Q3, while more recent data suggest that growth rate will be revised lower. While the amount of data available on fourth quarter activity is quite limited, as of this writing we anticipate a decline of real GDP of around 4% (annual rate).

Real PCE grew at a 1% annual rate over the first half of 2008, better than expected given the magnitude of the energy price shock, a deteriorating labor market, declining household net worth, and a general tightening of the supply of credit. **[Figure 7 through 10]** The distribution of the rebate checks, originally scheduled for the third quarter, was accelerated to the second quarter. This infusion to the household sector no doubt provided a temporary boost to consumer spending.[1] However, with the release of the August retail sales data it became clear that the effect of the rebates was quickly fading. Moreover, sales of light weigh vehicles fell below 13 million units (annual rate) in the third quarter. High gasoline prices, a tightening of credit for both new and used autos, and falling prices for used vehicles combined to produce the lowest sales volume since 1993. BEA's advance estimate indicates that real PCE declined at a 3.1% annual rate in 2008Q3, the steepest quarterly decline since 1980Q2 when credit controls where imposed. Auto sales weakened even further in October, to just 10 1/2 million units (annual rate), and October non-auto retail sales fell sharply, due only in part to falling gasoline prices. At this point we expect real PCE to decline at a 4% to 4 ½% annual rate in 2008Q4.

Through mid year, incoming data on housing starts, sales, and prices were broadly in line with our expectations, despite the fact that contract interest rates on 30-year fixed rate mortgages moved up from the 5 ¾% to 6% range in the first five months of the year to around 6 ½% by July and August. **[Figures 11 through 14]** Single-family housing starts continued to decline, but the rate of decline was slowing, consistent with our view that housing starts would bottom out in the second half of the year. The rate of decline of sales of new single-family homes was also slowing, and the absolute number of new homes for sale was beginning to decline quite rapidly.

[1] There are a range of estimates of the percentage of these funds that were spent. CBO assumes that 40 cents of every dollar is spent within six months of receipt. This corresponds to an initial estimate made by Macroeconomic Advisers (MA) in January of 2008. In August, MA revised their estimate for this particular round of rebates to 30%.

Sales of existing homes had stabilized around 5 million units (annual rate). Lastly, the rate of decline of home prices, which had been quite intense during the first quarter, was beginning to subside.

However, as the third quarter data came in it became clear that the housing market downturn was re-intensifying. Sales of new single-family homes fell nearly 13% (monthly rate) in August and remained at this lower level in September. Single-family housing starts declined to just 544,000 units (seasonally-adjusted annual rate) in September, roughly 20 percent lower than the 2008Q2 average level and 70% below the 2005Q3 peak level of this cycle. Sales of existing homes remained near the 5 million annual rate in 2008Q3, but they are defined as closings rather than signed contracts and so are a lagging indicator.

This most recent leg down of housing market activity appears to be due to a further tightening of credit conditions. The mortgage insurance industry has tightened underwriting standards in general and stopped insuring loans altogether in some markets. As a result, the share of conventional loans with loan-to-value ratios above 80% has declined sharply in recent months. **[Figure 15]** Initial fees charged to obtain a mortgage have increased, as have minimum credit scores. Anecdotal reports from industry sources indicate that even the FHA program has tightened lending standards. As a result of these developments, we have once again lowered the projected level of the trough in housing starts and moved it forward to mid 2009.

Very current information also suggests that home prices remain under significant downward pressure. **[Figures 16 through 23]** Monthly declines in both the FHFA (formerly OFHEO) purchase-only and the Case-Shiller 20-city composite home price indices were considerably larger in July and August than in the immediately preceding months. Year-over-year declines of home prices remain most intense in California, Florida, Arizona, and Nevada. However, home prices are now falling in the major metro areas of the Northeast as well. Mortgage delinquency and foreclosure rates continue to move higher, and the stock of vacant homes for sale continues to expand. Under these conditions, we suspect that home prices will remain under downward pressure well after housing construction finally bottoms out.

While the performance of consumer spending and housing market activity turned out to be weaker than expected, the growth contribution from net exports has been an upside surprise. **[Figures 24 and 25]** Over the first half of 2008 the net export growth contribution was 1.9 percentage points, versus our expectation of 0.4 percentage points back in April. Based on the advance estimate of GDP for 2008Q3, the growth contribution for that quarter was lower but still 1.1 percentage points. Growth of exports has remained stronger for longer than anticipated; real exports were up 11% over the year ending in 2008Q2 and grew nearly 6% (annual rate) in 2008Q3. Growth of exports to China and Western Europe has been particularly strong.

However, the upside surprise from net exports was due mainly to fact that import growth slowed considerably more than was predicted by traditional models. Analysis conducted at the FRBNY suggests a possible explanation for this is that the import elasticity of demand for residential investment is considerably higher than for domestic demand in the aggregate. This in turn explains the strong growth of imports during the period from 2003 through 2005 as well as the pronounced slowing of imports since then.

Trade data coming in for the month of October, while sketchy at this point, suggest that US import and export activity is weakening as part of a global slowdown. Shipping capacity utilization is reported to be falling and shipping rates have fallen sharply.

Business investment in equipment and software, which had gradually rebounded through 2007Q3, weakened in the final quarter of 2007 and declined thus far in 2008. **[Figure 26]** Investment in IT equipment has been well maintained, although some weakness has begun to emerge in the latest high frequency data. However, investment in industrial equipment and transportation equipment has fallen off quite sharply. In contrast to equipment and software,

business investment in nonresidential structures has remained relatively strong in 2008. **[Figures 27 and 28]** The source of this strength has shifted to structures related to manufacturing, electric power generation and distribution, and petroleum and natural gas production and distribution. More traditional categories of nonresidential structures investment, such as office buildings, hospitals, and warehouses, which had been quite strong earlier in 2006 and 2007, slowed or actually declined thus far in 2008. Despite this recent strength, leading indicators of this category of final demand suggest a significant slowing in 2009.

Inventory investment was a drag on growth over the first half of 2008, in line with expectations. **[Figures 29 and 30]** There was a modest increase in inventory accumulation in the third quarter, but another steep decline is anticipated for the fourth quarter. Inventories relative to final sales of goods and structures have been declining for some time, and that rate of decline appears to have increased in 2008.

The rate of growth of real federal spending increased markedly in 2008 in both the defense and nondefense categories. **[Figures 31 and 32]** In contrast, the rate of growth of spending by state and local governments slowed in 2008. On balance the growth contribution from government in 2008 is expected to be essentially the same as in 2007.

The officially scored federal budget deficit increased to $455 billion or 3.2% of GDP during Fiscal Year 2008, up from $162 billion or 1.2% of GDP the previous fiscal year. Total federal receipts fell by nearly 2% in FY2008, reflecting somewhat slower growth of nominal GDP, over $100 billion of tax rebates to households, and a significant decline of corporate tax receipts. Federal outlays grew over 9% in FY2008 due largely to a sharp increase in defense outlays. State and local receipt growth has slowed significantly in 2007 and is now well below the rate of growth of expenditures.

Growth of manufacturing output, which was moving higher over the course of 2007, has slowed sharply in 2008. **[Figure 33]** Manufacturing output rose 0.6% in October, led by a sharp rebound in production of petroleum and natural gas following hurricane-related disruptions in September. Also, production of aerospace equipment began to recover in October following settlement of the strike at Boeing. But manufacturing output was still down 5.3% on a year-over-year basis in October, with weakness evident in a wide range of industries. For example, output of computer and electronic products declined in August, September, and October.

Employment, Wages, and Productivity

The demand for labor input, which began to weaken in mid-2007, weakened considerably further over the first 10 months of 2008. **[Figure 34]** Over the six months ending in October, nonfarm payroll employment has declined at a 1 ¼% annual rate. Over the past three months nonfarm payroll employment has declined an average of 220,000 per month. The unemployment rate rose to 6.5% in October, exceeding the peak unemployment rate of mid 2003. Over the past two quarters, hours worked in the nonfarm business sector declined at a 1 ¾% annual rate.

The rise of the unemployment rate has been, and likely will continue to be, somewhat steeper than previous business cycles after taking account of the respective growth rates. One reason for this is that thus far the labor force participation rate has not declined as typically occurs during a downturn. Second, the rate of growth of labor productivity has increased over the past year whereas in past downturns it has tended to slow. **[Figures 35 and 36]**

The weakening of the labor market has been associated with a slowing of the rate of increase of labor compensation, at least as measured by the Employment Cost Index (ECI). **[Figure 37]** The rates of increase of both wages and salaries and of benefits have slowed. Within the benefits category, the rate of increase of the cost of health insurance has slowed, as have the rate of increase of benefit costs linked directly to wages.

Financial markets. The financial crisis intensified markedly since the last EAP meeting in April. Continued asset writedowns and funding problems increased concerns about the viability of numerous financial firms. Such concerns escalated with the bankruptcy of Lehman Brothers on September 15 and the rescue of AIG on September 16, and led to the sudden takeover, or conversion to bank holding companies, of the remaining large investment banks. The nation's largest thrift bank, Washington Mutual, was seized by the FDIC on September 25 and the FDIC facilitated a planned takeover of Wachovia by Citigroup under its systemic risk exception (Wachovia subsequently agreed to be acquired by Wells Fargo).

Conditions in financial markets deteriorated notably with prices on many riskier assets falling sharply, credit and term spreads widening, volatility increasing, and liquidity in many markets deteriorating. These developments partly reflected the increased losses and risks in the financial sector, as well as risk aversion and financial sector deleveraging, with the resultant decline in capital committed to market making and arbitrage activities. The developments also appeared to reflect greater perceived downside real risks, in part because of fears of an adverse feedback loop between financial markets and the real economy.

In an attempt to address the foundations of the crisis, the Treasury Department proposed, and Congress eventually passed, the Troubled Asset Relief Program (TARP). The program was originally intended to purchase troubled assets from financial institutions, but was subsequently modified to instead supply capital directly to financial institutions. The FDIC also took steps to shore up confidence in regulated institutions by increasing the limit on insured (interest-bearing) deposits, insuring non-interest bearing deposits without limit, and agreeing to insure the senior debt of regulated institutions. The Federal Reserve undertook numerous steps to improve market functioning and ensure borrowers' access to financing, as discussed later.

Concerns about the creditworthiness of financial firms had been increasing modestly through the late spring and summer, as evidenced by widening CDS and credit spreads [**Figures 38, 39**]. These spreads then spiked higher at the time of the Lehman bankruptcy and AIG rescue. The announcement of capital injections from the Treasury department and that the FDIC would insure the senior debt of regulated institutions caused a sharp drop on October 14, although spreads remain wide by historical standards.

Corporate credit spreads more generally widened through the late spring and summer, perhaps reflecting growing concerns about the real-side effects of the crisis, and then jumped higher around the time of the Lehman bankruptcy [**Figures 40, 41**]. These spreads continued to widen out through September and October gaining little relief from the policy efforts targeted to financial firms as real-side effects of the crisis started to materialize. Of particular concern to the real sector, spreads on consumer asset-backed securities, which had widened throughout the summer, have widened more recently at an accelerated pace, indicating sharply higher consumer financing costs [**Figure 42**]. Corporate issuance, particularly high-yield, had been declining even before September's developments [**Figure 43**].

Subprime mortgages contained the origins of the financial crisis and continue to sustain it. The ABX index, indicative of prices on subprime mortgage-backed securities, has generally declined since the last EAP meeting [**Figure 44**]. This is particularly true of the highly rated AAA and AA tranches. Values of these tranches fell further last week when the Treasury announced it would not use the TARP to purchase troubled assets from financial institutions.

The poor performance of outstanding MBS backed by lower quality mortgages has caused private label MBS issuance to virtually cease [**Figure 45**]. The spread between conforming and jumbo mortgage rates, already quite wide at the time of the last EAP meeting, has widened even further [**Figures 46, 47**]. Moreover, both conforming and jumbo mortgage rates have increased in absolute terms and relative to Treasuries. Conforming spreads immediately narrowed 50 basis points when Fannie Mae and Freddie Mac were put in conservatorship in early September, but

widened about half as much in ensuing weeks. Jumbo spreads narrowed about 30 basis points, but have since given back all those gains.

Reduced borrower creditworthiness, losses at financial institutions, and heightened uncertainty have led banks to tighten lending standards and widen spreads [**Figure 48**]. Despite this, commercial and industrial loans outstanding continue to grow, perhaps reflecting the drawing down of bank lines of credit [**Figure 49**].

Increased concerns about the health of financial institutions and increased demand by these institutions to hold liquidity increased strains on money markets since the last EAP meeting. Unsecured lending spreads to Treasuries and LIBOR/OIS spreads jumped higher in mid September and continued widening over the next month [**Figures 50, 51**]. Various policy initiatives, including the Treasury capital injections and an expansion of U.S. dollar lending by the Fed and foreign central banks have since caused these spreads to narrow considerably. Treasury bill rates, in contrast, declined sharply in mid September with flight-to-quality flows and have remained low despite massive increases in bill issuance through the Treasury Supplemental Financing Program [**Figure 52**].

Money markets were particularly affected by the September developments. The bankruptcy of Lehman Brothers led to losses at money market mutual funds and caused one fund to break the buck. Concerns about losses at other funds led investors to withdraw funds more widely and reduced the ability of commercial paper issuers to roll over borrowings. Commercial paper outstanding declined for several consecutive weeks from mid September, most notably for unsecured paper [**Figure 53**]. Amounts outstanding then bottomed out right before the Fed's Commercial Paper Funding Facility was introduced and have risen appreciably since then. The increase in paper outstanding since the October 22 trough ($154 billion) amounts to about $100 billion less than what the Fed has purchased through the CPFF ($258 billion).

The flight-to-quality in mid September also caused Treasury repo rates to decline sharply [**Figure 54**]. Subsequent declines in the fed funds target rate and the even lower level of the effective fed funds rate have kept this rate close to zero. The low level of Treasury repo rates contributed to a high level of settlement fails in the Treasury market [**Figure 55**]. Such fails commonly arise in low interest rate environments and can adversely affect market functioning because of increased counterparty credit risk concerns and increased operational costs.

Equity market indices fell sharply since the last EAP meeting as the economic outlook deteriorated and downside risks to real activity and corporate profits increased [**Figure 56**]. The S&P 500 index, for example, declined over 35% over this period and is close to its lowest level since March 2003. Not surprisingly, financial firms were particularly hard hit [**Figure 57**]. Implied and realized equity volatility rose sharply [**Figures 58, 59**].

The developments in the economy and credit markets led to sizable drops in short-, but not long-term Treasury rates [**Figures 60, 61**]. The 2-year nominal rate fell about 100 basis points since the last EAP meeting, from about 2¼% to about 1¼%, close to levels last reached in June 2003. In contrast, the 5-year rate fell about 50 basis points to just over 2¼% and the 10-year rate was basically unchanged at about 3¾%. It follows that one-year forward rates are now lower at the short-end of the curve than they were in mid-April and higher at the long-end [**Figure 62**].

Real rates increased notably since the last EAP meeting despite the deteriorating outlook and lower expected path for policy [**Figure 63**]. By some measures, the 5-year real rate is now higher than the 5-year nominal rate [**Figure 64**]. In contrast, the 5-year, 5-year forward real rate (that is the 5-10 year real rate) rose less than the nominal rate over the period [**Figure 65**]. Some of the changes and differences may reflect an environment of poor liquidity and high liquidity risk premia. TIPS are far less liquid than nominal Treasury securities, so a flight-to-liquidity could cause TIPS prices to decline (that is, yields to increase).

Market-based measures of inflation expectations are hard to gauge in the current environment given poor market liquidity and high liquidity premia, but generally suggest near-term deflation followed by typical or higher-than-usual inflation several years out. Some measures derived from TIPS and nominal securities indicate modest expected deflation over the next few years [**Figure 66**]. Longer-term measures constructed using the same methodology indicate unusually high inflation five to 10 years out [**Figure 67**]. A caveat of these measures, and an indication of how disrupted the markets are, is that measures of expected inflation from TIPS and nominal securities differ drastically depending on the particular estimation method used [**Figure 68**].

An alternative way to gauge inflation expectations from market prices is to look at the rates on inflation swaps. While inflation swaps are even less liquid than TIPS, the rates are not directly affected by liquidity differences among securities. Implied inflation from swaps over the next five years has also decreased sharply since mid-April, but its latest value is far above zero [**Figure 69**]. One-year forward rates calculated from inflation swaps suggest deflation over the next two years, but positive inflation after that [**Figure 70**]. Over the long term, inflation is expected to revert to its usual range [**Figure 71**].

International equity markets behaved similarly to that of the U.S. since the last EAP meeting, reflecting the global nature of the financial crisis and associated real-side implications. The DAX, FTSE, and Nikkei indices all declined 30-40% since mid-April, in line with the decline in the S&P 500. Long-term sovereign yields in Europe converged toward U.S. levels, with 10-year German bund rates declining almost 50 basis points to about 3¾%. JGB yields increased slightly to 1.5%. Reflecting the impact of the financial crisis on financial institutions worldwide, LIBOR-OIS spreads for the euro and the pound behaved similarly to those for the U.S. dollar, and remain elevated [**Figures 72, 73**].

The dollar abruptly reversed its general trend of depreciation since 2002, with nominal dollar indices indicating appreciations of 15-20% since April [**Figure 74**]. The dollar rose about 20% against the euro, in particular [**Figure 75**]. In contrast, the dollar depreciated just over 5% against the yen [**Figure 76**].

Consistent with the global deterioration in the economic outlook and the greater downside risks to that outlook, commodity prices have declined sharply in recent months. Spot oil prices are down 50% since the last EAP meeting, and even more sharply from their peak in July [**Figure 77**]. Agricultural commodity prices are also down sharply, with wheat, corn, rice, and soybeans all off 30-40% since mid-April and even more since their recent peaks [**Figures 78, 79**].

Monetary policy. While the FOMC sought to balance downside real risks and upward underlying inflation pressures through the late spring and summer, recent market developments have made downside real risks its more immediate concern. The appropriateness of this shift has been borne out by recent weak economic data. The FOMC has responded to the deteriorating real outlook, greater downside real risks, and concerns about the adverse feedback loop between financial markets and the real economy. In addition, with financial markets becoming increasingly disrupted, the Fed expanded on older initiatives and engaged in several new initiatives in response to threats to orderly market functioning.

The FOMC lowered its policy rate a cumulative 125 basis points to 1% since mid-April [**Figure 80**]. The FOMC had aggressively cut rates in January and March as the financial crisis intensified, the real outlook deteriorated, and downside risks increased. When the crisis stabilized in the late spring and summer, the FOMC sought to maintain a balance between downside real risks and upward inflation pressures. The FOMC cut its policy rate 25 basis points to 2% at its April meeting, but made no change at its June, August, or September meetings. The FOMC then cut rates 50 basis points in an inter-meeting move coordinated with several foreign central banks and cut rates a further 50 basis points to 1% at its late October meeting.

The expected path of policy shifted down in line with the policy rate since mid-April [**Figure 81**]. Note that the path is intended to measure the expected path of the *effective* fed funds rate, which has been trading below the target rate [**Figure 80**]. The expected rate for November is only about 40 basis points, which likely reflects the low level of the effective fed funds expected for the rest of the month, as well as the low level experienced month-to-date, as opposed to expectations for an inter-meeting rate cut. The expected policy rate rises to about 1% by August 2009 and 2% by August 2010.

Short-term uncertainty about the level of Eurodollar rates increased sharply in September and early October, but then quickly declined [**Figure 82**]. This behavior is probably being driven by credit and liquidity concerns as opposed to policy rate uncertainty. Longer-term uncertainty about the level of Eurodollar rates remains high, likely reflecting a combination of uncertainty about policy rates and credit/liquidity concerns [**Figure 83**]. Implied skewness measures suggest a modestly greater expectation of a large rate decrease relative to expectations as opposed to rate increase [**Figure 84**].

Besides the easing of policy rates, the Fed implemented several measures to promote orderly market functioning since mid-April, with most coming since mid-September. Through the late spring and most of the summer, the Fed expanded the availability and terms of its facilities. On July 30, in particular, it announced 84-day Term Auction Facility (TAF) loans (in addition to the 28-day loans), it modestly increased the size of its swap line with the European Central Bank, and it introduced the TSLF Options Program. The options program allows for up to $50 billion in borrowing through the Term Securities Lending Facility during periods that are typically characterized by elevated stress in financing markets. Also of note, the Fed authorized lending to Fannie Mae and Freddie Mac at the primary credit rate in mid-July.

Several measures instituted since mid-September increase the ability of financial institutions to borrow U.S. dollars directly from the Fed or a foreign central bank. In September, swap lines were introduced with several additional foreign central banks and the amount available on the lines increased from $67 billion to $620 billion. On October 13, the Fed lifted the limit on the swap lines with several foreign central banks, allowing them to offer unlimited funds at fixed rates. The Fed also expanded TAF auction amounts in September and introduced forward TAF auctions, providing for funding over the year-end. These measures appear to have been effective at easing strains in the interbank lending market, as indicated earlier.

New measures introduced since mid-September address the disruptions emanating from money market mutual funds. On September 19, the Fed announced a facility (the AMLF) to extend non-recourse loans to depository institutions at the primary credit rate to finance their purchase of high quality asset-backed commercial paper from money market mutual funds. At the same time, the Fed announced its intention to purchase agency discount notes to further support market functioning. Also that day, the Treasury Department introduced its Money Market Guaranty Program, whereby it insures the holdings of money market mutual funds that pay a fee to participate.

The Commercial Paper Funding Facility (CPFF) was announced October 7. This facility addresses disruptions in the commercial paper market by providing for direct lending from the Fed to issuers. The launch of this facility, on October 27, seems to have been effective at reversing the decline in paper outstanding, as noted earlier. The Money Market Investor Funding Facility was announced October 21, but has not yet commenced operations. The facility is intended to promote the secondary market for money market instruments through the Fed's senior secured funding of special purpose vehicles formed to buy such assets.

The introduction of new facilities and expansion of existing facilities has resulted in an unprecedented expansion of the Fed's balance sheet [**Figure 85**]. The Fed's assets more than doubled between September 17 and November 12, from $996 billion to $2,214 billion (they were $888 billion at the time of the last EAP meeting in April). Most of the increase can be attributed to

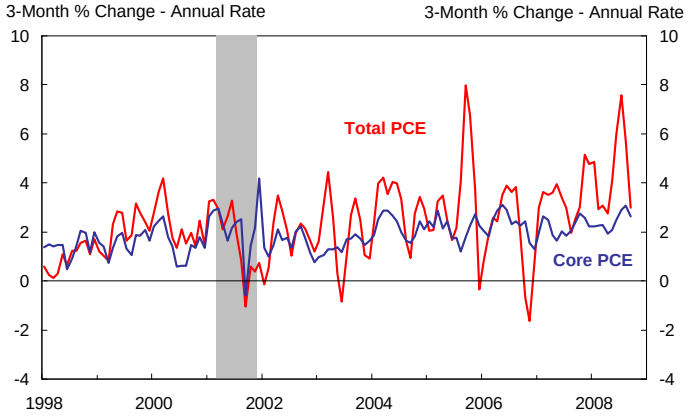
the swap lines, term auction credit, and the CPFF. On the liabilities side, the increase is roughly split between deposits of depository institutions and the Treasury's supplemental financing account. Under the Treasury Supplemental Financing Program, announced September 17, the Treasury issues bills to provide cash for the Fed's lending initiatives. The increase in deposits of depository institutions reflects the Fed's introduction of interest on reserves. The payment of interest on reserves increases the Fed's ability to expand its lending programs while maintaining the fed funds rate close to the target.

Conclusion.

The stress on financial markets and institutions intensified substantially from the high levels exhibited around the time of the last EAP meeting. This was marked on the institutions side by the bankruptcy of Lehman Brothers, the rescue of AIG, and Fannie Mae and Freddie being placed in conservatorship, and on the markets side by asset price declines, wider credit spreads, higher volatility, and reduced liquidity. The response by the Fed and other policy institutions was considerable. The Fed cut its target rate by 100 basis points in October, greatly expanded programs providing direct U.S. dollar lending to financial institutions and instituted several new programs, including ones providing funds to nonfinancial firms, to address disruptions in the money markets. The Treasury, FDIC, SEC, and foreign central banks took steps to relieve the liquidity and capital pressures on financial institutions. These efforts appear to have been successful, at least temporarily, at relieving pressure in the interbank and commercial paper markets.

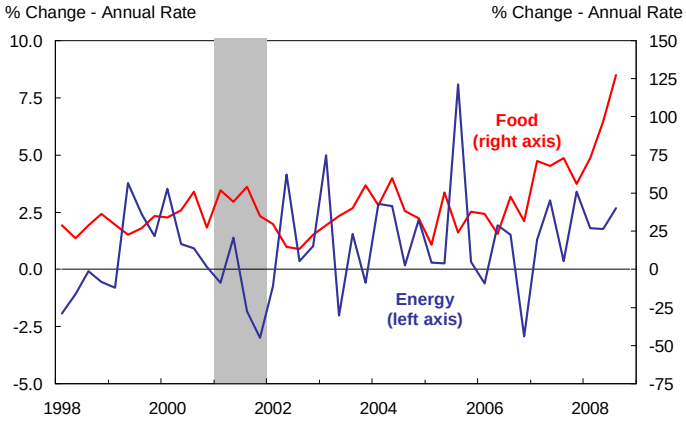
Inflation

Figure 1: PCE Inflation: Total & Core



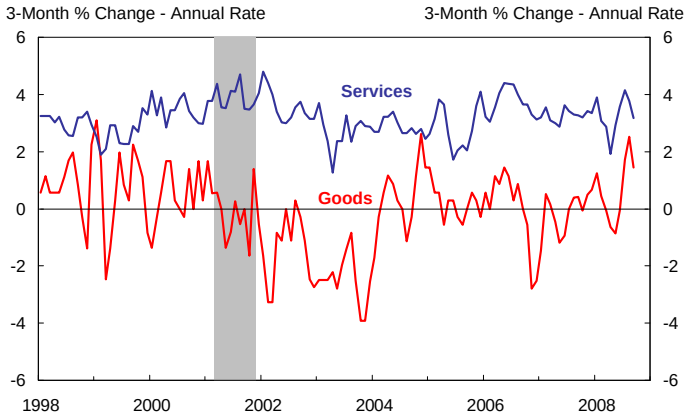
Source: Bureau of Economic Analysis

Figure 2: PCE Inflation: Food and Energy



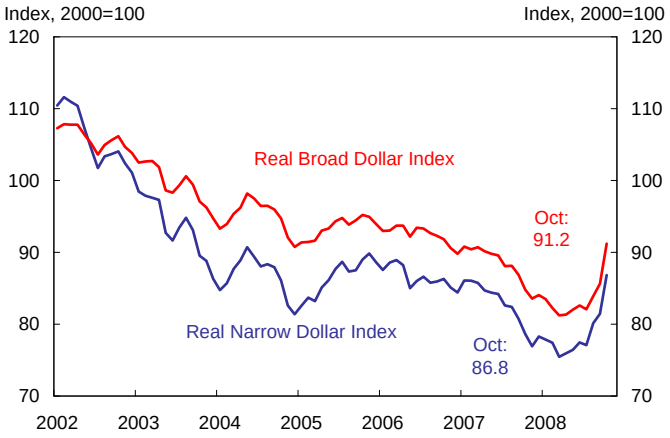
Source: Bureau of Economic Analysis

Figure 3: CPI Inflation: Core Goods & Core Services



Source: Bureau of Labor Statistics

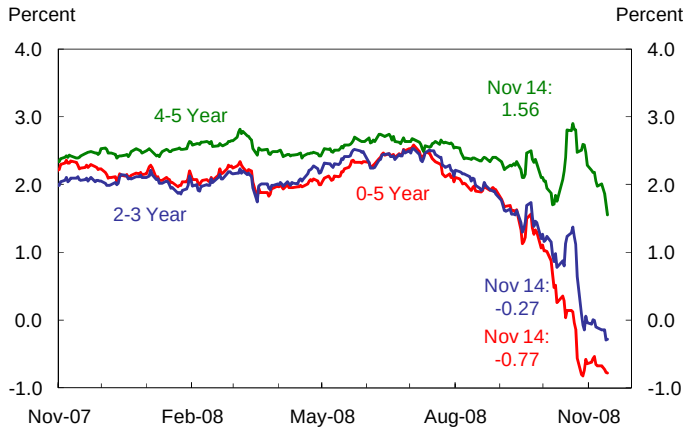
Figure 4: Real Effective Exchange Rates



Source: Federal Reserve Board

Note: Data are Monthly Averages.

Figure 5: TIPS Implied Inflation Compensation: 0-5, 2-3, 4-5 Year Horizons



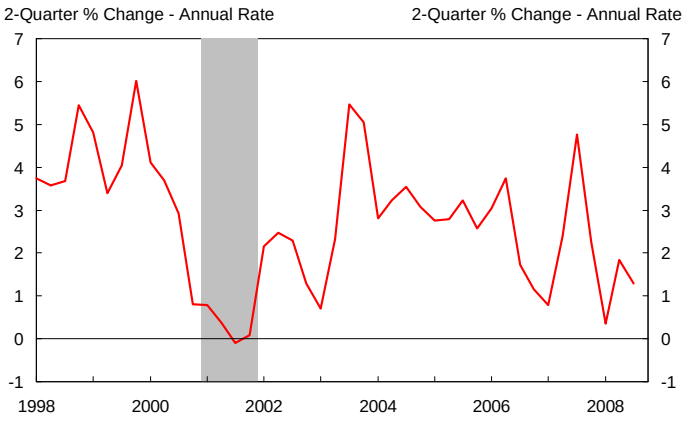
Source: Federal Reserve Board

Note: Carry-adjusted

Note: Shading represents NBER recessions, unless otherwise noted.

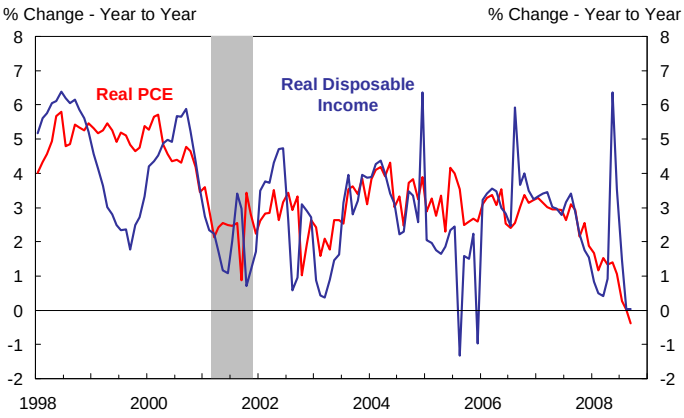
Real Activity

Figure 6: Gross Domestic Product



Source: Bureau of Economic Analysis

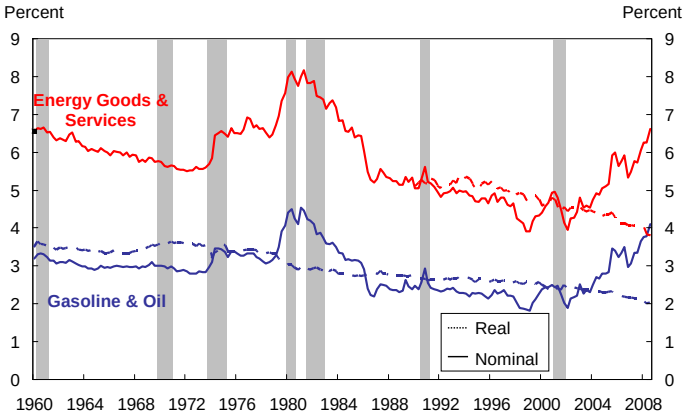
Figure 7: Real PCE and Disposable Income



Source: Bureau of Economic Analysis

Figure 8: Consumer Usage of Energy and Gasoline

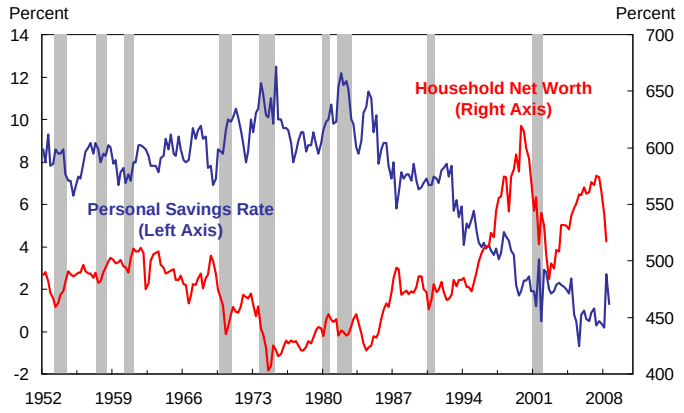
(Share of Disposable Income)



Source: Bureau of Economic Analysis

Figure 9: Personal Savings Rate and Household Net Worth

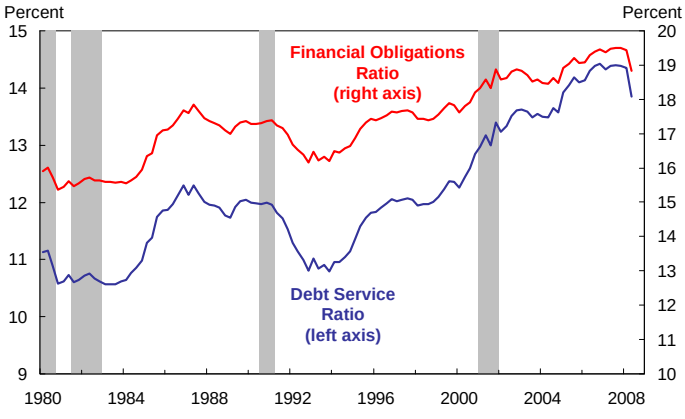
(Percent of Disposable Personal Income)



Source: FRB and BEA

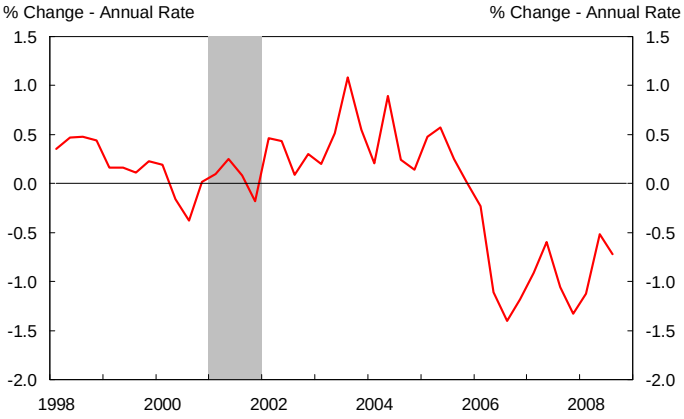
Figure 10: Debt Service and Financial Obligations

(Percent of Disposable Personal Income)



Source: Federal Reserve Board

Figure 11: Private Residential Investment: Contribution to Real GDP

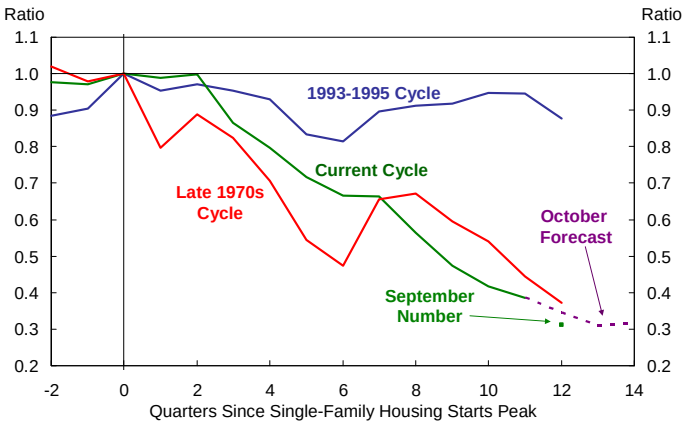


Source: Bureau of Economic Analysis

Note: Shading represents NBER recessions, unless otherwise noted.

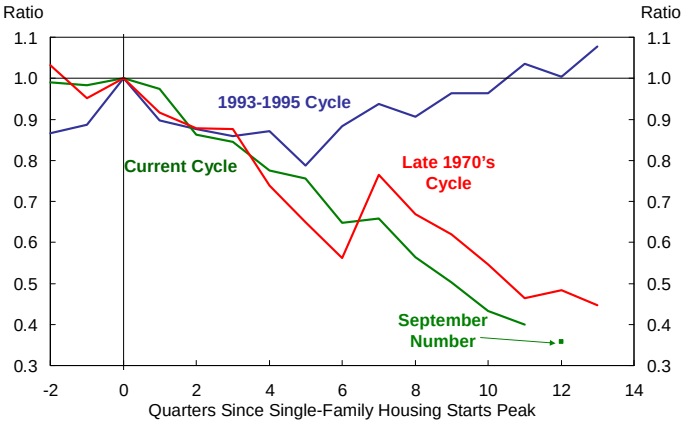
Real Activity, ctd.

Figure 12: Single-Family Housing Starts



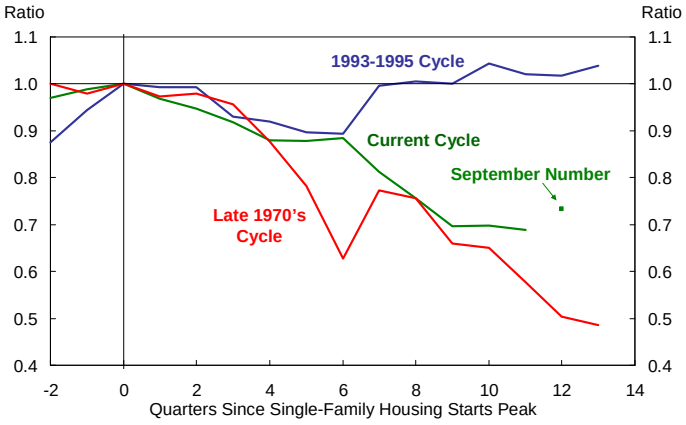
Source: Census Bureau Note: Series set to 1.0 at Housing Start Peak.

Figure 13: Single-Family New Home Sales



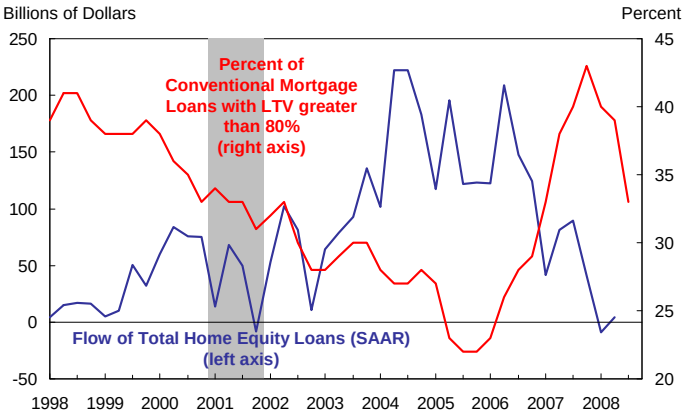
Source: Census Bureau Note: Series set to 1.0 at Housing Start Peak.

Figure 14: Single-Family Existing Home Sales



Source: Census Bureau Note: Series set to 1.0 at Housing Start Peak.

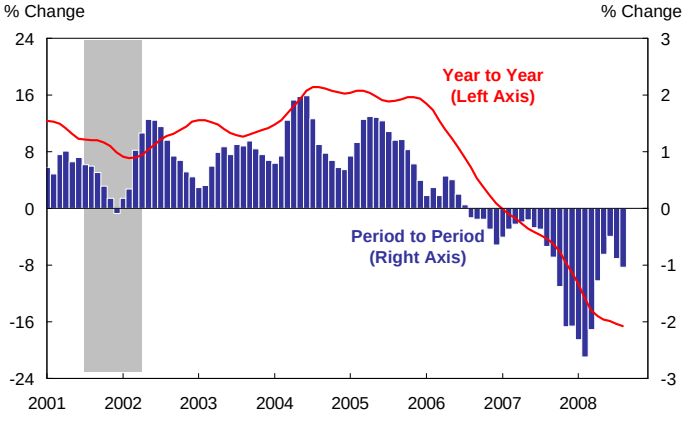
Figure 15: New Mortgage Loan LTV



Source: Federal Housing Finance Board & Federal Reserve Board

Figure 16: Case-Shiller Home Price Index

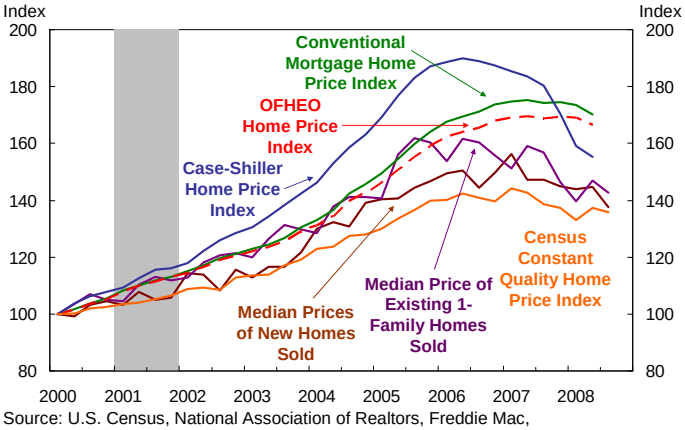
Composite 20-NSA



Source: S&P, Fiserv, and MacroMarkets LLC Note: Monthly Data.

Figure 17: Home Price Indexes

2000 Q1 = 100

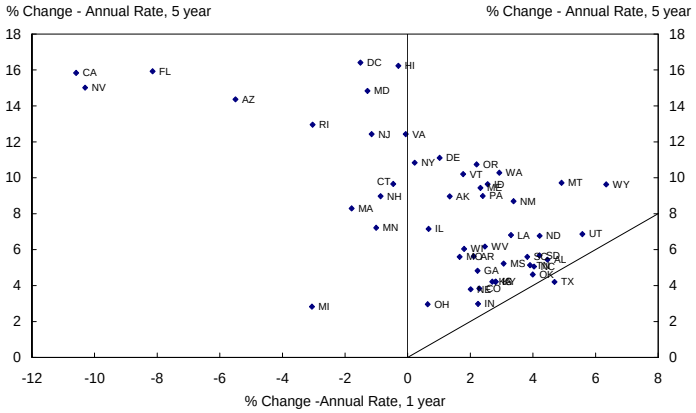


Source: U.S. Census, National Association of Realtors, Freddie Mac, Office of Federal Housing Enterprise Oversight and Standard and Poors.

Note: Shading represents NBER recessions, unless otherwise noted.

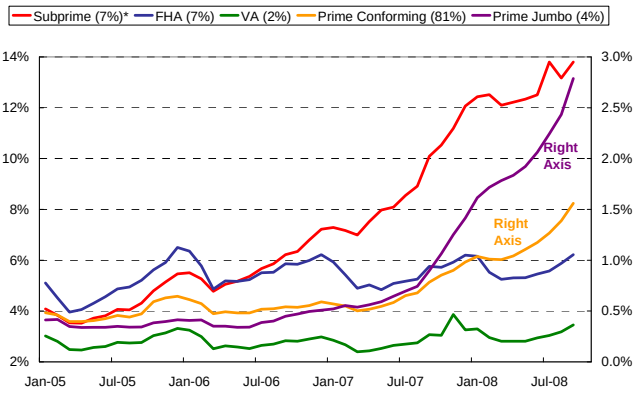
Real Activity, ctd.

Figure 18: Home Price Change by State



Source:Office of Federal Housing Enterprise Oversight

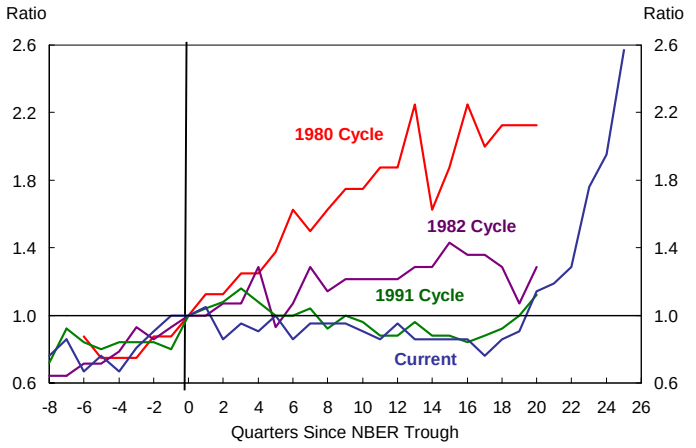
Figure 19: 60+ Day Delinquency Rates by Loan Type



Source: FirstAmerican CoreLogic LoanPerformance

Note: Series plotted on left axis unless otherwise indicated
*The percent of total loans that falls into specified category

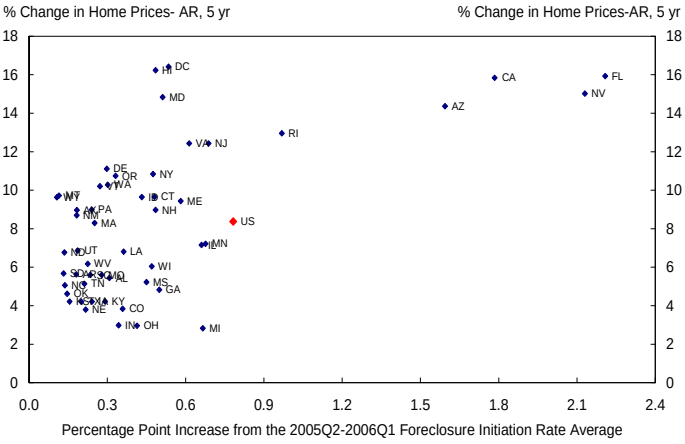
Figure 20: Prime Mortgage Foreclosures Started



Source: MBA

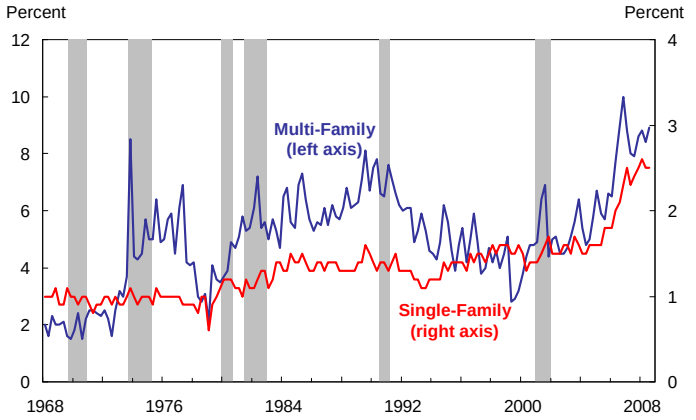
Note: Series set to 1.0 at NBER Recession Trough

Figure 21: Foreclosure Initiation & Home Price Appreciation



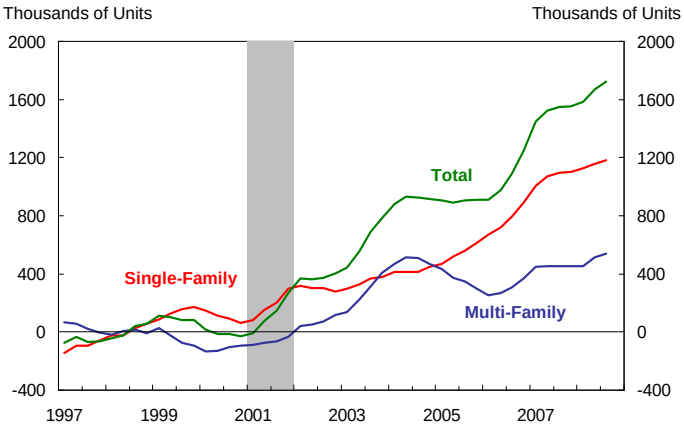
Source:Office of Federal Housing Enterprise Oversight & Mortgage Bankers Association

Figure 22: Homeowner Vacancy Rates



Source: Census Bureau

Figure 23: Excess Home Supply - 4Q Moving Average

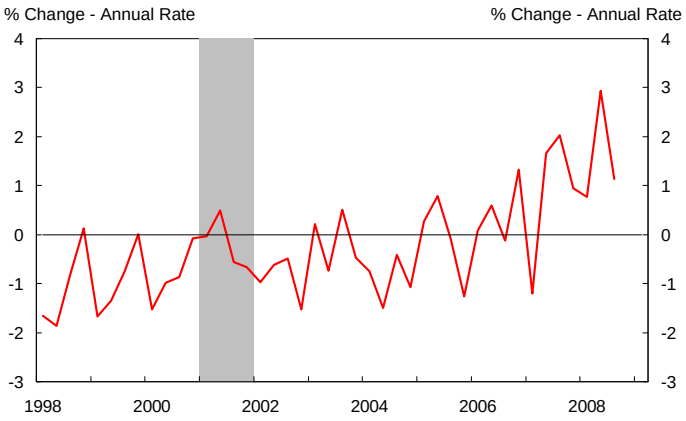


Source: Census Bureau, FRBNY Calculations

Note: Shading represents NBER recessions, unless otherwise noted.

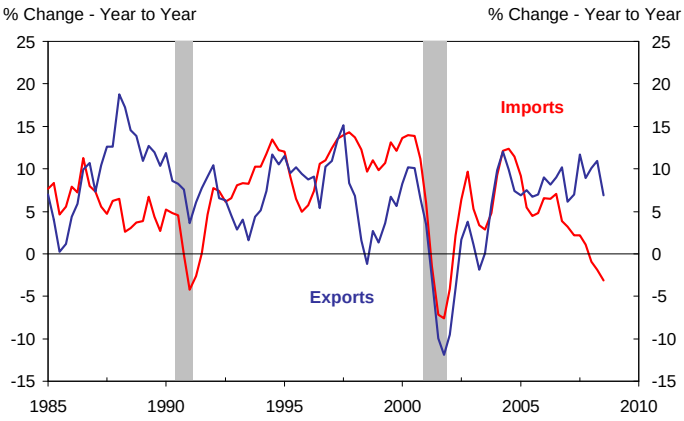
Real Activity, ctd.

Figure 24: Net Exports: Contribution to Real GDP



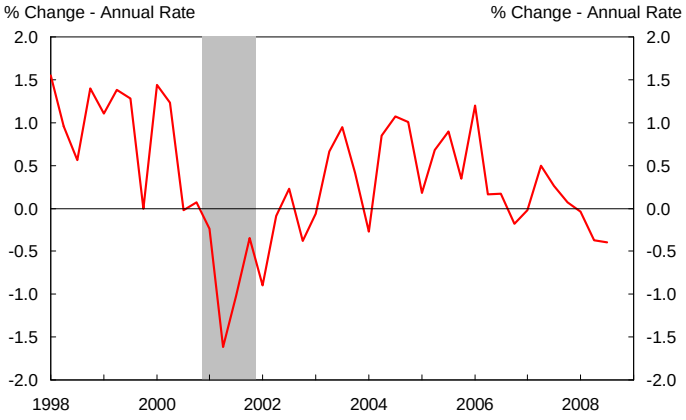
Source: Bureau of Economic Analysis

Figure 25: Quantity Index of Imports and Exports



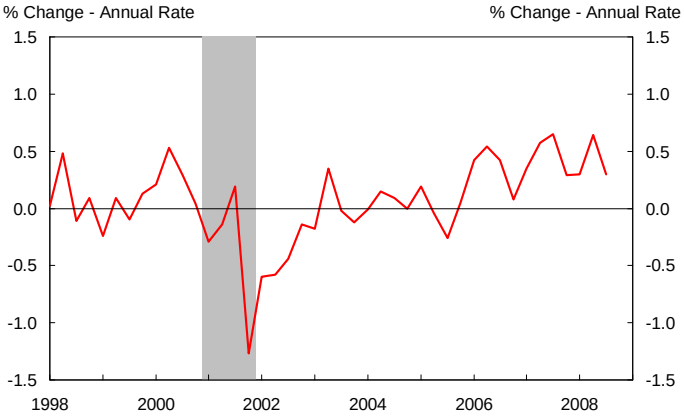
Source: Bureau of Economic Analysis

Figure 26: Private Nonresidential Equipment/Software: Contribution to Real GDP



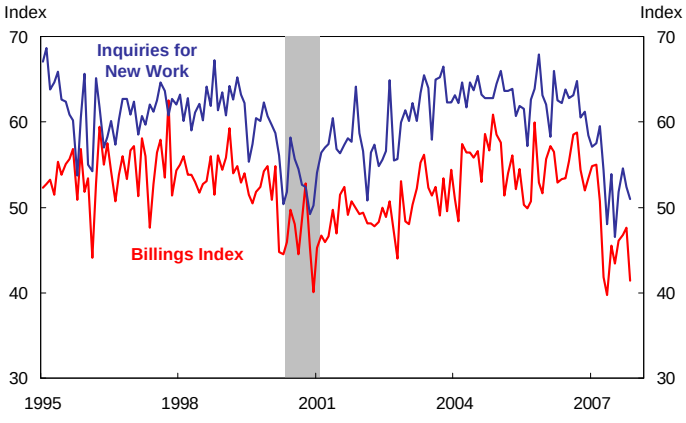
Source: Bureau of Economic Analysis

Figure 27: Real Nonresidential Structures: Contribution to Real GDP



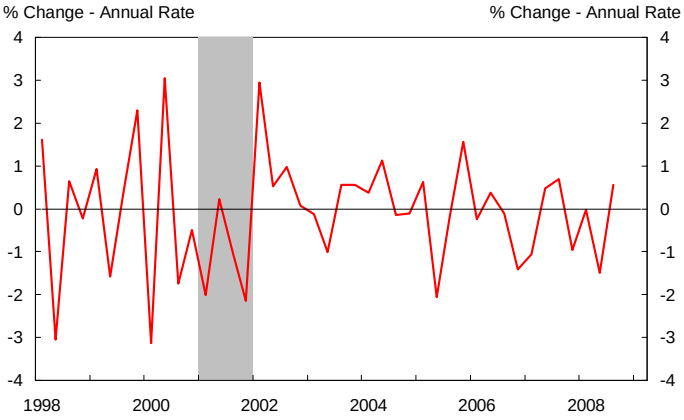
Source: Bureau of Economic Analysis

Figure 28: Architecture Billings Index



Source: American Institute of Architecture

Figure 29: Change in Private Inventories: Contribution to Real GDP

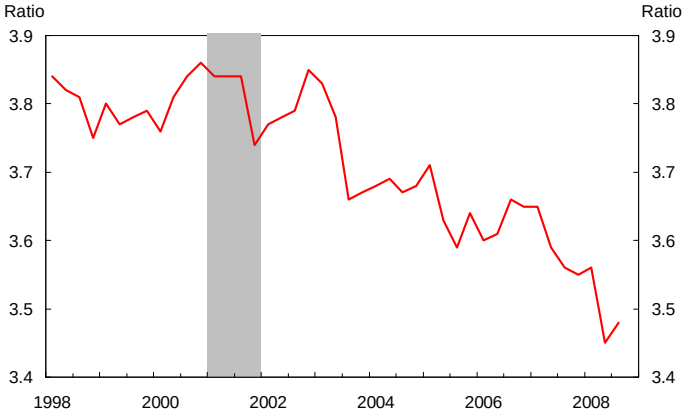


Source: Bureau of Economic Analysis

Note: Shading represents NBER recessions, unless otherwise noted.

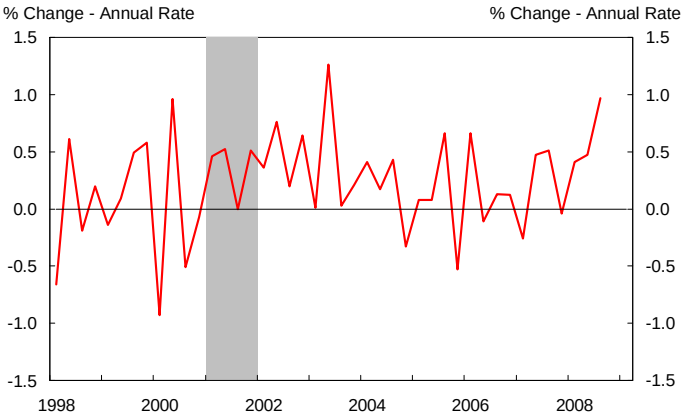
Real Activity, ctd.

Figure 30: Ratio of Nonfarm Inventory to Final Sales of Goods & Structures



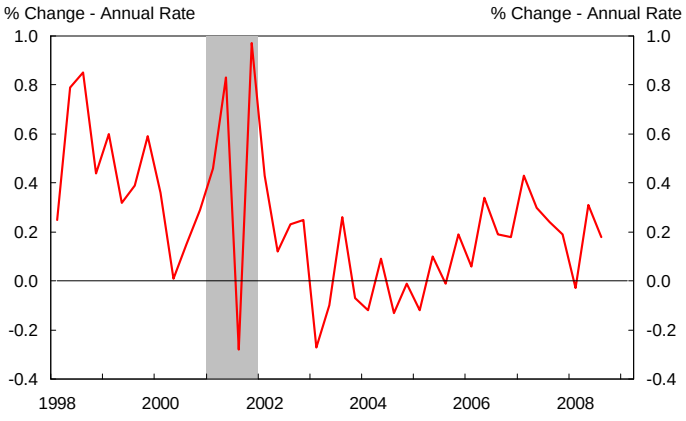
Source: Bureau of Economic Analysis

Figure 31: Federal Government Consumption & Investment: Contribution to Real GDP



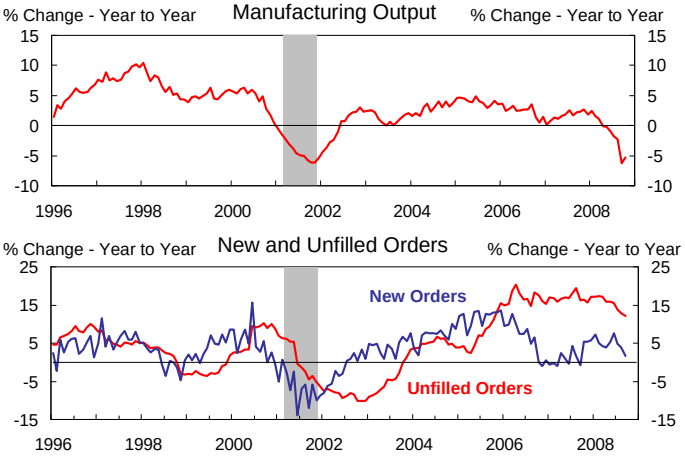
Source: Bureau of Economic Analysis

Figure 32: State & Local Government Consumption & Investment: Contribution to Real GDP



Source: Bureau of Economic Analysis

Figure 33: Manufacturing Sector Overview

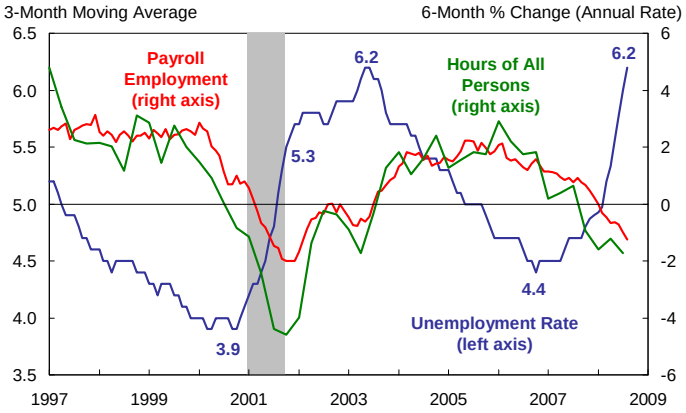


Source: Federal Reserve Board and Census Bureau

Note: Shading represents NBER recessions, unless otherwise noted.

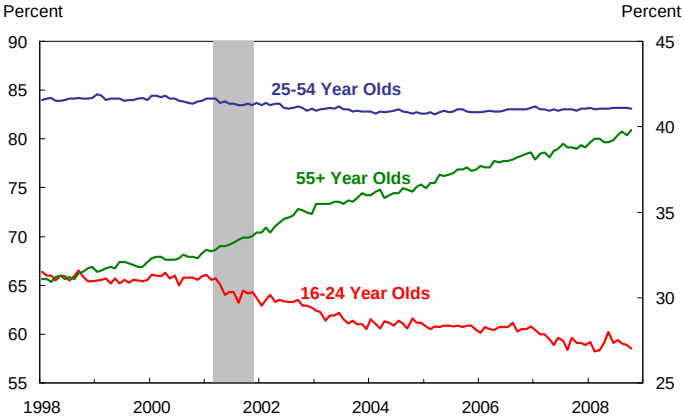
Employment, Wages, and Productivity

Figure 34: Labor Market Indicators



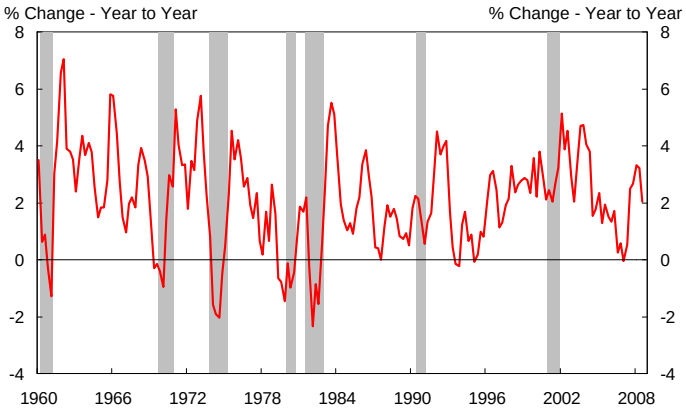
Source: Bureau of Labor Statistics

Figure 35: Labor Force Participation Rate



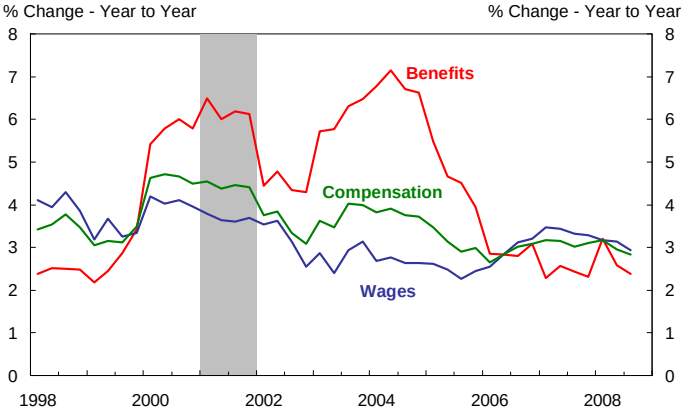
Source: Bureau of Labor Statistics

Figure 36: Productivity: Nonfarm Business Sector



Source: Bureau of Labor Statistics

Figure 37: Employment Cost Index: Private Industry

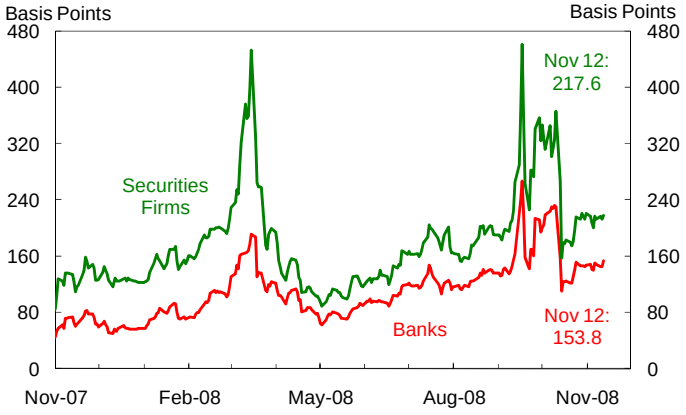


Source: Bureau of Labor Statistics

Note: Shading represents NBER recessions, unless otherwise noted.

Credit Risk

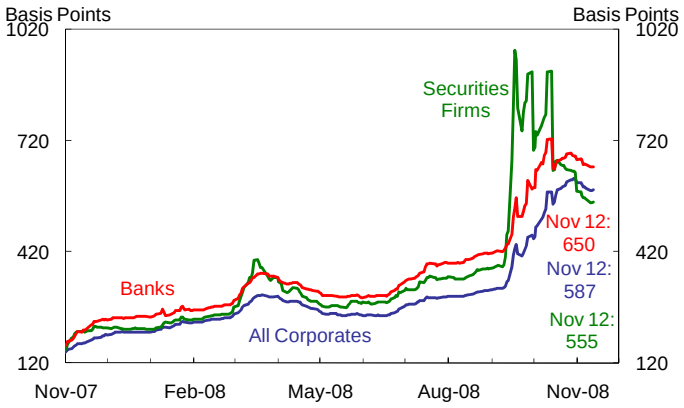
Figure 38: CDS Spreads



Source: CMA

Note: Securities firms index is average of Goldman Sachs, Bear Stearns, and Merrill Lynch. Bank index is average of Citigroup, JP Morgan, and Bank of America.

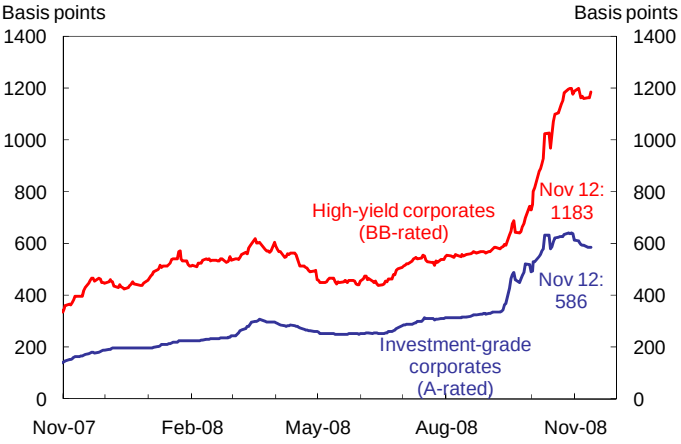
Figure 39: Credit Spreads



Source: Merrill Lynch

Note: Option-adjusted spreads. Banks series is Merrill Lynch Corporates, Banks bond index. Securities Firms series is Merrill Lynch

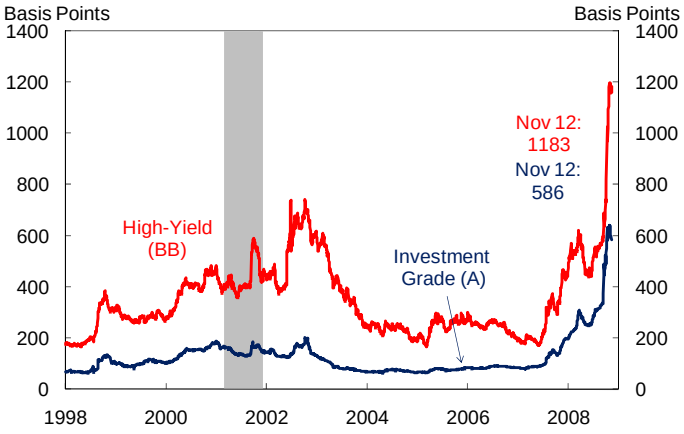
Figure 40: Corporate Credit Spreads



Source: Merrill Lynch

Note: Option-adjusted spreads.

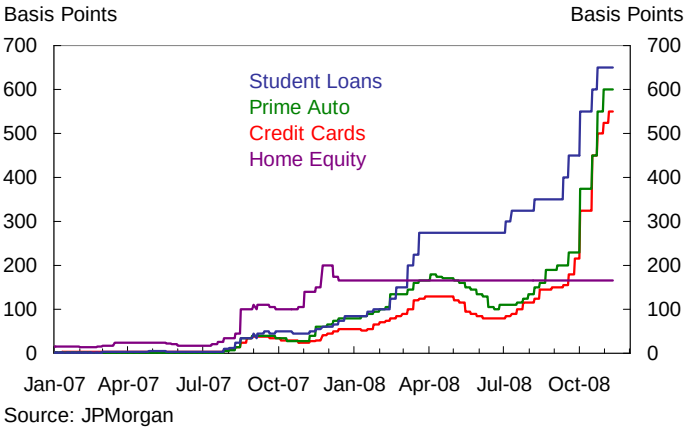
Figure 41: Corporate Credit Spreads: Long History



Source: Merrill Lynch

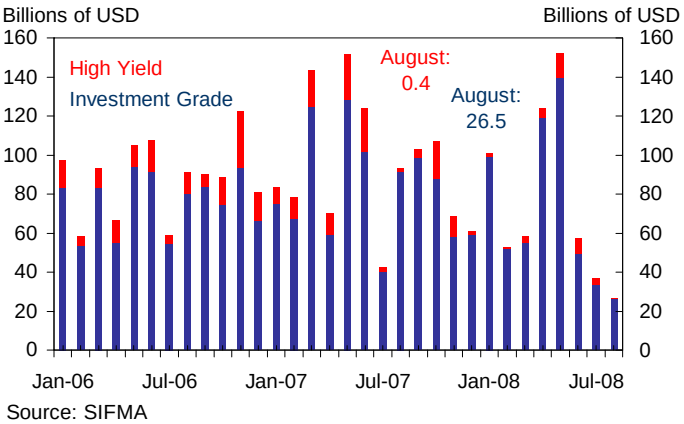
Note: Option-adjusted spreads

Figure 42: Spreads on Consumer ABS (AAA-rated tranches)



Source: JPMorgan

Figure 43: U.S. Issuance of Corporate Debt

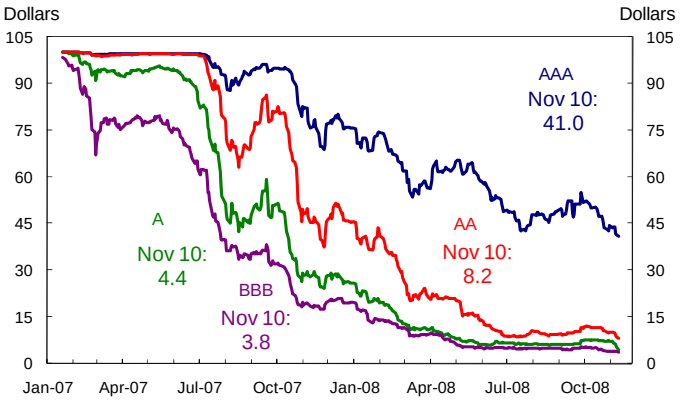


Source: SIFMA

Note: Shading represents NBER recessions, unless otherwise noted.

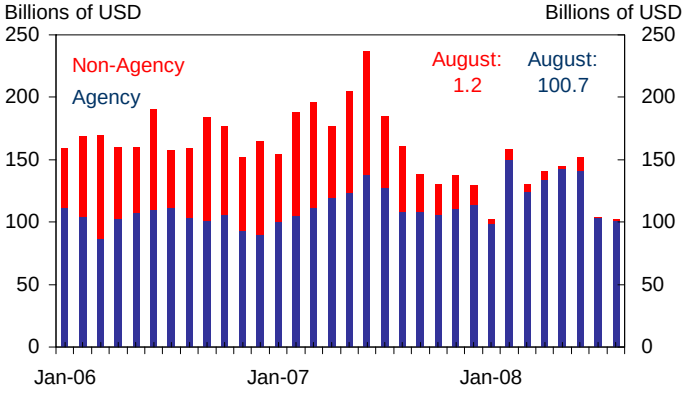
Mortgage Market and Bank Lending

Figure 44: 2007-1 ABX Closing Price



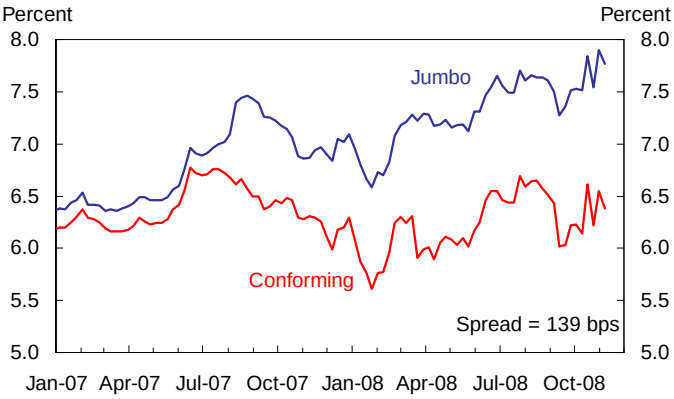
Source: JPMorgan

Figure 45: U.S. Issuance of Mortgage-Backed Securities



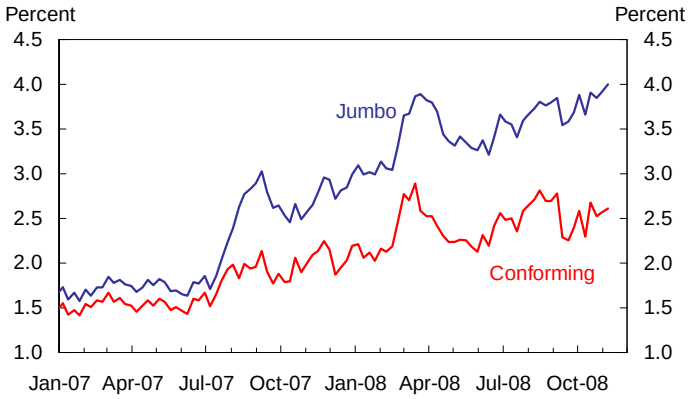
Source: SIFMA

Figure 46: National Average Offered Rates, 30-Year FRM



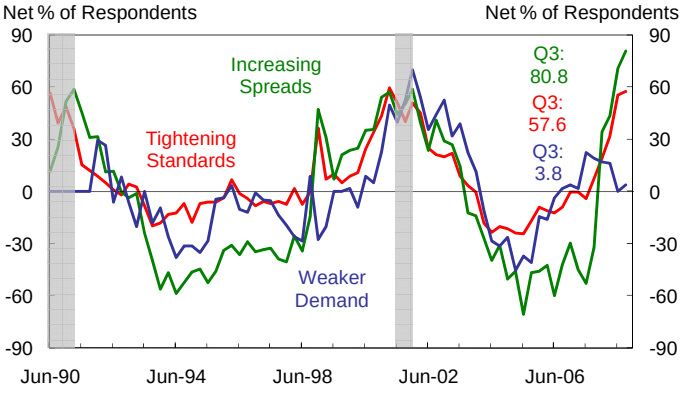
Source: HSH Associates

Figure 47: 30-Year FRM to 10-Year Treasury Spreads



Source: HSH Associates and Datastream

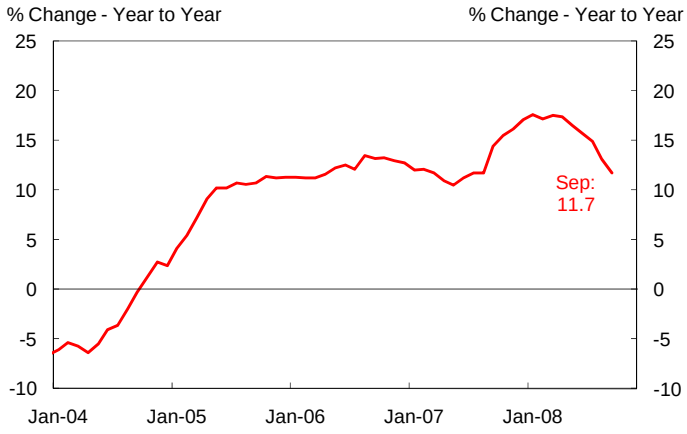
Figure 48: Bank Lending Practices



Source: Federal Reserve Board

Note: Data cover C&I loans to large- and medium-sized firms

Figure 49: Commercial and Industrial Loans Outstanding

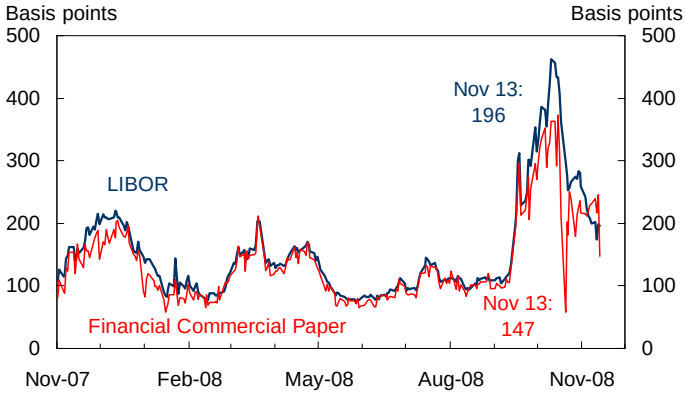


Source: Federal Reserve Board

Note: Shading represents NBER recessions, unless otherwise noted.

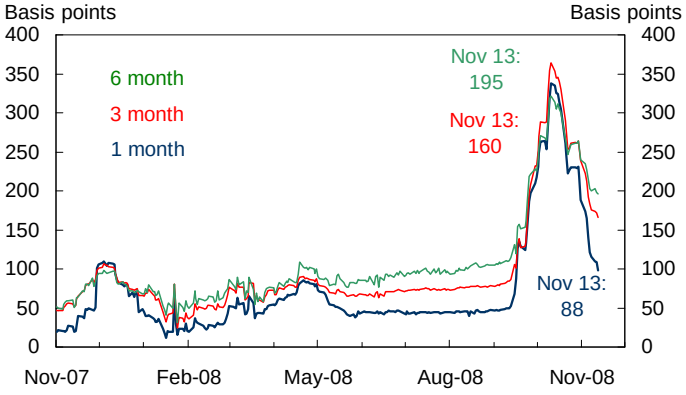
Money Markets

Figure 50: Unsecured Lending: 3 Month Spreads to Treasury



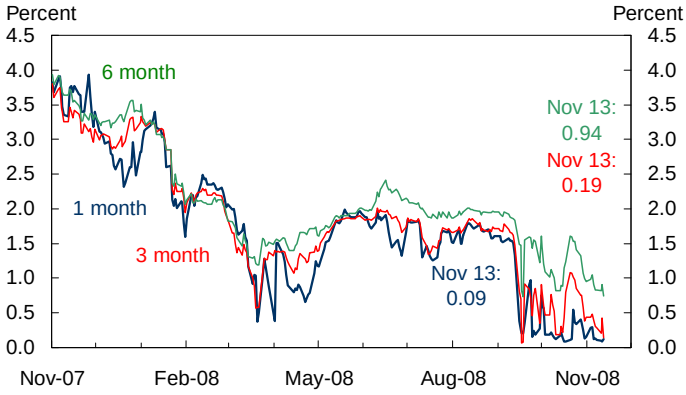
Source: Bloomberg

Figure 51: USD LIBOR-to-OIS Spreads



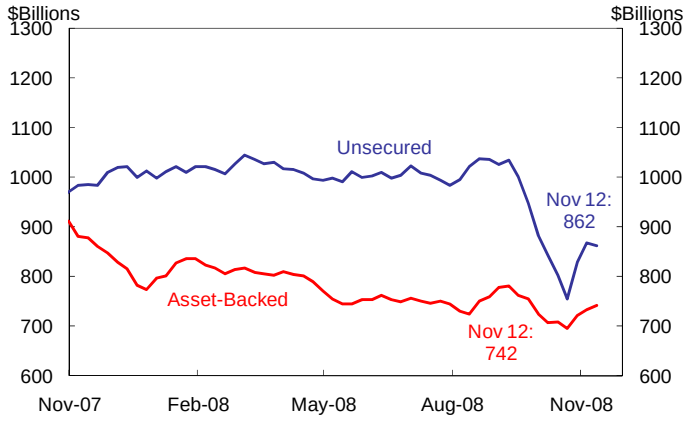
Source: Bloomberg

Figure 52: U.S. Treasury Bill Yields



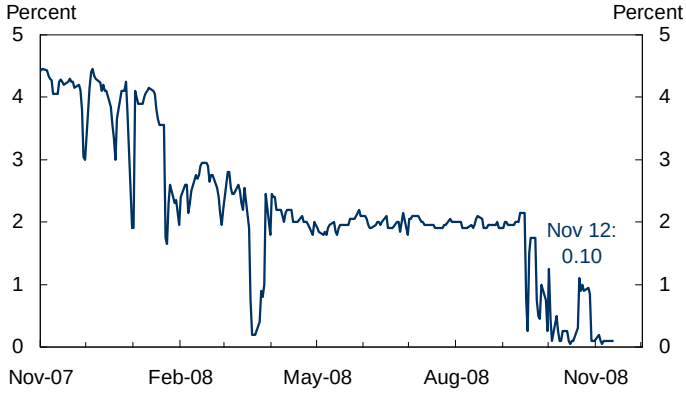
Source: Bloomberg

Figure 53: Commercial Paper Outstanding



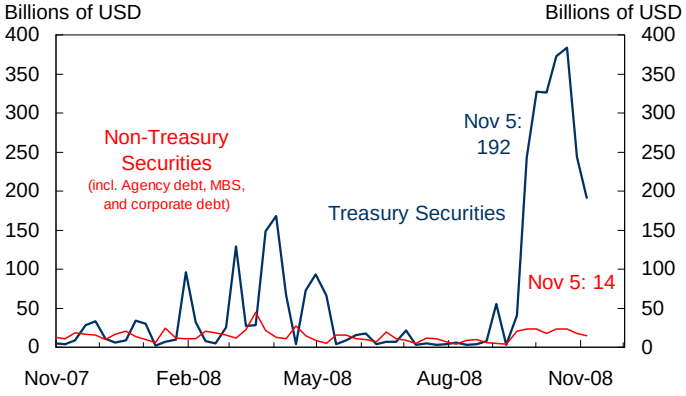
Source: Federal Reserve Board

Figure 54: Overnight Treasury Repo Rate



Source: Bloomberg

Figure 55: Primary Dealer Settlement Fails-to-Deliver (Daily Avg.)

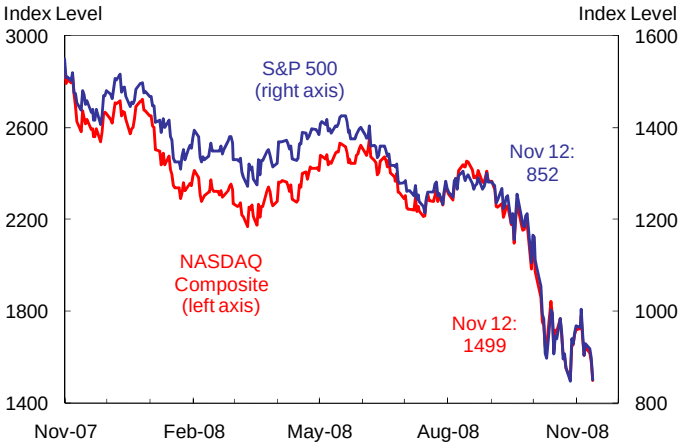


Source: FRBNY

Note: Shading represents NBER recessions, unless otherwise noted.

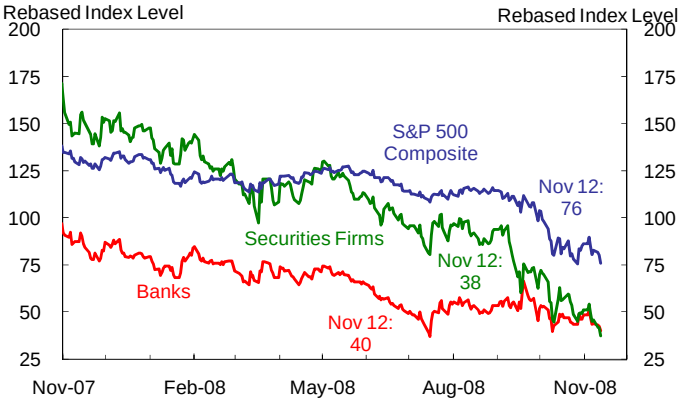
Equity Markets

Figure 56: Equity Market Performance



Source: Datastream

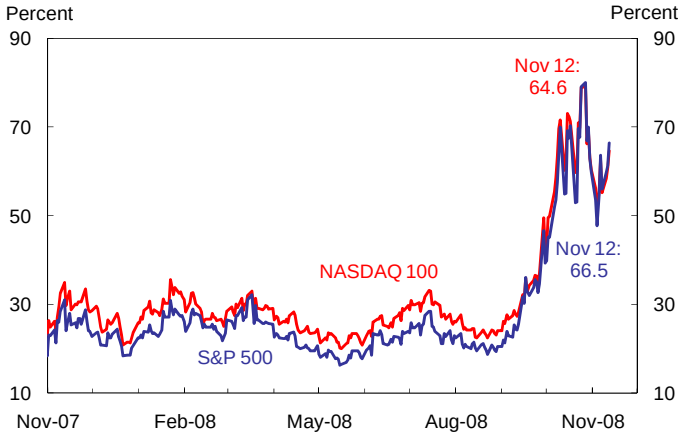
Figure 57: Equity Performance



Note: Rebased to equal 100 on June 1, 2004. Banks series is S&P 500 Banks index. Securities Firms series is S&P 500 Investment Banks and Brokerages index.

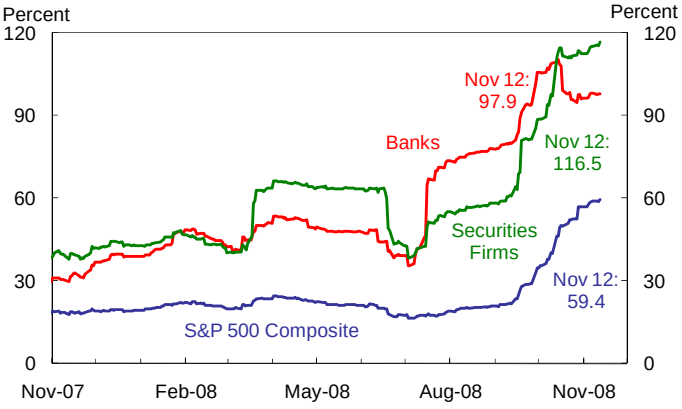
Source: Datastream

Figure 58: Equity Market Implied 1-Month Volatility



Source: Datastream

Figure 59: Historical Equity Volatility



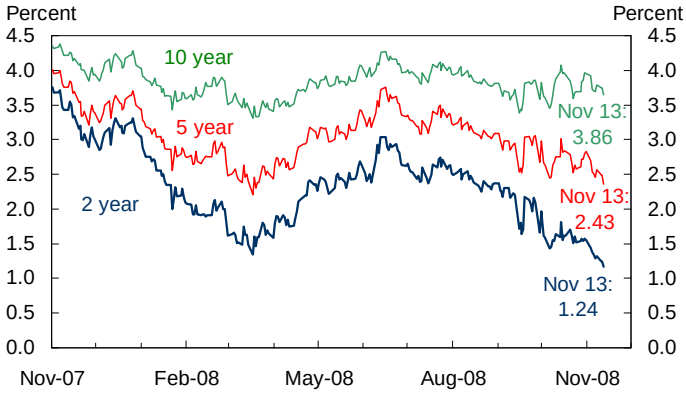
Source: Datastream

Note: Annualized rolling 3-month standard deviation of daily returns. Banks series is S&P 500 Banks index. Securities Firms series is S&P 500

Note: Shading represents NBER recessions, unless otherwise noted.

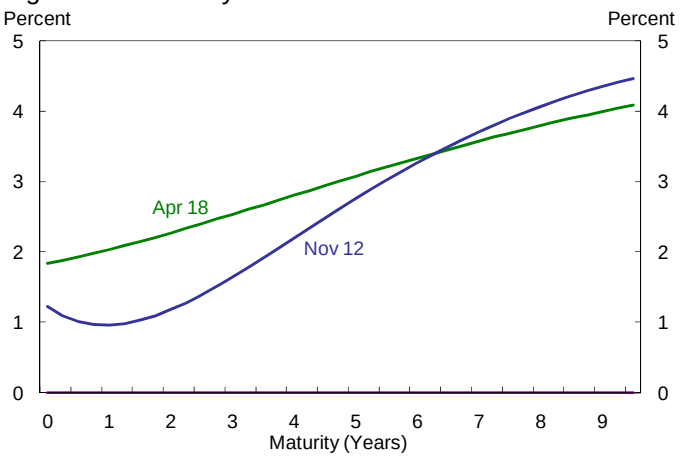
Treasury Yields

Figure 60: U.S. Treasury Note Yields



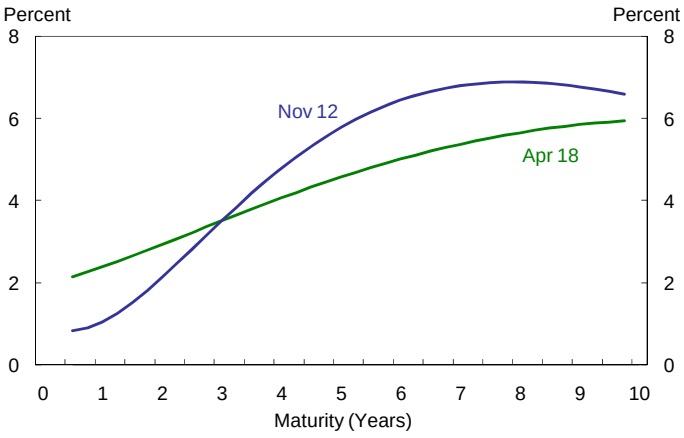
Source: Bloomberg

Figure 61: Treasury Yield Curves



Source: Federal Reserve Board

Figure 62: Implied One-Year Forward Rates

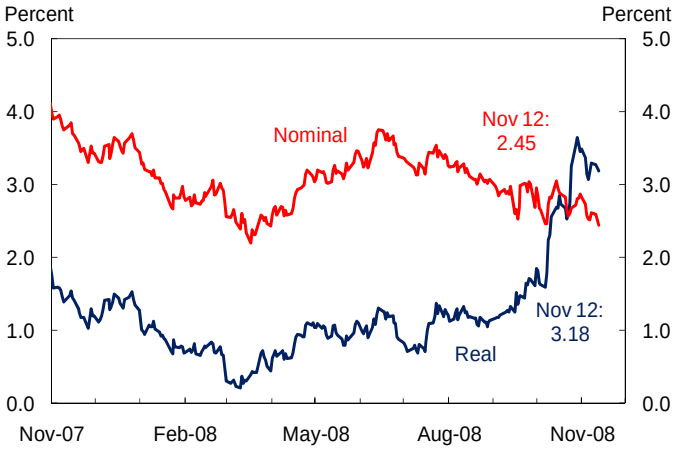


Source: Federal Reserve Board

Figure 63: 5- and 10-Year Real Treasury Rate

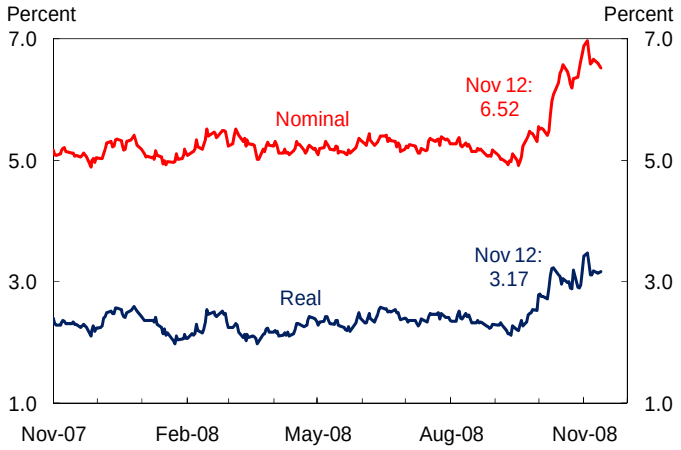
Source: Federal Reserve Board

Figure 64: 0-5 Year Rates



Source: Federal Reserve Board

Figure 65: 5-10 Year Rates

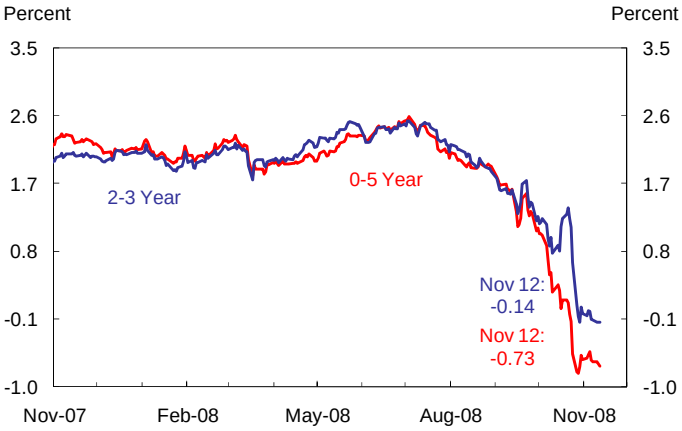


Source: Federal Reserve Board

Note: Shading represents NBER recessions, unless otherwise noted.

Inflation Expectations

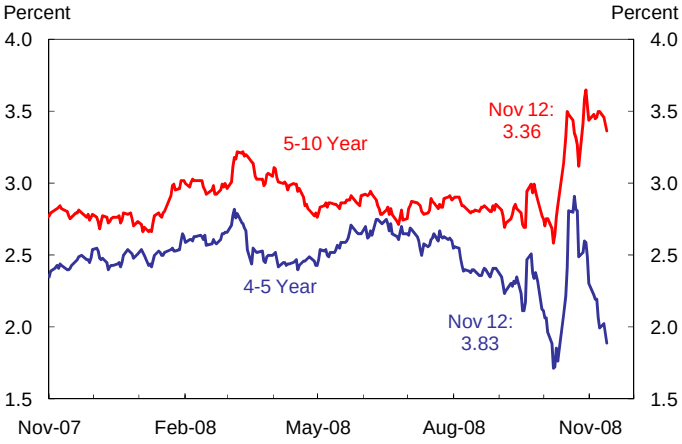
Figure 66: TIPS Implied Inflation: 0-5, 2-3 Year Horizons



Source: Federal Reserve Board

Note: Carry-adjusted

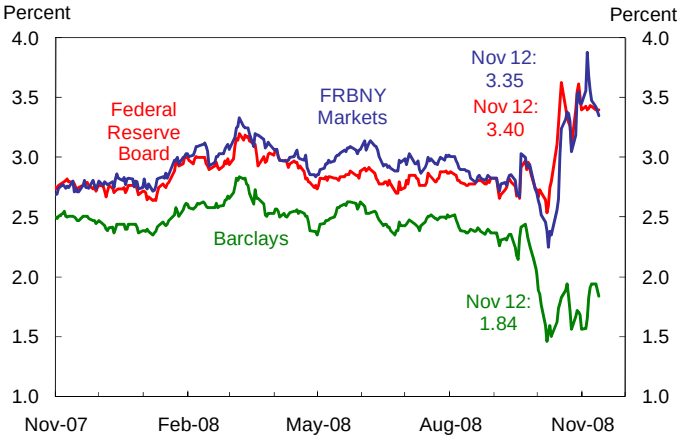
Figure 67: TIPS Implied Inflation: 4-5, 5-10 Year Horizons



Source: Federal Reserve Board

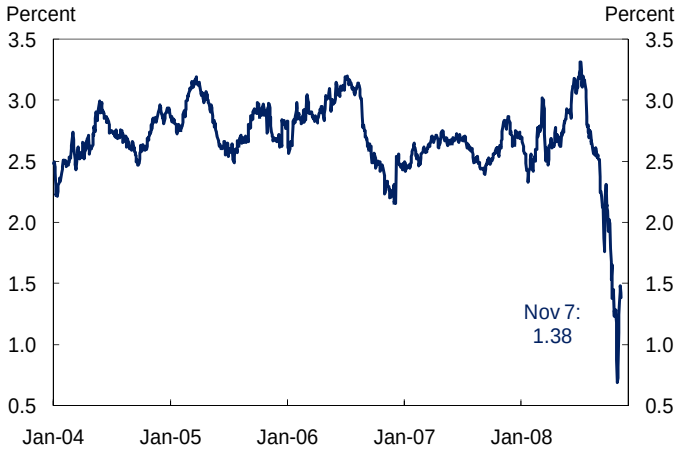
Note: Carry-adjusted

Figure 68: Alternative Measures of 5-10 Year Implied Inflation Compensation



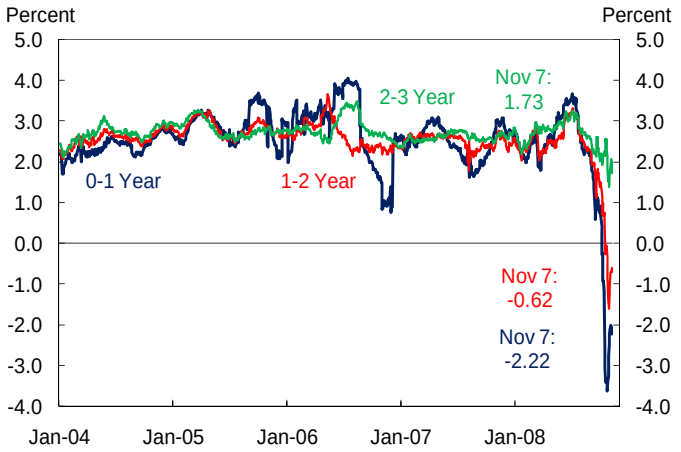
Source: Federal Reserve Board, Barclays, and FRBNYcalculations

Figure 69: Implied Inflation from Inflation Swaps: 0-5 Year Horizon



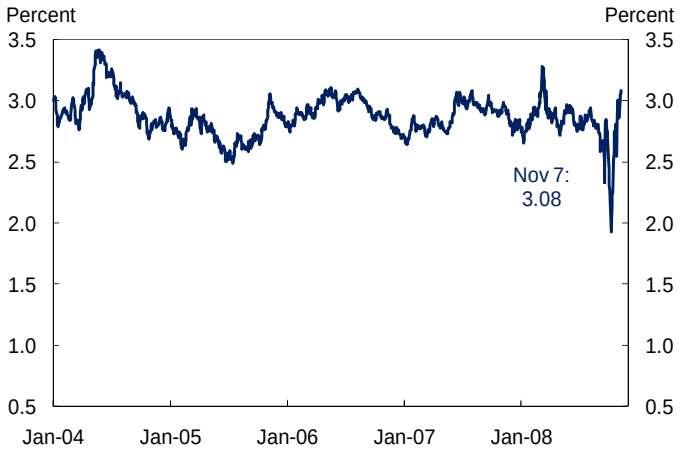
Source: Barclays

Figure 70: Implied Inflation from Inflation Swaps: 0-1, 1-2, 2-3 Year Horizons



Source: Barclays

Figure 71: Implied Inflation from Inflation Swaps: 5-10 Year Horizon



Source: Barclays

Note: Shading represents NBER recessions, unless otherwise noted.

International

Figure 72: Euro LIBOR-to-OIS Spread

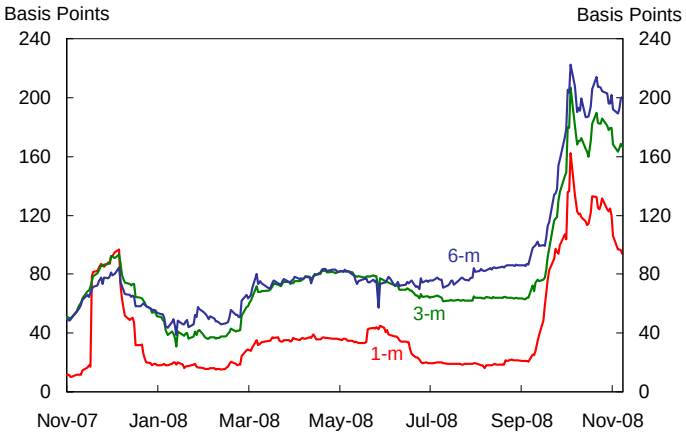


Figure 73: GBP LIBOR-to-OIS Spread

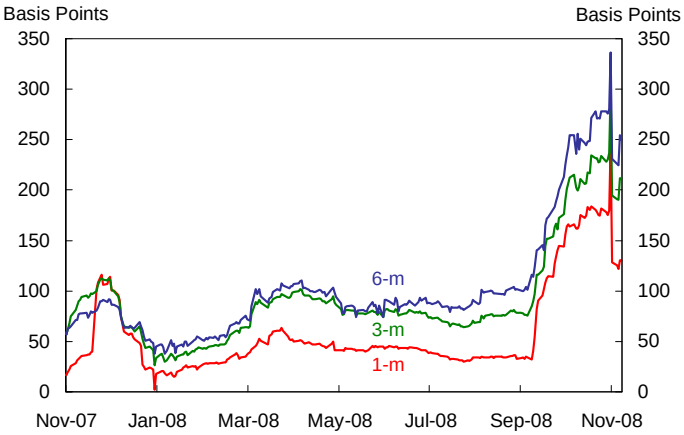
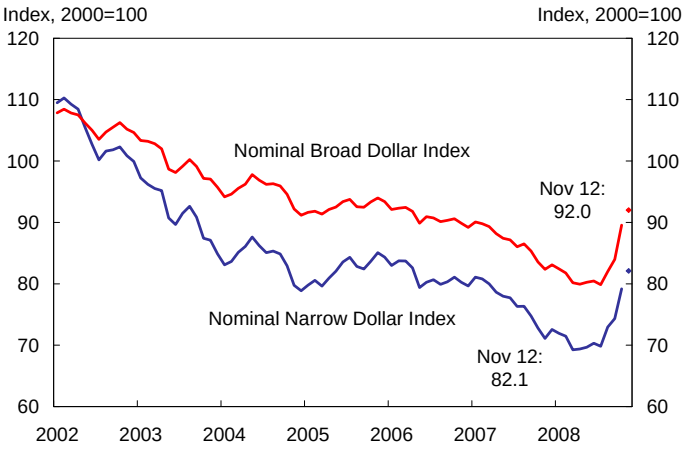


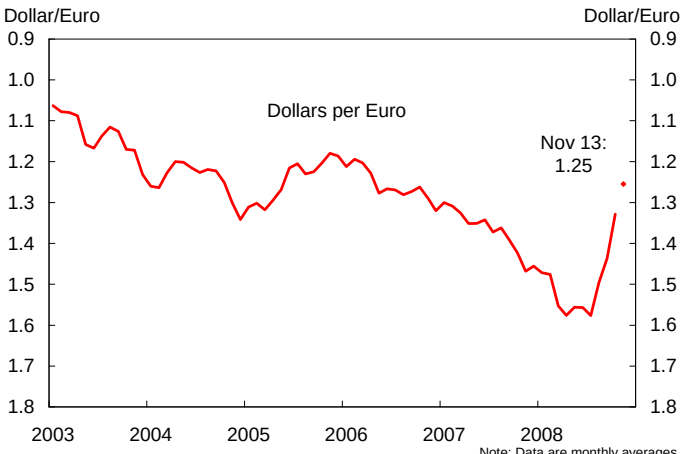
Figure 74: Nominal Effective Exchange Rates



Source: Federal Reserve Board

Note: Data are monthly averages.

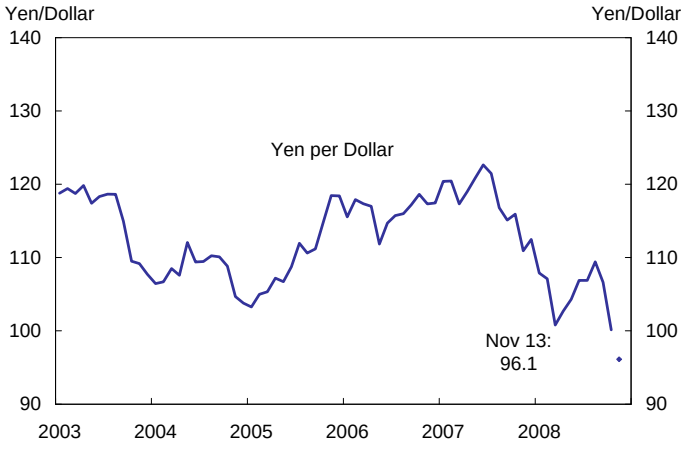
Figure 75: Dollar-Euro Exchange Rate



Source: Bloomberg

Note: Data are monthly averages.
Exchange rate scale is inverted.

Figure 76: Yen-Dollar Exchange Rate



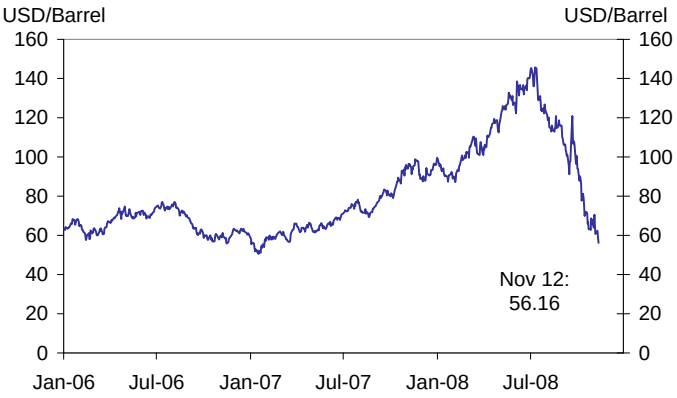
Source: Bloomberg

Note: Data are monthly averages.

Note: Shading represents NBER recessions, unless otherwise noted.

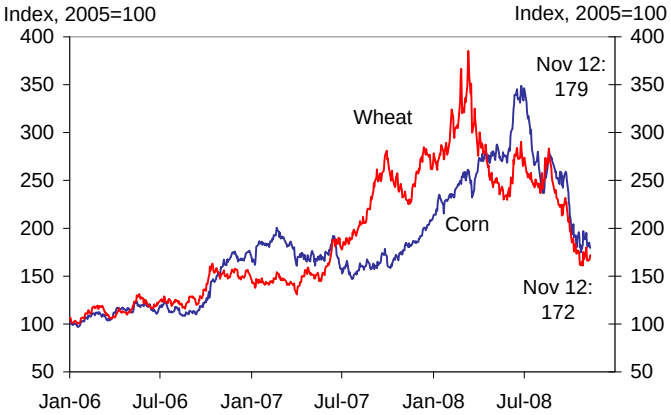
Commodities

Figure 76: Spot Commodity Price, WTI Oil, Cushing, OK



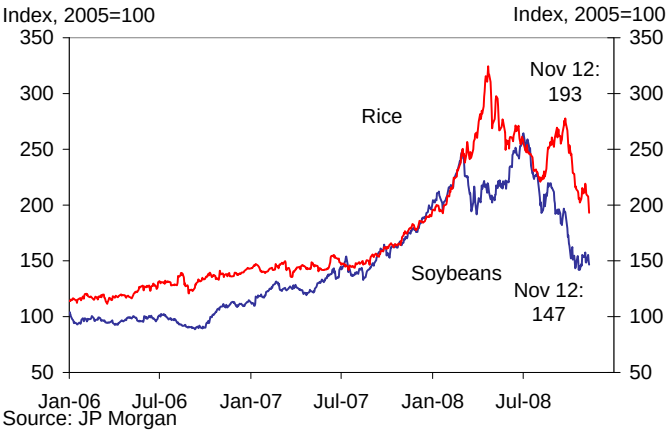
Source: Federal Reserve Board

Figure 77: Grain Prices, Daily



Source: JP Morgan

Figure 78: Grain Prices, Daily

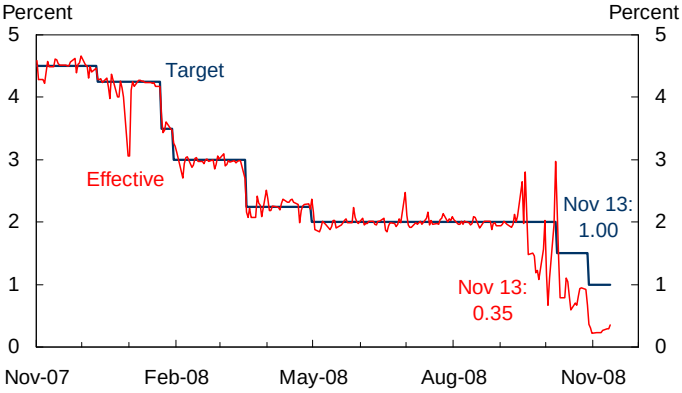


Source: JP Morgan

Note: Shading represents NBER recessions, unless otherwise noted.

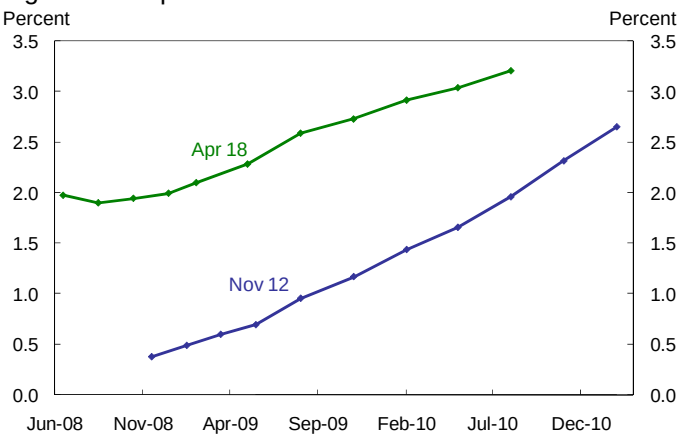
Policy Rates and Expectations

Figure 80: Effective Fed Funds Rate and Target



Source: Bloomberg

Figure 81: Expected Fed Funds Rate

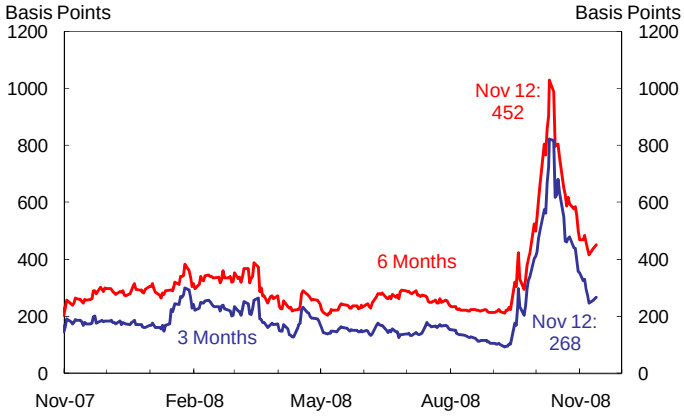


Note: Estimated using fed funds and Eurodollar futures.

Source: Federal Reserve Board

Figure 82: Short-Term Interest Rate Expectations

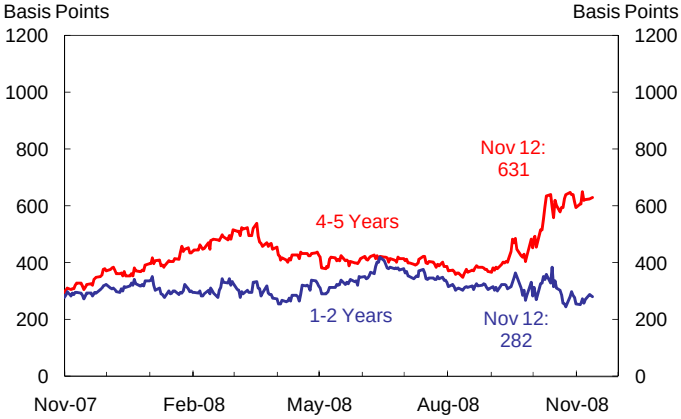
Width of 90% Confidence Interval Implied by Eurodollar Options



Source: Datastream, FRBNY calculations

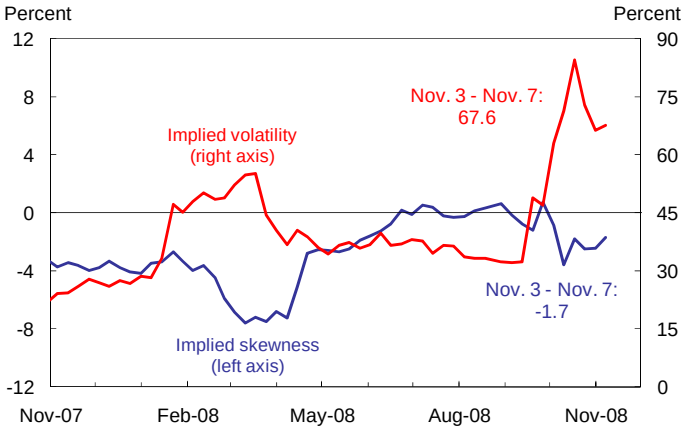
Figure 83: Long-Term Interest Rate Expectations

Width of 90% Confidence Interval Implied by Swaptions



Source: Datastream, FRBNY calculations

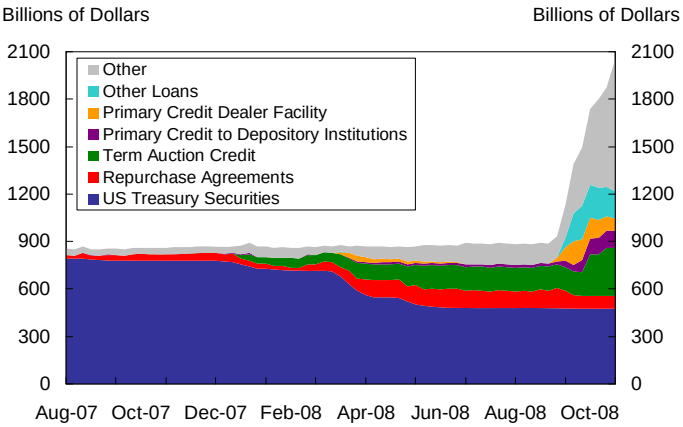
Figure 84: Implied Skewness and Volatility



Note: Weekly averages based on 3-9 month implied volatilities from Eurodollar futures options.

Source: CME and FRBNY calculations

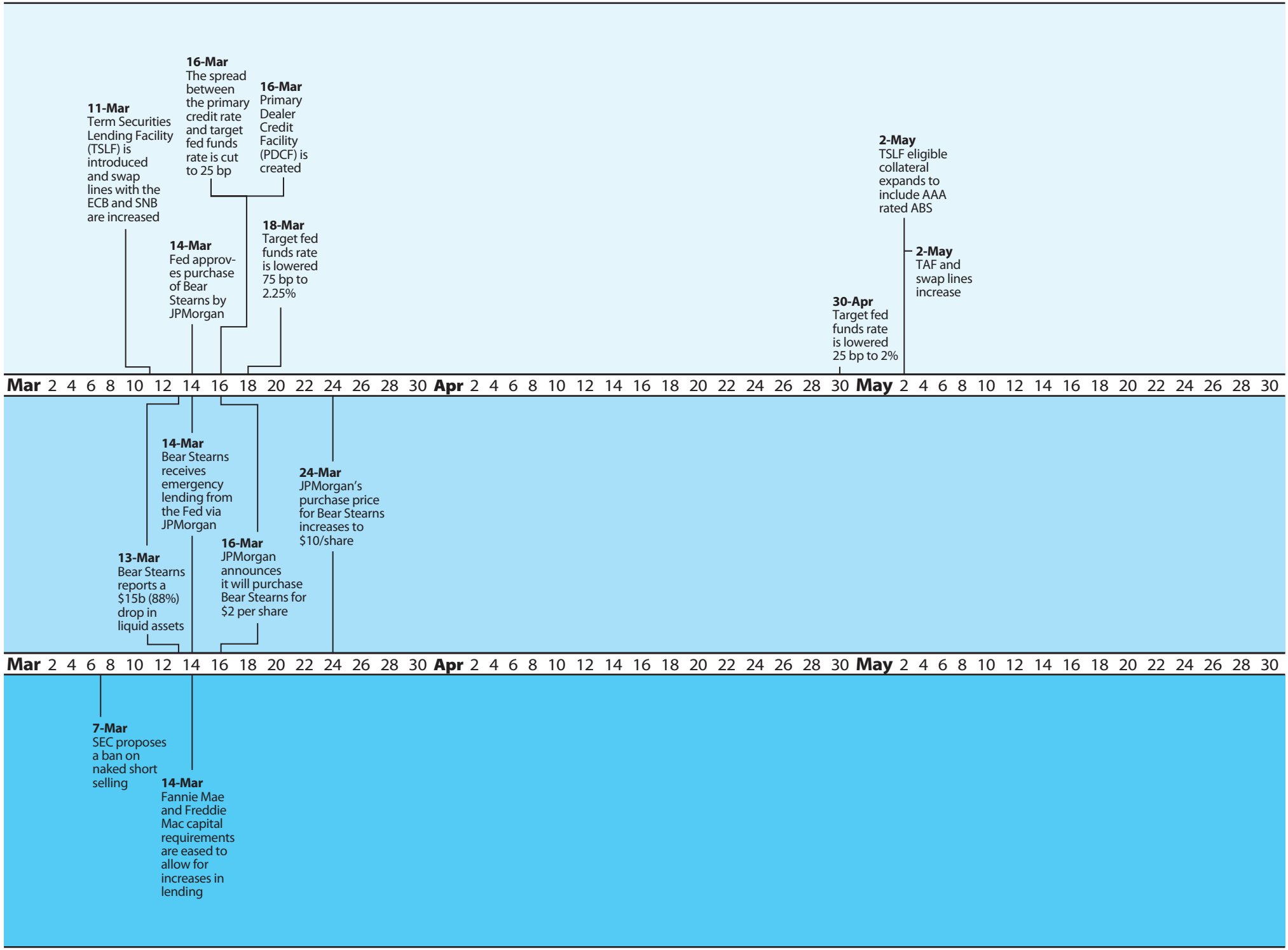
Figure 85: Composition of Reserve Bank Credit Outstanding



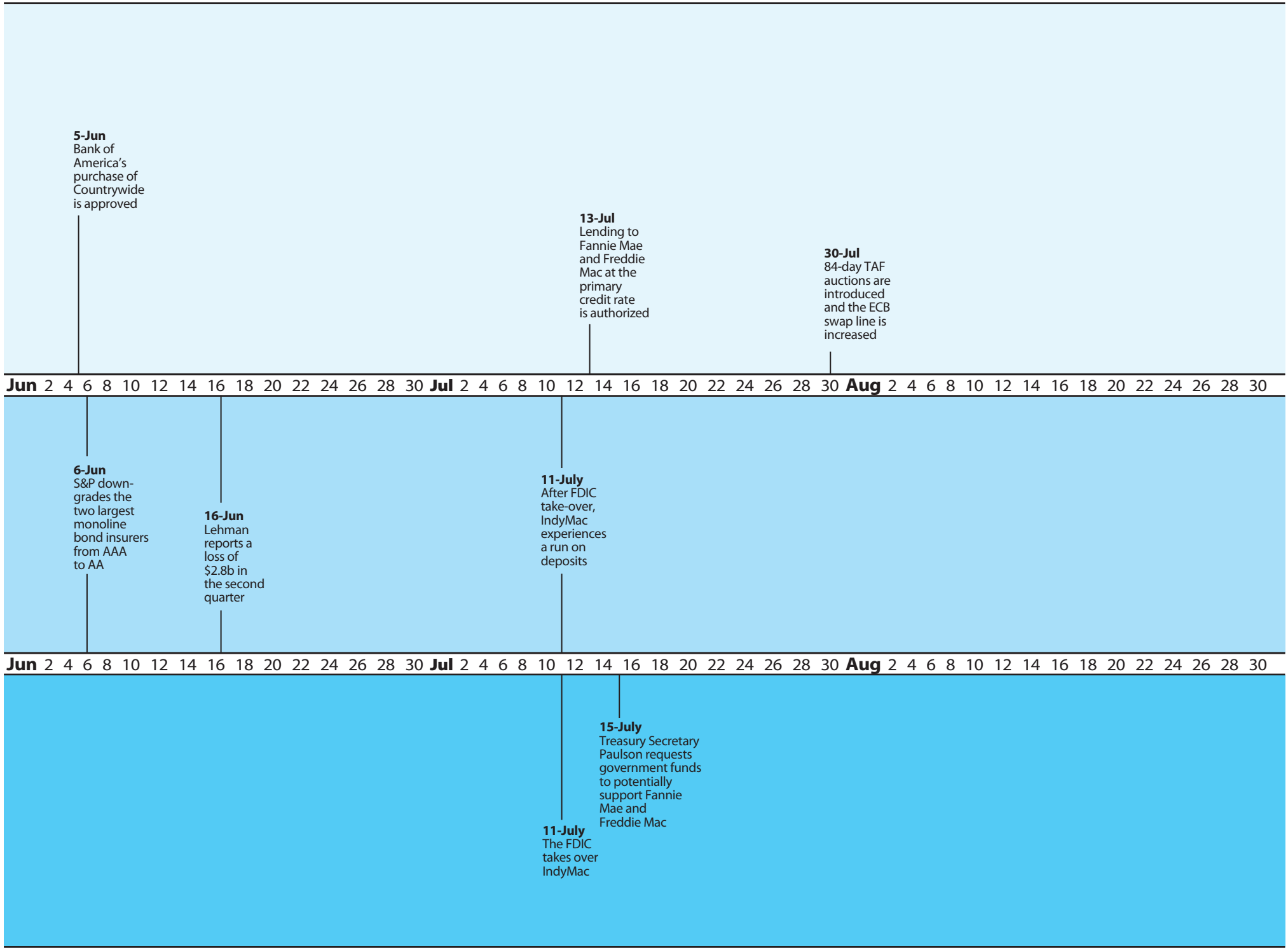
Source: Federal Reserve Board

Note: Shading represents NBER recessions, unless otherwise noted.

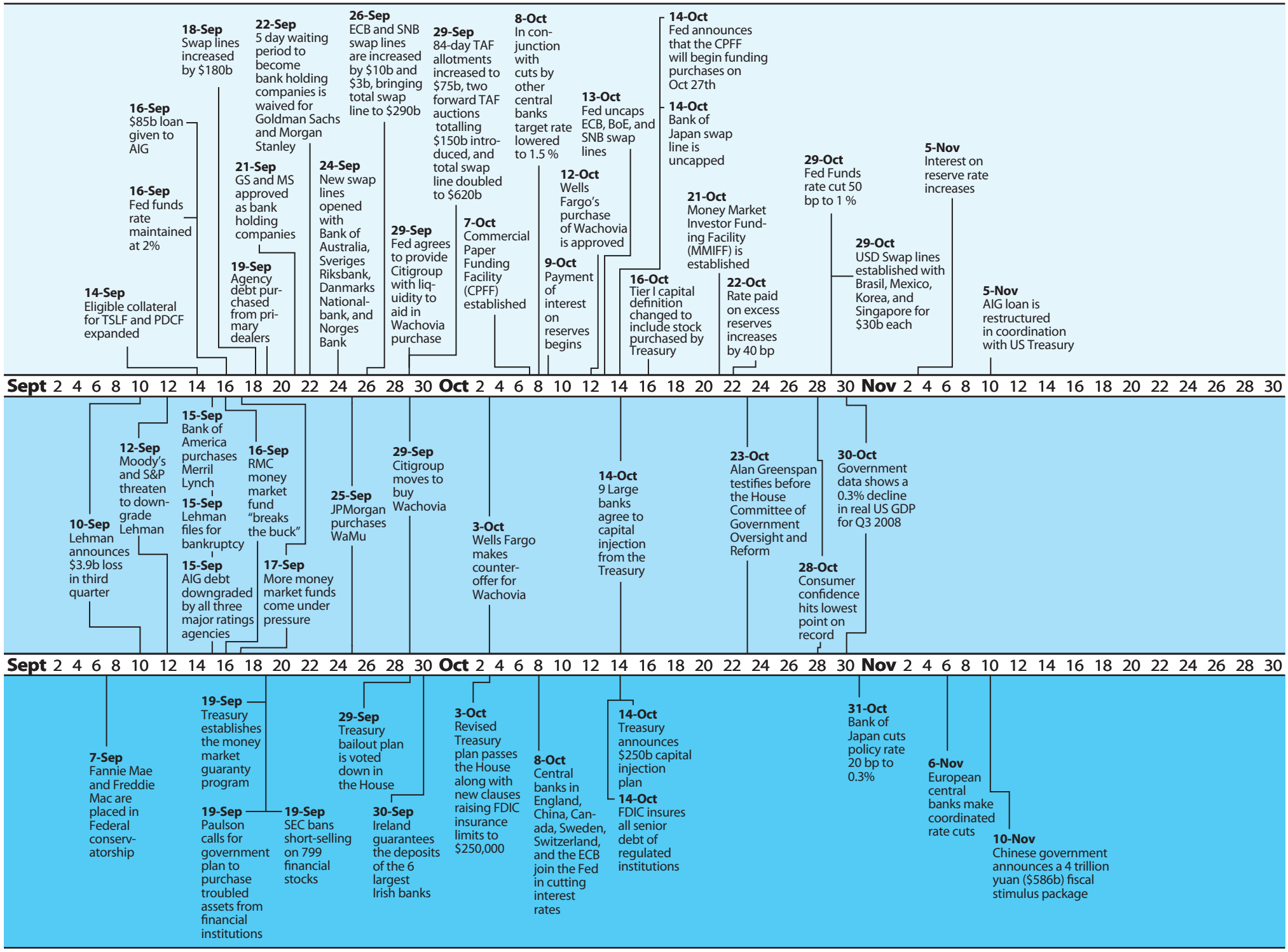
Financial Turmoil Timeline (March-May)



Financial Turmoil Timeline (June-August)



Financial Turmoil Timeline (Sept - Nov)



Memos Related to EESA

1. **Global Losses – Presentation summarizing loss estimate work by Bank Supervision, Markets and Research Groups of New York Fed**

2. **Escalation Options – memo describing boundary, performance and exit problems**

3. **Economic and Monetary Policy Meeting -- Analysis of October 14th policy actions provided to a general New York Fed audience**

4. **Assessments of "Paulson's Gift," by Veronesi and Zingales – two examinations of the approach of Veronesi and Zingales (http://www.chicagogsb.edu/email/chicago_on/PaulsonsGift.pdf) to measuring the value of the Capital Purchase Program and FDIC guarantee.**

5. **Market Intervention Options – September 2008 analysis of what assets to buy under the TARP based on two complementary goals**

Global Loss Estimates

Beverly Hirtle and Simon Potter
Research and Statistics Group
October 1, 2008

FEDERAL RESERVE BANK of NEW YORK

Global Losses

Global Loss Estimates

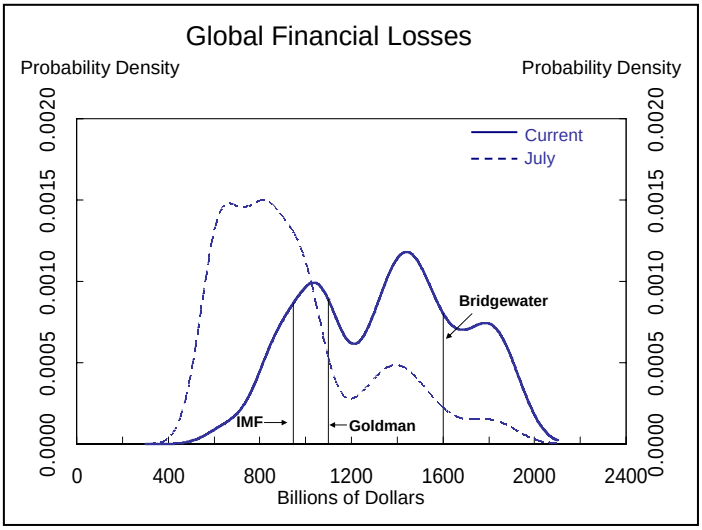
- Losses for residential real estate are lifetime
- Losses on other loans and securities either two year horizon or mark to market
- Includes “business as usual” losses

Macro Scenarios

- Resilient Economy: minimum 4 quarter growth *above* 1.5%
- Mild/Growth Recession: minimum 4 quarter growth *between* -0.5% to 1.5%
- Moderate Recession: minimum 4 quarter growth *between* -3% and -0.5%
- Severe Recession: minimum 4 quarter growth *below* -3%

Construction of Loss Estimates

- Base residential mortgage losses on Lehman analysis that takes into account regional variation
- Base other losses on a mixture of historic loss rates for BHCs and April IMF Global Financial Stability Report
- “Heroic” assumptions to match to macro scenarios
- Simulation used to capture uncertainty



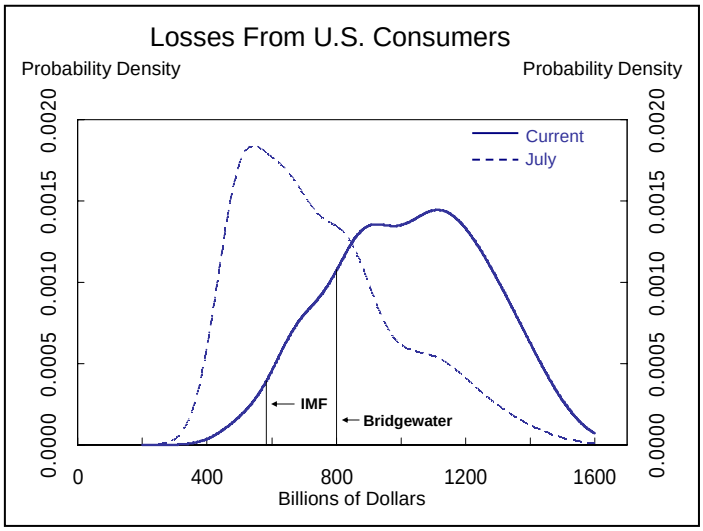
Scenario Losses
October 2008
(July 2008)

	Global Losses *($, Billions)*	**Probability**
Resilient Economy	660 (621)	0.03 (0.26)
Mild/Growth Recession	968 (894)	0.33 (0.52)
Moderate Recession	1440 (1393)	0.43 (0.18)
Severe Recession	1812 (1798)	0.21 (0.04)

Losses from Consumers

Consumer Losses

- Mortgage loss rates well above historical maximums
- Junior Liens large source of losses
- Consumers are defaulting at a higher rate than predicted based on observables
- Credit card losses already high



Losses from US Consumers in Scenarios

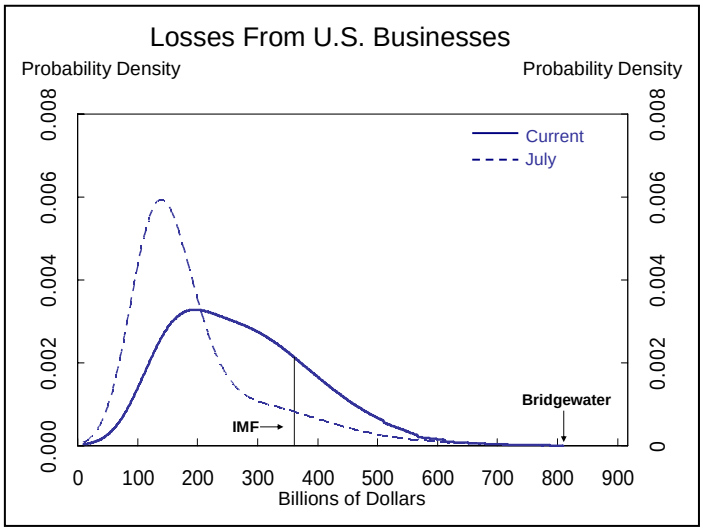
($, Billions)

	Resilient	Mild/Growth Recession	Moderate Recession	Severe Recession
Residential Mortgage	**448**	**607**	**880**	**1046**
First Liens	72	115	174	204
2nd Liens/Home Equity	60	92	133	159
Securities	316	401	574	683
Consumer Loans	**87**	**110**	**165**	**221**
Cards	62	81	111	141
Other	25	29	54	80
Total	**535**	**717**	**1045**	**1267**

Losses from Businesses

Losses from U.S. Businesses

- Not high in the two more optimistic scenarios
- In pessimistic scenarios consumer weakness and financial sector distress spreads to non-financial business sector



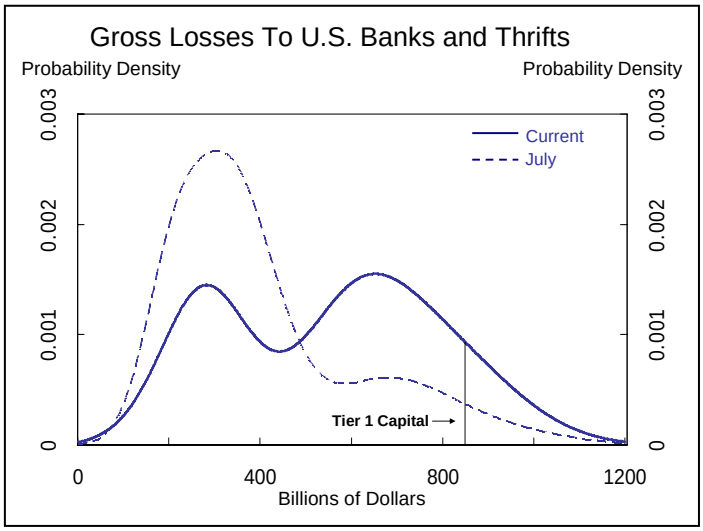
Losses from U.S. Businesses
($, Billions)

	Resilient	Mild/Growth Recession	Moderate Recession	Severe Recession
Loans	**89**	**178**	**285**	**391**
CRE	30	60	97	134
C & I	55	110	146	181
Other	4	8	42	76
Securities	**36**	**72**	**110**	**154**
CMBS	26	52	83	114
Other	10	20	27	40
Total	**125**	**250**	**395**	**545**

Losses to U.S. Banks

Losses to US Banks

- Loss rates applied to US banks share of outstandings across 13 categories of loans and securities
- Simulation allows for uncertainty in this allocation
- 40% to 60% of global losses go to US Banks



Impact of Losses in the U.S. Banking Sector

($, Billions)

	Resilient Economy	Mild/Growth Recession	Moderate Recession	Severe Recession
Future Losses	**167**	**309**	**609**	**803**
Resources to Absorb Losses:	**444**	**316**	**325**	**325**
Increase in Reserves	62	62	62	62
Revenue	382	254	263	263
Losses in excess of Resources	**0**	**0**	**283**	**478**
Excess Losses as % of:				
Tier 1 Capital	0%	0%	34%	57%
Tangible Equity Capital	0%	0%	48%	82%
Tier 1 Capital Buffer over 4%	0%	0%	63%	106%
Tier 1 Capital Buffer over 6%	0%	0%	110%	185%

Appendix: Assumed Loss Rates

	Resilient Economy	Mild/Growth Recession	Moderate Recession	Severe Recession
Residential Mortgage				
First Liens	**2.46%**	**3.92%**	**5.95%**	**6.98%**
2nd Liens	**6.55%**	**9.99%**	**14.48%**	**17.35%**
Securities:	**4.65%**	**5.91%**	**8.44%**	**10.06%**
Agency MBS	**0.46%**	**0.76%**	**1.12%**	**1.47%**
Non-Agency AAA	**1.22%**	**1.73%**	**2.63%**	**3.08%**
CDOs	**37.82%**	**44.44%**	**67.44%**	**79.07%**
Sec 2nd Liens	**29.91%**	**40.00%**	**50.00%**	**60.00%**
Loans				
CRE	**1.25%**	**2.50%**	**4.04%**	**5.58%**
C & I	**1.42%**	**2.84%**	**3.76%**	**4.68%**
Consumer	**6.23%**	**7.85%**	**11.82%**	**15.78%**
Cards	**8.18%**	**10.63%**	**14.55%**	**18.47%**
Other	**3.88%**	**4.52%**	**8.54%**	**12.57%**
Other	**0.53%**	**1.05%**	**5.39%**	**9.73%**
Securities				
CMBS	**2.79%**	**5.58%**	**8.86%**	**12.12%**
Other	**1.05%**	**2.11%**	**2.84%**	**4.21%**

Appendix: Comparison to Historic Loss Rates

	Loan Losses/ Assets	Loan Losses/ Loans	Non-residential Loan Losses/ Non-residential Loans	Residential Loan Losses/ Residential Loans
BHC Sector Scenarios Losses				
Resilient Economy	**1.44%**	**2.92%**	**2.05%**	**4.66%**
Mild/Growth Recession	**2.30%**	**4.65%**	**3.21%**	**7.52%**
Moderate Recession	**4.08%**	**8.26%**	**6.79%**	**11.16%**
Severe Recession	**5.29%**	**10.72%**	**9.45%**	**13.22%**
Historical BHC-level Losses:				
90th Percentile	**1.74%**	**2.70%**	**2.72%**	**0.73%**
95th Percentile	**2.54%**	**3.88%**	**3.98%**	**1.12%**
99th Percentile	**3.80%**	**5.88%**	**6.57%**	**2.49%**
Maximum	**5.08%**	**8.77%**	**14.39%**	**8.73%**
Historical Banking System Losses:				
Maximum	**2.19%**	**3.32%**	**4.01%**	**1.02%**

Escalation Options

Kenneth Garbade
Jamie McAndrews
September 26, 2008

In the interest of preventing or terminating a wide-spread "run" on claims commonly held as stores of liquidity, i.e., on assets which are normally convertible – on demand or in the very near future – into bank demand deposits or currency, the Federal government may want to provide assistance to the issuers of such claims.

This memo briefly describes three broad categories of assistance:

- guarantees,
- discount window loans, and
- capital injections.

At recent historical levels of usage, these devices are substantially different. For example, a discount window loan is a senior contractual obligation of the borrower secured by specific, reasonably liquid, collateral, while preferred stock is an equity claim ranking below all creditor claims (albeit ahead of the claims of common shareholders). However, at the level of usage contemplated for purposes of this memo, they are all roughly equivalent. One way or another, the Federal government – either the Treasury or the Federal Reserve – will come to bear a substantial amount of enterprise risk, and will suffer loss if an enterprise fails.

It is important to bear in mind that two of the devices, discount window loans and capital injections, would result in a substantial increase in public holdings of short-term, risk-free assets, either in the form of Treasury securities (as in the current Supplementary Financing Program) or reserve balances (as would normally occur with unsterilized discount window lending). Policymakers should be prepared to review options for paying interest on reserves (to facilitate the conduct of monetary policy at target Federal funds rates above zero) and for making Treasury securities easier to obtain.

Guarantees

The Federal government could extend guarantees beyond the existing FDIC insurance on bank deposits under $100,000 and the Treasury guarantee of money market mutual funds to include other claims commonly held as stores of liquidity, including,

- bank deposits in excess of $100,000,
- shareholder claims on short-term fixed-income mutual funds, including ultra-short bond funds and money market funds not presently guaranteed by Treasury,
- finance company commercial paper,
- claims on short-term investment funds, such as those sponsored by state governments for the benefit of local governments, and
- repurchase agreements.

This approach has several drawbacks:

The Boundary Problem: It separates issuers into two distinct camps, those that issue guaranteed claims and those that do not. This could precipitate a run on non-guaranteed claims and force liquidation of investments held by issuers of non-guaranteed claims. Additionally, it may be difficult to identify where the boundary between the camps is best placed.

The Exit Problem: Although providing guarantees may stem a run on claims issued by those in the insured camp, it is far from clear how the guarantees can be wound down in the future.

The Performance Problem: If an issuer of guaranteed claims fails and the guarantees are not honored promptly, market participants may come to question the *credibility* of the guarantees. Thus, the guarantor would have to have adequate processing capacity.

Discount Window Loans

The Federal Reserve could further expand access to the discount window, an approach that would likely entail a significant expansion of the Fed's balance sheet. A large volume of new discount window loans could be financed by Treasury sales of bills, notes, and/or bonds and deposit of the proceeds in the TGA (or some similar account). In

the absence of such issuance, Federal Reserve Bank liabilities to depository institutions will rise, driving the Federal funds rate down to the rate of interest paid by Reserve Banks – zero at present, possibly a positive number in the future.

This approach has the advantage of being discretionary (we don't have to lend to somebody who is of questionable solvency). In other words, this approach mitigates the "boundary problem" by the discretion exercised by the Fed in providing discount window loans. Borderline cases can be judged individually given the circumstances prevailing at the time of a request.

The approach has the drawback of possibly imposing a large operational burden on Reserve Bank staff, who would be tasked with monitoring compliance with collateral pledge and haircut requirements. Some of this burden could be mitigated if the Fed were prepared to extend credit to non-depository institutions on a back-to-back basis through depository institutions, using the latter as collateral custodians.

In addition, it may prove to be difficult to wean some borrowers off of Reserve Bank credit, i.e., this approach has an "exit problem" of its own. However, it may be easier to solve the exit problem in this case – by stepping up interest rates on continuing loans after a crisis has passed.

With the use of this policy, the stock of credit risk-free claims available to market participants other than depository institutions would be enlarged if the discount window loans are financed through the sale of Treasury securities.

Capital Injections

The Treasury could enhance the capital adequacy of incorporated issuers of short-term claims by, e.g., purchasing preferred stock and funding the purchases with sales of Treasury debt. The preferred stock should be redeemable at any time (no reason to have the Treasury as a stockholder longer than necessary), and may either be convertible into common or come with detachable warrants on common stock (to provide an "equity

kicker" to reward taxpayers in the event the issuer thrives, and to provide a way to dilute the interests of existing shareholders in the event the issuer comes close to insolvency and the federal government chooses to forego a formal insolvency proceeding).

This approach also has the advantage of being discretionary, and it can be used to bolster the ability of moderately well-capitalized companies to absorb more highly-leveraged enterprises. The discretionary character of the approach does not require the construction of a "bright line" that would exclude a particular class of firms. However, some constraints might be helpful. For example, it may be better to limit the government to investing in well-managed banks, rather than allowing it to invest in all types of financial firms.

The approach has the drawback of involving the Federal government in the internal governance of an issuer. Governance rights, including representation on boards of directors, representation on compensation committees, ability to block dividends on common shares, etc., may have to be tailored on a case-by-case basis. There may also have to be provisions for expanding governance rights if a firm deteriorates, as well as contracting governance rights if a firm thrives.

This approach does not suffer from a "performance" program, because the government would be investing money at the outset. There is, of course, a challenge to obtain the legislative authority to invest, but if that hurdle is overcome the performance is achieved upon the investment – it does not rely on any subsequent action.

Finally, the "exit" problem can be addressed by including a provision that the dividend rate on any preferred stock issued to the Treasury will increase by, say, one percent per year after the tenth year. This would incentivize issuers to redeem the stock.

Summary

This memo reviewed three alternative approaches for the government to abate a broad run on the financial sector: guarantees, wide-scale discount window lending, and

capital injections. Two of the alternatives have the ancillary advantage of expanding the amount of short-term, risk-free assets available to banks and the public.

We believe that guarantees could be effective in preventing and terminating runs, as was seen in the creation last week of the insurance program for money market mutual funds. However, such guarantees come with significant boundary, performance, and exit problems.

Wide-scale discount window lending can assist firms facing a run to quickly obtain funds to meet withdrawal demands. Discount window lending alone does not guarantee that the liability-holders, the depositors, will stay in place, and is likely to be much less effective than a broad guarantee in stopping a run that is already in progress. In addition, discount window lending has some boundary, performance, and exit problems, although these are amenable to solution in ways that are quite practical when compared with a guarantee program.

Capital investment by the Treasury would greatly strengthen the ability of firms to withstand runs, although it might be ineffective in stopping a run in progress. Capital investment would assist banks in stabilizing their business and planning for the future, in addition to dealing with an incipient crisis. It appears that equity capital investment exhibits the least significant boundary, performance, and exit problems. In addition, such a solution has been a common one in financial crises in many countries, including the U.S. in the 1930s.

It is likely that some combination of the three options outlined here would be the best approach in a broad financial sector run. We saw the creation of money market mutual fund insurance last week, and the Federal Reserve has made extraordinary efforts to provide funding through the discount window to investment banks, commercial paper issuers, foreign banks, and the U.S. banking system. The missing policy, to date, has been bank capital injections. We suggest that it may be the best policy for setting the stage for recovery from this crisis.

Economic and Monetary Policy

FEDERAL RESERVE BANK OF NEW YORK

MEETING DATE

Open Session:
Wednesday, October 22nd
11 a.m.
33 Maiden Lane
10th Floor Large Meeting Room

"What, then, happened during the last few days of February and the first few days of March? Because of undermined confidence on the part of the public, there was a general rush by a large portion of our population to turn bank deposits into currency or gold. -- A rush so great that the soundest banks could not get enough currency to meet the demand. The reason for this was that on the spur of the moment it was, of course, impossible to sell perfectly sound assets of a bank and convert them into cash except at panic prices far below their real value."
-- President Franklin Delano Roosevelt, First Fireside Chat, March 12, 1933

MEETING AGENDA:
Intermeeting Developments

Olivier Armantier ***Jamie McAndrews***
Adam Ashcraft ***Simon Potter***
Beverly Hirtle ***Til Schuermann***

Intermeeting Developments

Since the last EMP meeting on September 9, the financial turmoil that began in August 2007 has intensified into a global financial crisis requiring immediate policy action. The response by policymakers across the major industrial countries has been forceful and comprehensive. Many parallels have been drawn with the Great Depression, the last financial crisis to affect all the principal industrialized countries simultaneously. However, history never repeats itself exactly. While the policy interventions over the last few weeks are as dramatic as those adopted by FDR in the first few days of his administration in March 1933, there are crucial differences.

In the current period, the policy interventions, both rumored and actual, have been discussed and dissected in the modern media fully—and while financial markets were open. Seventy-five years ago, at the end of a nationwide bank holiday, it fell to the newly inaugurated president to explain to the American people in the first of his famous fireside chats over the radio what policy steps he was taking to solve the bank panic. Roosevelt's first fireside chat marked the turning point in a severe contraction of the U.S. economy that had lasted more than three years. In 1933, the unemployment rate was about 25 percent, real output had declined 30 percent, the stock market had dropped 90 percent, and prices for all goods and services were falling. In contrast, the recent intervention has occurred against a backdrop of high global growth and low unemployment, although also at a time of enormous worldwide imbalances that have produced complex, little understood interconnections in the global financial system.

Intermeeting Developments

"These are momentous steps, but they are being taken to address a problem of historic dimensions. In one respect, however, we are fortunate. We have learned from historical experience with severe financial crises that if government intervention comes only at a point at which many or most financial institutions are insolvent or nearly so, the costs of restoring the system are greatly increased. This is not the situation we face today."

-- Chairman Ben Bernanke, October 7, 2008

In some respects, history is repeating itself in an even more transparent manner. Just as in February and early March 1933, a banking panic has developed, but this time it has occurred among wholesale, rather than retail, depositors. Further, these wholesale deposit runs have been of a global nature. For example, the country of Iceland was virtually bankrupted by this modern form of a bank run. The spark for this panic was the failure of a major investment bank, Lehman Brothers, on September 15, 2008. As the panic fed on itself, the need for a time-out became clear. However, unlike the policy actions of the 1930s, which were not coordinated across countries, the policy response in the recent period has been virtually simultaneous across the major industrialized countries. The reason was partly that there was no way to call a global bank holiday and partly that the lesson from history was clear: restore confidence in the banking system by injecting capital, providing guarantees for bank liabilities, and meeting all near-term liquidity demands of the financial system.

Policy Options for Stemming the Crisis

The financial situation in early October 2008 deteriorated quickly. After the bankruptcy filing of Lehman Brothers on September 15, 2008, money market mutual funds had experienced losses from their holdings of Lehman Brothers' commercial paper. On September 16, two money market mutual funds' net asset values fell below the level, 99.5 cents, at which they could maintain withdrawals, prompting the funds to disband—they "broke the buck." The succeeding weeks saw enormous withdrawals from other money market mutual funds, which severely curtailed that sector's usual purchases of commercial paper.

These abrupt events led to an almost complete breakdown of the short-term money markets for commercial paper, term interbank lending (including certificates of deposit), and Eurodollar deposits. As wholesale depositors sharply reduced their lending to banks, the resulting strain on banks was in effect quite similar to what occurs when retail depositors make a run on banks.

Intermeeting Developments

These events led to the October 3, 2008, passage of the Emergency Economic Stabilization Act of 2008 (EESA), which provided the U.S. Treasury Department with a wide range of alternatives for addressing the financial crisis. In particular, the Treasury was authorized to spend up to $700 billion toward the purchase of troubled financial assets or toward other kinds of support that might stem the rapidly emerging run on the U.S. financial system.

What policy options are available to deter such a run? First, expansions of lender of last resort operations by the central bank can assist the sectors of the economy that are not able to obtain credit through the normal channels. Second, broader guarantees of financial sector liabilities can reassure depositors and other holders of financial firm debt that their wealth will be preserved if they maintain their holdings of these liabilities. Finally, an injection of capital by the government can strengthen the creditworthiness of financial firms.

With each of these policies, the government faces difficult choices in determining which firms or liabilities should be included in the lender of last resort operations, the guarantees, or the capital injections—what we might call a "boundary" problem. Inevitably, wherever the government draws the line in applying its policy, there will be some winners and some losers. A second problem for the government is how well it can perform on the promises implicit in each policy—particularly the guarantee of financial firm liabilities. How quickly can the government identify guaranteed liabilities and provide funds in case of a default? Finally, in each case, the government faces the problem of how to exit from a policy action once normal market conditions return.

Intermeeting Developments

The policies announced by the Treasury, the Federal Deposit Insurance Corporation (FDIC), and the Federal Reserve on Tuesday, October 14, represented an advance on all three policy fronts. Under the authority of the EESA, the Treasury injected $125 billion of capital into nine large, systemically important banks in the newly launched Capital Purchase Program (CPP). Under the systemic risk exception provisions of the FDIC Improvement Act of 1991, the FDIC guaranteed funds in non-interest-bearing accounts and the senior debt of banks and bank holding companies as well as thrifts and thrift holding companies through the Temporary Liquidity Guarantee Program, or TLGP. The Federal Reserve announced a lending facility to support the commercial paper market. With these actions on three policy fronts, the government sought to stem the sense of panic and uncertainty that pervaded financial markets in early October. In implementing each of these policies, the government will face the challenges of defining the boundaries of the policy, performing in a timely and credible way, and ending the intervention when appropriate.

With the introduction of these programs, the menu of tools for improving the health of the U.S. financial system has widened significantly. Both sides of a bank's balance sheet can now be addressed: the Treasury may buy an asset directly using the Troubled Asset Relief Program (TARP) of the EESA, and it may purchase equity and thereby directly inject capital into a bank with the CPP. Meanwhile, the TLGP vastly expands the portion of liabilities that enjoy some form of government protection.

We can view the efficacy of these tools through a standard bank balance analysis. Returning to the example used in the EMP meeting of March 12, 2008, consider a bank with $10 billion of assets (some of which may be "troubled"), $9 billion of liabilities or debt—a mix of small and large deposits, senior and subordinated debt—and $1 billion in equity or capital. The bank thus has 10:1 leverage, or a 10 percent capital ratio.

Intermeeting Developments

Assets	Liabilities/Debt
10	9
	Equity/Capital
	1

With this example, we examine the relative impact and efficacy of asset purchases and capital injections.

Consider first the case in which the U.S. Treasury purchases some troubled assets. The bank's current mark-to-market valuations ("marks") show that the institution has $10 billion in assets. Some of these assets are of very high quality, such as Treasury instruments, with unambiguous marks. Other assets are of lower quality, such as residential mortgages, with somewhat ambiguous worth. Let us examine two cases, one in which the use of an auction mechanism in the Treasury's asset purchase program reveals prices to be higher than the marks, and another in which prices are revealed to be lower.

Suppose in the first case that the Treasury spends $2 billion to buy bank assets previously marked at $1 billion. Then the bank's new balance sheet shows assets of $11 billion and capital of $2 billion, for a new leverage of 11:2 or a capital ratio of 18.2 percent. The "profit" of $1 billion is simply booked as capital.

In the second case, prices turn out to be lower than the marks, so the bank now has assets of just $9.5 billion. Thus, the Treasury has spent $0.5 billion to acquire assets thought to be worth $1 billion. This action reduces the bank's capital base to $0.5 billion, for a new leverage of 9.5:0.5 or a capital ratio of 5.3 percent.

Alternatively, the Treasury could simply inject $1 billion of equity into the bank directly through the CPP. This action would have the same outcome as spending $2 billion on assets, namely a new leverage of 11:2 or a capital ratio of 18.2 percent. However, Treasury achieves this outcome for half the cost (it spends $1 billion on capital instead of $2 billion on troubled assets), and without needing to go through an auction process. This approach describes the capital injection program announced on October 14, 2008. Together with the TLGP, the program helps protect banks' balance sheets against the uncertain valuation of bank assets.

Most, if not all, interventions around the globe in the last few weeks can be evaluated in this simple way. The value of bank assets has become progressively less certain—hence the flight from banks. By injecting capital into banks, a government raises the banks' capital ratios and provides a guarantee of their liabilities. As a result, investors, depositors, and other banks can have greater comfort in continuing to extend credit to those banks. The government's action gives banks more capital to absorb possible future losses and reduces the incentives for investors and depositors to call in their debts with the bank (withdraw their deposits) since the debts are now all guaranteed by the government. Moreover, with the additional capital in place, banks are able to extend new credit to allow for macroeconomic growth.

The Need for Capital Injections

As we have seen, a key element of the policy debate has concerned the need to inject capital into the banking system. Why has this been an area of such intense focus? Recent data suggests that nearly all U.S. banks and bank holding companies meet or comfortably exceed regulatory capital standards—that is, they are "well capitalized" according to a regulatory notion of "good" capital known as Tier 1. For instance, the median Tier 1 capital ratio among the thirty largest U.S.-owned bank holding companies is 8.82 percent, nearly 50 percent higher than the 6 percent regulatory minimum required to be considered well capitalized.

Intermeeting Developments

However, these figures may not provide an accurate picture of the industry's true capital strength. One way to assess the industry's capital strength is to ask how well capital ratios would hold up in the event of a relatively deep recession, with commensurate consumer- and business-related credit losses. Capital is intended to protect banks against unlikely but severe events, so this is a reasonable standard.

In testing such a "stress loss scenario," we have determined that the U.S. banking industry would face about $750 billion in losses. The median Tier 1 capital ratio for the thirty largest domestic bank holding companies would fall to 3.50 percent after losses of this magnitude, even after we factor in the resources that the banks would have to buffer such losses—including loan loss reserves and income from other activities. We estimate that it would require capital injections of $100 billion to $400 billion to restore the industry to adequate capitalization in this scenario. The lower figure in this range is what would be required to enable bank holding companies to meet the minimum regulatory requirement to be considered "well capitalized," while the larger figure is what would be required to raise Tier 1 capital ratios to 7.50 percent, a common internal management target.

Discussion Items

1. Is fiscal policy the most effective stabilization policy in current circumstances?

2. What is the appropriate exit strategy from the new government and Federal Reserve programs or alternatively which of these programs should remain as permanent defenses against future financial crises?

3. How much blame should economists take for the crisis?

4. Why did economists almost universally recommend capital injections rather than asset purchases in reacting to the EESA?

Assessment of "Paulson's Gift," by Veronesi and Zingales

Asani Sarkar[1]
Research and Statistics Function

Summary

- Veronesi and Zingales (VZ) make the reasonable argument that, if banks are to willingly increase lending, then it is necessary for the revised Paulson plan to benefit the banking sector before the rest of the economy and to a greater extent.
- To estimate the value created in the banking sector by the plan, after accounting for the net costs to taxpayers, VZ implements an event-study methodology using asset price changes of 10 large banks over a short event window.[2] This approach, which is an important contribution of the paper, provides a template for quantifying the economic impact of alternative plans.
- VZ conclude that the plan did not create any value for the 10 banks they study.
- However, the estimates of value creation reported by VZ have a wide enough range that it is difficult to support the claim of no value creation with high confidence.
- Some of VZ's methodologies are questionable or may be even unreasonable. Small (and reasonable) changes in VZ's methodology and data result in substantially larger estimates of bank value creation, a further indication of the large uncertainty embedded in VZ's valuation estimates.
- Even using VZ's own estimates of value creation, the revised Paulson plan fares better than other alternatives, except for a debt-equity swap.
- The swap plan involves debt restructuring post-default, and hence does not appear to qualify as a rescue plan. Thus, it is not clear whether the Paulson plan and the swap plan are strictly comparable.
- If different plans have different systemic effects, a complete assessment of the plans appears to require estimation of these systemic effects (although the estimation problem is likely to be difficult).
- There were large reductions in the sensitivity of banks' equity and CDS returns to systematic factors after the Paulson plan was announced, suggesting that the quantitative effects of a reduction in systemic risk may be substantial.

[1] I have incorporated and summarized many comments from Beverly Hirtle, James McAndrews, Simon Potter, and Zhenyu Wang.

[2] Wachovia is treated as independent in the analysis rather than part of Wells Fargo.

Description of the Paper

Veronesi and Zingales (VZ from now on) empirically evaluate the impact of the revised Paulson plan on the banking industry and compare the Paulson plan with competing plans. The net benefit of the plan is estimated as the difference between the value-creation for equity and debt holders of 10 large banks and the net cost to taxpayers (the sum of the cost of the FDIC guarantee of bank debt and the net cost of equity infusion).

In estimating value creation for the 10 large banks, the study utilizes their asset price changes over a short window (October 10 to October 14 2008). The use of a short window allows the paper to mitigate the impact of factors unrelated to the plan on asset prices. The paper estimates a total value creation of about $133 billion (reduced to $109 billion in a later version of the paper due to a different recovery rate assumed on the bonds) for the 10 large banks against a net cost to taxpayers of between $112 billion and $135 billion. To estimate the value creation for debt holders, the paper uses the reduction in CDS prices of the banks. Since some part of the CDS price change is due to factors unrelated to the Paulson plan, the CDS price change of GE Capital is subtracted from the CDS price change of banks. To estimate the value creation for equity holders, the equity return of banks is adjusted for its systematic response to the S&P 500 market index.

The net cost to taxpayers consists mainly of the cost of guaranteeing bank debt. This is obtained as the discounted value of the difference between the value of the guarantee (estimated as the CDS price times the amount of debt guaranteed) and its cost to the banks (estimated as 75 basis points times the amount of debt guaranteed) over the guarantee period of 3 years. In addition, there is a small cost of equity infusion which is difference between the amount of equity invested and the theoretical value of the preferred stocks and warrants.

The paper concludes that the revised Paulson plan did not create any net benefit in the 10 large banks. VZ write, “It was simply a redistribution of money from the taxpayers to the investors in the major financial institutions, especially the debt-holders.”

To compare different plans, VZ assume that the objective of all plans is to reduce CDS prices by an amount equal to the actual decline between October 10 and 14 2008. The comparison is made along four dimensions: the required investment, the net cost to taxpayers, the value at risk for taxpayers (5% probability of a loss in one year) and the percent ownership of the government if it had invested only in equity. VZ conclude that the revised Paulson plan is worse than a pure equity infusion and a debt for equity swap.

Assumptions Underlying VZ’s Analysis

For the purposes of their analysis, VZ make (either implicitly or explicitly) the following assumptions:

- A necessary (but not sufficient) condition for the success of the Paulson plan is that the banking industry benefits to a larger extent compared to other sectors in the economy
- It is possible to estimate the effect of the Paulson plan on the 10 large banks with a high degree of confidence (after abstracting from systemic effects) using asset price changes over short intervals

The Logic of Focusing on Value Creation in the Banking Industry

The paper argues that value creation in the banking industry is a necessary (but not sufficient) condition if the economy is to benefit more broadly. This is because the Paulson plan intends to create private incentives for banks to increase lending which requires that banks find it more profitable to lend. In other words, the value created by the pan for the banking sector must precede and exceed that for the rest of the economy. Thus, even though the paper does not estimate systemic benefits from the plan, it has implications for potentially broader economic benefits from the plan.

The paper acknowledges that "the plan could have succeeded in helping the economy through other channels" and that they do not attempt to "estimate the systemic effects of the plan." Since systemic benefits are possibly harder to estimate, the focus on the banking sector allows the paper to utilize a relatively simply event-study methodology to quantify the impact of the plan. The methodology is an important contribution of the paper, as the approach can provide a template for assessing alternative plans.

Did the Paulson Plan Create Value for the 10 Large Banks?

There is large uncertainty associated with VZ's estimates of value creation.

- The paper's estimates of the net benefit from the plan, as a percent of the cost, has changed from in its initial to its current version. In the initial version, the net benefit of the plan varied between -1% and 19% with Morgan Stanley, and between -13% and -35% without it. In the later version, the estimated benefits vary between -3% and -19% without Morgan Stanley and between 7% and -21% without it. Thus, there is large uncertainty associated with the estimates and it appears unreasonable to conclude with high confidence that the point estimate of the benefit is zero.
- The difference in value creation between the two versions of the paper arises from different assumptions on the recovery rate of bonds. To obtain the value creation for debt holders, VZ calculates the expected cost of buying protection on the bonds using CDS. In the latter version, VZ multiplies the bank's CDS price by the probability of not defaulting in that year (itself computed from the CDS price by assuming a 20% recovery rate). Since the CDS price already incorporates the default probability, it is not clear why it further needs to be multiplied by (one minus) this probability.

- The most negative benefit estimates are obtained in the initial version of the paper after omitting Morgan Stanley from the list of banks based on the argument that all of Morgan Stanley's value creation is attributable to Mitsubishi's confirmation of its investment in the firm.
- The presumption that part of Morgan Stanley's value is created by Mitsubishi's investment appears to directly contradict the conclusion that Treasury's investment did not create value. In particular, Treasury's investment should be cheaper for banks compared to private investment since private investors are unlikely to be gift givers (i.e. they must at least break even on any investment). Therefore, the net cost of Mitsubishi's investments is expected to be zero and so, in theory, should create zero value for Morgan Stanley. Hence, VZ's starting premise (i.e. Mitsubishi's investments create value) is false and so the value gain in Morgan Stanley on account of the Treasury investment should not be excluded.

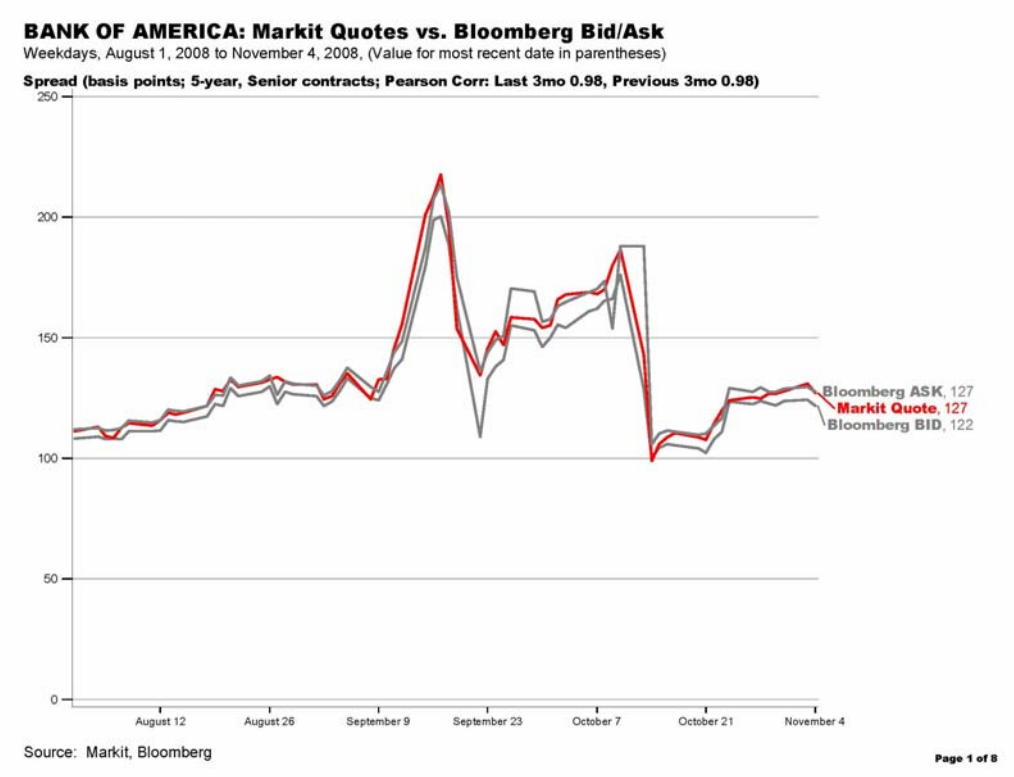
Are the Estimates of Value Creation Reasonable?

The total value creation is the sum of value created for debt and equity holders. To estimate the value creation for debt holders, the paper uses the reduction in CDS prices of the banks. Since some part of the CDS price change is due to factors unrelated to the Paulson plan, the CDS price change of GE Capital is subtracted from the CDS price change of banks. To estimate the value creation for equity holders, the equity return of banks is adjusted for its systematic response to the S&P 500 market index.

- It seems inappropriate to assume that GE Capitals' CDS prices represent a systematic factor since it is unlikely that bank's CDS beta and GE Capital's CDS beta are the same (i.e. they both respond identically to systematic factors). Indeed, three banks have smaller CDS price changes than GE's, leading to negative "adjusted CDS change," an indication of over-adjustment to systematic factors. Recognizing that a negative number makes no sense, the paper sets the "adjusted CDS change" to zero for these three banks! Second, the paper does not use GE's stock price as a benchmark when estimating the value creation for bank equity holders. Instead it uses the S&P 500 index. This indicates an inconsistency in the approach towards estimating value creation for equity and debt holders.
- We estimate the value creation for debt holders using an approach similar to what VZ uses for equity holders. We replace GE capital with the CDX index, which is a broad market index of CDS issuers. We estimate the systematic response of banks' CDS price changes to that of the CDX index changes, and adjust the CDS price changes of banks for this correlation. We find an additional $70 billion of value creation for debt holders using this approach. We do not find any instance of a negative "adjusted CDS change," which indicates the appropriateness of the approach.
- In estimating the value creation for bank equity holders, VZ uses the S&P 500 index to adjust equity returns for systematic factors. The use of a single market index is open to question as over the years academics have demonstrated that

there are more factors than the general market index. Adding additional factors could change the numbers substantially.

- There is some question regarding the event window used by VZ (October 10 to 14 2008). The UK plan was reported on October 8 and, on October 9, US media reported that the US Treasury was considering following the UK plan. This suggests that asset prices may have responded to an anticipated US plan on October 9. CDS prices of banks mostly *increased* between October 9 and 10, so moving the event date to October 9 would result in lower estimated value creation for debt holders of banks. The impact on equity holders is not clear as equity prices of 7 banks increased while those of Goldman, Merrill and Morgan Stanley decreased between October 9 and 10.
- To obtain a more accurate picture of value creation in the banking sector, it is desirable to expand the sample of banks to include all publicly traded banks and related financial intermediaries.
- CDS prices do not trade on a centralized exchange. As such, it is difficult to estimate what the representative CDS price is on any day. The most popular data source is Markit which receives quotes from the largest number of CDS dealers. VZ uses Bloomberg data instead. A study by Mark Lueck of FRB Minnesota finds that, while these data sources track each other closely most of the time, they have diverged in the months of September and October 2008. (Caveat: It was not possible to verify whether the ISDA DocClauses were identical for the Bloomberg and Markit CDS; some price variation may be expected on account of different DocClauses alone). In particular, Bloomberg ask-side quotes have been sluggish during this period (see figure), likely due to the presence of "stale quotes" as buyers remained on the sideline. Consequently, it is likely that price changes using Bloomberg data may have understated the true change. Indeed, we estimate that use of Markit data would have resulted in an additional $8.5 billion of value creation for debt holders.



Comparing the Paulson and Other Plans

The conclusion that the revised Paulson plan fared worse than other plans does not appear to be borne out even based on VZ's reported results.

- Using the reduction in the "adjusted CDS price" as the objective, the revised Paulson plan is worse than a pure equity infusion and a debt for equity swap. However, as argued earlier, the adjustment is overdone due to the use of GE Capital as a systematic factor.
- Using the reduction in the unadjusted CDS price (which is closer to the appropriate value, as we have argued) as the objective, the revised Paulson plan does better than any plan other than the debt for equity swap.
- One might question whether the debt for equity swap should be compared to the Paulson plan as it is done in the paper. By the time the debt is converted to equity with a swap, the debt holder has probably already taken a loss for the restructuring. Thus, the swap appears to be equivalent to letting banks default on some of their debts. In this sense, the swap is not a rescue plan but rather an issue of optimal debt restructuring following default.
- For the equity-debt swap plan, the authors claim that converting the long-term debt of banks results in a dramatic drop in CDS prices to pre-crisis levels. However, the authors do not explain clearly how the CDS on the restructured debt is settled in the model. One possibility is that the authors restructure part of the debt and then calculate the price drop of the CDS on the remaining debt. (In theory, by defaulting on part of the debt there is more money left to pay for the remaining debt. In practice, the story will be entirely different.) However, while

the CDS on the remaining debt drops, the CDS on the restructured debt should rise to its settlement value. Therefore, the authors' methods (assuming that this is indeed what they do) leads to an unfair comparison between the swap and the Paulson plan. A fair comparison requires that the value changes of all of the existing CDS contracts are accounted for.

Implications of Ignoring the Systematic Effect of the Paulson Plan

The authors acknowledge that they do not attempt to "estimate the systemic effects of the plan." As discussed earlier, the paper has implications for the broader economy in spite of its focus on the 10 large banks. Nevertheless, a complete comparison of various alternatives seems to require an estimation of the systemic effects.

- The different rescue plans may have different systemic effects and so the latter cannot be ignored when comparing alternative plans.
- While it is difficult to estimate systemic effects, some simple calculations show that the quantitative effects may be substantial. For example, a reduction in systemic effects may be manifested in a reduction in the correlation or "betas" of the banks' equity shares and CDS contracts. Indeed, there is a substantial reduction in both the equity and CDS beta of banks from the early part of October to the latter part of October. Interestingly, the magnitude of the betas in the latter part of October reverts to levels observed in 2006. Under the assumption that the betas revert to their pre-crisis (i.e. January to June 2007) levels, we estimate an additional value creation of $40 billion for equity holders and $90 billion for debt holders of the 10 large banks.

The Impact of Treasury's Capital Injection on Banks' Value — A Direct Estimation from Banks' Corporate Bonds

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November 12, 2008

Using corporate bond prices, we directly evaluate the impact of Treasury's capital injection on banks debt, rather than inferring it from credit default swaps (CDS). Based on our estimate, the debt value of the participating banks, i.e., the banks receiving the capital injection, increased by $253 billions from October 10 to October 14, 2008. This estimate more than doubles the $104.5 billion debt value creation that Veronesi and Zingales (VZ) inferred from CDS. If our estimate is used in VZ's calculation, the participating banks have enjoyed a net benefit ranging from 122.85 to 145.45 billion dollars, much higher than the range (−$25.9 to −$3.3 billions) of net benefit based on the debt value inferred from CDS.

To obtain our estimate, we employ a standard two-stage event study method. We first calculate daily returns for 259 corporate bonds issued by the participating banks. We then compute each bond's abnormal return in the event window from October 10 to October 14. In Table I, the column labelled "Corporate Bond" shows each bank's bond value change, ranging from $0.85 billions (Bank of NY Mellon) to $67.33 billions (Citigroup). Table II shows the recalculated net benefit of Treasury's capital injection. This table is based on VZ's Table 5 but replaces the debt value change inferred from CDS with our direct estimate. The total net benefit estimated directly from the corporate bonds is substantially higher than VZ's number inferred from CDS.

Our approach addresses several questionable assumptions behind the numbers VZ have inferred from CDS prices. First, since bond prices are not influenced by the risk factors, such as liquidity and counterparty risk, that are particular to the CDS markets, our direct estimation avoids the challenges faced by researchers when translating CDS price change to debt value change. Second, to adjust for the general market movement, unlike VZ's approach that uses the GE CDS prices as the benchmark, our approach takes a combination of bond market indices as the benchmark. Third, in our approach market beta for each bond is estimated using the data in a pre-event period so that the effect of systematic factors is accurately controlled.

We agree with VZ that an immediate benefit to the participating banks is a necessary condition for the Treasury's capital injection to benefit the whole economy. Nevertheless, the estimation of the benefit is challenging. It is particularly so for the estimation of the debt value change. A direct estimation of the debt value might be a better way to meet this challenge than an indirect inference.

[1]We thank Zhenyu Wang for helpful discussions and suggestions.

Table I. Change in the Value of Debt ($bn)

	Corporate Bond	Veronesi-Zingales
Citigroup	67.33	22.3
Bank of America	38.50	5.3
JP Morgan Chase	22.84	5.5
Wachovia	22.50	6.9
Wells Fargo	25.97	2.5
Bank of NY Mellon	0.85	
State Street Corp	0.94	
Goldman Sachs	38.50	18.0
Morgan Stanley	27.27	32.5
Merrill Lynch	8.65	11.5
Total	**253.35**	**104.5**

Note: Change in debt value is estimated on a two-stage event study of 259 corporate bond daily returns. In stage I, each bonds market beta is estimated using a two-factor bond market pricing model between June 16 and September 20, 2008 (the estimation window). In stage II, daily abnormal returns between October 10 and October 14 (the event window) are calculated by subtracting the predicted returns from the realized returns for each bond.

Table II. Net Benefit of Treasury's Capital Injection

		Corporate Bond	Veronesi-Zingales
A: *With Morgan Stanley*			
Net Benefit Estimate ($bn)	Lower	122.85	-25.9
	Upper	145.45	-3.3
Net Ratio of Benefit/Cost (%)	Lower	91%	-19%
	Upper	130%	-3%
B: *Without Morgan Stanley*			
Net Benefit Estimate ($bn)	Lower	137.28	-16.8
	Upper	158.18	4.1
Net Ratio of Benefit/Cost (%)	Lower	168%	-21%
	Upper	261%	7%

Adam Ashcraft and Simon Potter
September 24, 2008

Market Intervention Options

Objective: Improve market functioning.
Reduce cost of credit in primary markets by enhancing secondary market liquidity

Strategy:

- Focus on widely-held, illiquid securities
- Goal is to reduce illiquidity distortion, price volatility
- Reduce precautionary behavior which limits trading, creates illiquidity in secondary markets

What to buy? (In order of preference)

AAA-rated ABS

AAA-rated CMBS

Municipal securities

Investment-grade corporate bonds

> Pricing is significantly lower than would be implied by expected loss due to illiquidity. Widely held assets with clear link to real economy.

AAA-rated non-agency MBS

> Same as above, but absence of private non-prime originations and presence of public originations (GSEs and FHA) implies a less-clear link to real economy.

Home equity ABS

Junior Non-agency MBS

CDOs

> Almost all cash exposures have been written down. Concentrated holdings with no link to real economy.

From whom to buy?

MTM investors (dealers) most likely to sell

HTM investors (banks and insurance companies) likely to sell only if downgrade risk exists or if you let them retain upside

How to buy?

- Start with one-sided auction with Treasury as only buyer. Simple, most likely to succeed.
- Ultimate objective is two-sided auction (FIs participate as buyers as well as sellers) to promote market functioning, private risk transfer from weak to strong FIs, and permits UST to rebalance its portfolio.
- Note: Unique situation requires learning. Assets very heterogeneous, want to promote competition, and not reveal too much price information.

Objective: Improve lending capacity of financial system. Reduce cost of credit in primary markets by improving bank economic capital adequacy

Strategy:

- Focus on assets with high downside risk, high exposure to US house price risk
- Goal is to reduce required economic capital and consequently increase lending capacity
- Reducing tail risks and exposure to housing should improve banks' ability to raise external capital

What to buy? (In order of preference)

Senior capital notes

> Most direct way. Preferably done contingently. UST sells options which permit future write-downs to be offset by public capital injections.

Junior lien whole loans

> Highly-leveraged exposure to home prices, taking up significant economic capital on bank balance sheets. Ownership by public sector could facilitate reduction in foreclosures by preventing hold-up of 1st liens by subordinate lien holders.

Commercial real estate loans

> Significant risk on balance sheets of financial institutions, but likely loss of value if these information-intensive loans are transferred to public sector.

First lien residential real estate loans

> Significant risk on balance sheets of financial institutions, but certain loss of value given political constraints if transferred to public sector.

From whom to buy?

Banks and thrifts

How to buy?

- Initially focus on private purchases to minimize risk of further magnifying uncertainty about solvency of individual banks and the overall system.
- Later shift to auctions as uncertainty about the housing cycle is revealed, and auction mechanism is refined.
- Note: Need to use capital notes where FIs and UST share in upside to prevent the acceleration of losses by these HTM investors.

Liquidity Policies

1. **Economics of the Federal Reserve's Liquidity Actions** – an update on the note by Jamie McAndrews from the April EAP.

2. **Central Bank Credit Policies** – a copy of a paper by Marvin Goodfriend that frames the most important issues.

3. **The Income Effect of Balance Sheet Changes** – a memo by Michael Fleming analyzing the effects of income on the balance sheet increases as of October 15th 2008.

4. **Foreign Central Bank Use of Federal Reserve FX Swap** -- a memo by Michael Fleming and Nick Klagge describing the reciprocal currency agreements entered into over the last 11 months.

Economics of the Federal Reserve's Liquidity Actions[1]

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Federal Reserve Bank of New York
November 17, 2008

Following the failure of Lehman Brothers and the intensification of the financial crisis, the Federal Reserve announced three new lending facilities, expanded its existing facilities and increased the size and number of central bank counterparties for its swap lines. These actions addressed the funding needs of a wide range of global financial intermediaries and in one case provide direct funding to the real economy.

The significant expansion in Federal Reserve lending was accommodated in two ways. First, the U.S. Treasury, under the Supplementary Funding Plan, sold bills to the public, and deposited the resulting funds in a non-interest bearing account at the Federal Reserve, essentially reducing outstanding reserves. Second, the Emergency Economic Stabilization Act 2008 gave the Federal Reserve the authority to pay interest on reserves almost immediately after its passage; the Federal Reserve used this authority beginning on October 9, 2008. As described in the *Economic Policy Review* article by Keister, Martin and McAndrews, interest on reserves can be implemented in a way that allows for a separation between monetary policy and the liquidity policy of a central bank.[3] As a result, the authority to pay interest on reserves would allow the Federal Reserve to maintain its policy rate even with a large increase in bank reserves.

In practice, the rapid expansion of the balance sheet of the Federal Reserve and an initial period of market adjustment to and learning about the importance of remaining restriction of payment of interest on reserves of primary dealers and GSEs under the new operating framework has not yet produced a complete separation. For the purposes of this note assume that the operating framework will be perfected over time to achieve this separation. The overall strategy for the liquidity policy, as well as the existing primary credit facility for deposit institutions (often simply called the "discount window") is based on the traditional concept of the central bank as the lender of last resort. However, with the evolution and expansion of the global financial system, including the rapid increase in tradable securities held by financial intermediaries, the precise manner in which central banks perform their lender of last resort role is very different from that of earlier periods.

This note outlines the key economic problems and institutional frictions addressed by the wide range of liquidity actions taken by the Federal Reserve. In a separate note the general philosophy for the "credit" policy of a central bank performing its lender of last resort function is discussed, along with some of the risks inherent in such a large

[1] This paper supplements and updates "Economics of the Federal Reserves New Lending Facilities," April, 2008.

[2] The views expressed in this paper are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of New York or the Federal Reserve System.

[3] "Divorcing Money from Monetary Policy," Todd Keister, Antoine Martin, and James McAndrews, *Economic Policy Review*, September 2008, Volume 4, Number 2, Federal Reserve Bank of New York.

expansion of a central bank's balance sheet. The statement in the document *Understanding Recent Changes to Federal Reserve Liquidity Provision* continues to capture the intent of this wide range of actions, "Although these changes were made incrementally in response to changing market conditions, they share the common objectives of reducing risks to financial stability and strengthening the effectiveness of monetary policy in addressing risks to the outlook for growth and inflation."[4]

Preliminary discussion

The Federal Open Market Committee determines monetary policy by setting an interest-rate target in its periodic meetings. This target is for the federal funds rate, which is the interest rate on unsecured overnight borrowing and lending among banks. The policy is implemented by the Open Market Desk when it transacts daily with primary dealers in open market operations, thereby adjusting the quantity of reserves in the U.S. banking system.

The interest rate through which monetary policy is transmitted is a market interest rate. Its level is affected by a number of factors: the quantity of reserves supplied by the Open Market Desk, their rate of remuneration at the Federal Reserve (currently the target rate)[5], the rate at the primary credit program of the discount window, any penalties for running an overnight overdraft in a bank's reserve account, and the willingness of banks to lend to one another. The demand for borrowing reserves in the market and the willingness to lend depend on expectations of future rates and expectations of a bank's own ability to borrow funds in the future.

A bank's demand for funds in the market is usually presented in textbooks as a truncated demand curve. At high market rates of interest, a bank in sound financial condition with ample collateral would generally prefer to approach the primary credit program of the discount window and borrow funds at an interest rate that is set at a fixed premium to the target federal funds rate. In this line of thought, the discount window should meet any individual bank's demand for funds caused by some operational glitch or miscalculation.

The liquidity of the interbank market for both overnight and term lending can be thought of as the ease with which a bank can borrow or the willingness of banks to lend funds. Interruptions in banks' willingness to lend funds can cause an overall shortage of market-provided liquidity, which can be partly addressed by the Open Market Desk through an increase in the supply of reserves.

[4] Geithner, Timothy F., "Actions by the New York Fed in Response to Liquidity Pressures in Financial Markets, Annex 1: Understanding the Recent Changes to Federal Reserve Liquidity Provision." Testimony before the U.S. Senate Committee on Banking, Housing and Urban Affairs, Washington D.C., April 3, 2008. http://www.newyorkfed.org/newsevents/speeches/2008/gei080403.html

[5] The GSEs and the primary dealers are large participants in the interbank market and are not allowed to receive remuneration at the policy rate for their excess balances.

The seizure of term interbank markets during the financial crisis and the unusually wide spreads in markets for repurchase agreements ("repos") that have been observed more recently challenged conventional Federal Reserve open market operations and discount window programs to fully meet funding demands in these unsettled market conditions in a way that implements the monetary policy intended by the FOMC.

Before turning to the individual lending facilities, we point out four general imperfections to the pre-existing set of tools of the Federal Reserve in implementing policy.

- First, borrowing from the discount window is perceived to be accompanied by a negative inference about the borrower's credit quality, known as a "stigma." While such borrowing is private information, the identity of borrowers is often known to market participants, such as interdealer brokers, and leaks out. This fact has prevented the discount window from serving as an effective source of backstop liquidity.
- Second, Federal Reserve open market operations under normal conditions lead to a situation in which the Federal Reserve holds a large portfolio of Treasury securities whose markets are highly liquid, while many market participants hold less liquid securities; the illiquid portfolio composition of financial intermediaries can impede their ability to borrow easily in both secured and unsecured markets.
- Third, various market imperfections in over-the-counter money markets, in particular in the repo market, make the transmission of monetary policy from Open Market Desk to primary dealer, and then on to the unsecured interbank market, problematic and subject to considerable risk.
- Finally, while the target rate is an overnight rate, the closely related term interbank rate also has important consequences for the transmission of the intent of the FOMC.

Term Auction Facility

The Term Auction Facility (or "TAF") aims to overcome the problem of discount window stigma. It is also designed to provide depository institutions better access to term funds and to facilitate their holding of a more liquid portfolio of assets. Since its initial introduction on December 12th 2007, the facility has been enhanced in a number of ways: in late July 2008 additional auctions for an 84 day term were announced; in late September 2008, forward auctions to cover the year end were announced; finally, the total amount of funds available at the auctions was increased from the initial amount of $40 billion announced in December 2007 to $900 billion over the year end of 2008

Given the stigma at the discount window, banks face a pernicious strategic situation in case there is an overall shortage of liquidity. First, a shortage of liquidity in the term interbank market may not be fully addressed by open market operations that are aimed at influencing the overnight rate of interest. For example, suppose that on a particular day, a depository institution faces a risk that a borrower will draw down a line of credit at some time in the next few weeks, and it faces an immediate reserve

deficiency. In normal market conditions, the institution would prefer to borrow term funds, killing two birds with one stone, but if the term market is not functioning well, even if the Federal Reserve has supplied high levels of reserves, it will resort to overnight borrowing to cure the reserve deficiency, leaving it still facing the liquidity risk of the potential borrowing in coming weeks.

The primary conventional option for banks facing an illiquid market—a generalized unwillingness of banks to lend (in the case imagined here for a term such as one-month) is to approach the discount window and borrow funds. The Federal Reserve extended the term of primary credit program loans on August 17th, 2007 to encourage banks to address term funding needs at the discount window.

If a bank borrows funds at term through the discount window, it is likely to be more willing to lend funds in the market on subsequent days (or, alternatively, the counterparty to which the bank may have paid out its borrowing from the discount window will be more likely to lend funds). In any case, other banks in aggregate benefit nearly one-for-one from the additional willingness to lend funds occasioned by the discount window borrowing of the first bank. At the same time, only the first bank in the chain, the borrower from the discount window, faces a possible stigma from its actions.

The strategic situation is similar to what Eric Rasmussen has called the "Civic Duty Game."[6] In that game each of two parties observes a burglary. Each party, Smith and Jones, would prefer that the police are called. If Jones calls the police it adds 10 to Smith's payoff, but if Smith calls the police he adds only 7 to his payoff, as his effort costs 3. If both call they each receive 7, and if neither calls they each receive 0. There are three equilibria of this game: the two asymmetric equilibria in which only one of the two calls the police, and a mixed strategy equilibrium in which there is a chance that no one calls the police. The key insight of this game is that as more people observe the crime, the probability that no one calls the police in the mixed strategy equilibrium rises (each now relies on one of many others to call the police).

The strategic situation banks find themselves in when there is an aggregate unwillingness to lend in the term interbank market is similar to the Civic Duty game: each bank would benefit from someone borrowing from the discount window, and subsequently lending at a premium interest rate. However, the presence of the stigma implies that each bank would prefer that some other bank approach the discount window. Furthermore, the term market may be affected by adverse selection in which the high posted term interest rates signal that only borrowers of lower quality borrow at term. In that case, the bank that borrowed through the discount window will rationally choose to lend funds in the overnight market, but that would not allow the bank to lend funds at a premium. In a mixed strategy equilibrium with many banks, there is a high probability that no one will borrow from the discount window and the illiquidity in the interbank market will persist.

[6] Rasmusen, Eric. *Games and Information: an Introduction to Game Theory* Blackwell, 3rd Ed. 2001.

The TAF overcomes that problem by incorporating features that together reduce the chance that winning banks' identities would be revealed (no brokers are involved in the auction procedures). If a borrower's identity were revealed, it also has several features that would reduce the sense that the borrower either is in great need of funds on the day that the borrowing takes place or that it can only borrow at a premium to market rates. First, the minimum bid rate in the TAF is set at the overnight index swap rate for the term of the loan, which is an approximation to the expected average overnight rate over the term. Consequently, the bidders in the TAF do not face an exogenous premium to market rates. Second, the funds are delivered to winning bidders three days after the auction. Finally, the minimum bid rate and the uniform price nature of the auction should encourage participation my many banks.

Under normal market conditions, TAF auctions of a large size would be undersubscribed, and the auction rate of interest would be very close or equal to the minimum bid rate. These conditions would indicate that such auctions were of little added value, and the Federal Reserve could decide to hold the auctions only infrequently or for small amounts of funds.

The design of the TAF should improve the ability of the Federal Reserve to address liquidity needs of banks when there is an excess aggregate demand for funds. In this sense, it is an attempt to "perfect" the operation of the primary credit program of the discount window.

Term Securities Lending Facility

The Term Securities Lending Facility (the "TSLF") is designed to address various problems in markets for lending Treasury securities and in other securities lending markets. It does so by allowing primary dealers to bid at auction for a loan of general collateral Treasury securities. The loans of Treasury securities were initially secured by different types of collateral, including investment grade private-label mortgage-backed securities (MBS). Following the failure of Lehman Brothers the eligible collateral was expanded to all investment grade debt securities. Earlier the Federal Reserve had announced an options program related to the TSLF to counter quarter and year end funding pressures. As with the TAF the amounts available at auction were increased as the financial crisis deepened.

During the financial crisis, the general collateral Treasury repo rate ("GC repo" rate) has fallen to extraordinarily low levels, even falling to negative rates on some days. Such low rates are often said to reflect a flight to quality, and open up a large spread between GC repo rates and repo rates on other securities, such as MBS. A simple view is that GC repo rates falling to such low levels reflects a shortage of such securities (when

GC repo rates are so low, the lender of money is sacrificing a large amount relative to the fed funds rate to obtain GC Treasury securities).

In addition to a large spread in financing rates, as explained by Fleming and Garbade (2005), when the GC repo rate falls to levels near zero, as has occurred frequently over the last year, it is often accompanied by a high level of failures to deliver Treasury securities that are said to be on "special."[8] Certain Treasury securities such as benchmark on-the-run Treasuries are in specific demand, and repo rates on those securities fall below GC repo rates. As Fleming and Garbade (2005) explain, settlement fails can be self-perpetuating, leading to increased counterparty credit risk and a general pull-back in the Treasury market.

The high spread in the repo rates between GC Treasuries and MBS is anomalous. Under normal conditions, rates trade at a fairly constant spread between the two classes of securities. The rates are not intended to account for the market risk of the underlying instrument (such as the volatility of its price); instead the margin, or haircut, on the amount lent against the security is designed to protect the lender of funds against the market risk of the collateral. Consequently, the wide spread in rates is a reflection of market illiquidity.

The situation of wide spreads in rates can cause increased uncertainty in funding markets as dealers find it increasingly difficult to fund their portfolios of securities. At the same time, an increased level of settlement fails can cause general problems in the market for Treasury securities as well. Both of these problems can be addressed, at least in part, by an increase in the supply of Treasury securities.

The TSLF seeks to address those problems by auctioning a fixed supply of Treasury securities for one-month GC repos to be secured by various classes of alternative assets that are held by the Federal Reserve as collateral. It provides an increased amount of Treasury debt to the public (providing a greater supply of liquid

[8] "Episodes of fails can be self-perpetuating. If borrowing costs rise to near the GC rate and fails mount, some market participants that would otherwise lend securities may decide to step back from the market to avoid borrowers that might fail to return their securities. The reduced supply of securities available for lending exacerbates and prolongs the fails situation.
Because the benefit to avoiding a fail declines as the cost of borrowing securities rises toward the GC rate, an important factor in explaining fails is the general level of interest rates. When the fed funds rate, and hence the GC rate, are low, security borrowing costs can reach their upper limit more quickly. When the fed funds rate was only 1 percent in 2003 and 2004, for example, there was only a small margin before security borrowing costs reached the GC rate and the incentive to borrow securities became negligible." Fleming, Michael J., and Garbade, Kenneth D. "Explaining Settlement Fails," *Current Issues in Economics and Finance*, September 2005, Volume 11, Number 9.

securities) and adds an increased amount of an alternate, less liquid, class of securities to the Fed's balance sheet (increasing the demand of less liquid assets).

The TSLF auction has minimum bid rates for the asset classes that serve as collateral that slightly exceed an estimate of the typical market spreads in normal conditions. The haircuts on the collateral are determined by the Federal Reserve Bank of New York in a way that is consistent with those used in open market operations. Consequently, the program can be wound down when liquidity conditions in the particular asset classes involved have returned to normal, as measured, for example, by the spread between GC repo rates and the repo rates for that asset class.

The TSLF is intended to improve market conditions in repo markets, including the markets in which open market operations take place. As such, it is intended to perfect conditions in markets that are important to monetary policy transmission.

Primary Dealer Credit Facility

The Primary Dealer Credit Facility (PDCF) was designed to meet an emergency situation that threatened the efficient functioning of the repo market after the near failure of Bear Stearns. Initially only investment-grade debt securities could be pledged but following the failure of Lehman Brothers the eligible collateral was expanded to closely match the types of collateral that can be pledged in the tri-party repo systems of the two major clearing banks (JPMC and BoNY-Mellon).

The repo market is a large market in which broker-dealers obtain financing, much of it on overnight terms, for tradable assets on a collateralized basis. The repo market has grown rapidly in recent years, and was the most important source of short-term financing for security broker-dealers: 38 percent of the liabilities of security broker and dealers are repos at the end of 2007.[10] In contrast, the major source of short-term funding for U.S. commercial banks is deposits: 59 percent of commercial banks' liabilities are deposits, and only 11 percent are repos and fed funds obligations. The majority of the repo market borrowing is collateralized against Treasury securities, mortgage backed securities, agency securities, and corporate securities.

The most common repo contracts are tri-party repo contracts. In a tri-party repo agreement, the borrower puts collateral to a clearing bank and receives cash from a lender such as a money market mutual fund. The clearing bank assesses the value of the collateral, calculates a haircut, and manages margins. The haircut is determined in a way that reflects the riskiness of the security (for example, a corporate security is typically more risky than a Treasury bill), and it also depends on the counterparty credit risk of the borrower. Fleming and Garbade (2003) discuss the GCF Repo contract, which is a common form of tri-party repo contract in the inter-dealer market.[11]

[10] Computed from the Federal Reserve's Flow of Funds, as of 2007Q4.
[11] Fleming, Michael J., and Kenneth D. Garbade, 2003, "The Repurchase Agreement Refined: GCF Repo," *Current Issues in Economics and Finance* 9 (6) Federal Reserve Bank of New York.

The tri-party RP market suffers from a weakness similar to the one suffered by the commercial paper market prior to the Penn Central crisis of 1970. In particular, there is no market-based committed back-up source of credit. The PDCF fills this gap on a temporary basis. It provides an additional source of funding to the existing repo market among financial intermediaries. The PDCF offers a liquidity backstop facility for this central market by providing primary dealers with funding against a broad range of tradable collateral. The interest rate on the borrowing through the PDCF is set at the primary credit rate and the haircut on the collateral is set at 5 percent; the price of the collateral is set in the market by the clearing banks who organize the tri-party repo market.

The PDCF was designed to address an imperfection in an important money market, again, a market in which open market operations are conducted. It required the Board of Governors to find that "unusual and exigent" circumstances existed. Clearly the implementation of the PDCF raises many new challenges for the Federal Reserve. For example, considerable effort is devoted to monitoring the primary dealers as a different type of counterparty

By addressing imperfections in the repo market, the PDCF was intended to mitigate the systemic risk of other potential dealer failures that could have resulted from a broader retreat by repo market investors. In this regard, the PDCF was aimed at improving financial stability in an unsettled market environment. This action, while unusual, may have been effective and was similar to another historical episode of Federal Reserve provision of backstop liquidity facilities to financial intermediaries in uncertain conditions. Meltzer (2003) points out that at the time that banks were reopening following the bank holiday of 1933, "The president's announcement had assured the public that only sound banks would be reopened. Recognizing that the public would not distinguish between member and nonmember banks, Congress allowed state nonmember banks to borrow from Federal Reserve banks on acceptable collateral. This power expired after one year." [12]

Facilities related to Commercial Paper Market and Money Market Mutual Funds

Following the failure of Lehman Brothers, Money Market Mutual Funds (MMMF) came under unprecedented stress as depositors reallocated their portfolios to the most liquid and safe assets. On September 16th, the Primary Funds of the Reserve Management Co. Inc. "broke the buck," which led to the liquidation of 15 of the company's MMMFs.[14] Following this widely reported event, MMMFs experienced heavy withdrawals by shareholders. The US Treasury announced the Temporary Guarantee Program for Money Market Mutual Funds on September 19th. Using existing authority, relying on the Exchange Stabilization Fund, the program guaranteed

[12] Meltzer, Allan, H. *A History of the Federal Reserve*, University of Chicago Press, 2003 pg. 424.
[14] http://www.reservefunds.com/pdfs/Press%20Release%202008_0916.pdf

shareholder value in certain types of MMMF funds to enhance their perceived safety.[15] MMMF are a very important source of demand for commercial paper issued by a wide range of financial and non-financial institutions. As a result of the withdrawal pressure on MMMFs, demand for commercial paper was suddenly reduced dramatically. On the same day the Federal Reserve announced the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF), which extended nonrecourse loans at the primary credit rate to U.S. depository institutions and bank holding companies to finance the purchase of high-quality asset-backed commercial paper (ABCP) from money market mutual funds.[16]

Despite the Treasury's guarantee and the Federal Reserve's actions to increase demand, a range of short-term funding markets supported by MMMF demand remained under severe stress. On October 7, the Board announced the creation of the Commercial Paper Funding Facility (CPFF), which provides a liquidity backstop to U.S. issuers of highly rated commercial paper through a special purpose vehicle that purchases three-month unsecured commercial paper and ABCP directly from eligible issuers. Finally on October 21, the Federal Reserve publicized the creation of the Money Market Investor Funding Facility (MMIFF), under which the Federal Reserve Bank of New York will provide funding to a series of special-purpose vehicles to facilitate an industry-supported initiative to finance the purchase of certain highly rated certificates of deposit, bank notes, and commercial paper from MMMF.[17]

The economic friction addressed by these new facilities was based on the unwillingness of private agents to hold private liabilities for longer than overnight following the failure of Lehman Brothers. The source of this unwillingness should be viewed as a market failure as the vast majority of private institutions were sound if term markets were functioning. A number of policy actions were taken to address this market failure including the capital purchase program and the FDIC guarantee of unsecured bank liabilities.

Lehman Brothers was a major issuer of high grade commercial paper and its failure resulted in the problems at the Reserve fund. The initial policy response was to provide a guarantee for certain MMMF deposits. This was effective at slowing the rate of redemptions from certain funds but was less effective in providing incentives for fund managers to maintain and increase their holdings of commercial paper. The AMLF was set up to allow certain funds to diversify their existing holdings of commercial paper without producing unusual imbalances in the private market. One limitation of the AMLF is that it was restricted to purchasing asset-backed commercial paper.[18]

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[15] See the U.S. Treasury for details of the program: http://www.treas.gov/offices/domestic-finance/key-initiatives/money-market-fund.shtml

[16] See http://www.federalreserve.gov/monetarypolicy/abcpmmmf.htm for more details about the facility.

[17] Since the MMIF is not yet operational we do not discuss it in detail in this note.

[18] As loans under the AMLF were made on non-recourse basis, the assets backing the asset-backed commercial paper served to satisfy the legal requirement that lending by the Federal Reserve Banks be "secured to the satisfaction" of the Federal Reserve Bank.

During late September and early October funding conditions for issuers of commercial paper worsened as significant withdrawals from MMMFs continued, curtailing their purchases of commercial paper. Interest rate spreads rose dramatically and commercial paper issuance slowed. In light of these developments, the Federal Reserve introduced the Commercial Paper Funding Facility (CPFF) on October 7, 2008.[19] The CPFF was introduced as the economic environment deteriorated further and term borrowing in the CP market became very expensive for a number of large issuers. Although many of these issuers were able to fund in the overnight market, this produced a large increase in the fragility of the financial system as operational risks and market risks increase as the term of overall financing in the economy is shortened.

Other possible sources of demand for commercial paper were limited. Banks and other intermediaries specialize in more informationally intensive lending, rather than purchases of low-yielding marketable commercial paper. In addition, banks are currently under severe constraints as many face significant embedded losses on the assets currently held, making them largely unwilling to expand their holdings of assets. The commercial paper market emerged in recent decades as a way for creditworthy corporations to obtain credit through market-based means, with liquidity support provided by banks. However, drawing on bank liquidity support can carry with it a stigma for the corporation that cannot sell its commercial paper on the market. This dilemma complicated the situation for issuers.

There are historical precedents for the CPFF. In 1934 the Industrial Advances Act added Section 13(b) to the Federal Reserve Act, allowing the Federal Reserve banks to make advances of working capital to businesses if these enterprises were unable to find such capital from usual sources. These loans were made either in partnership with a commercial bank or directly to a business with maturities up to five years. By the providing working capital rather then just liquidity support, the Federal Reserve went further than the traditional lender of last resort role. This earlier use of the Fed's discount window was criticized by several observers and in 1958, the Small Business Investment Act created the Small Business Administration and repealed section 13(b).

The CPFF was structured to achieve its objectives of supporting the commercial paper market and to comply with the legal requirements that the Federal Reserve lend on a secured basis. To this end, the Federal Reserve established a Special Purpose Vehicle that purchases 3-month commercial paper at fixed interest rate spreads to the expected 3-month effective federal funds rate. Each issuer must pay a facility fee to participate in the program. Various means are used to secure the Federal Reserve's interest, including asset-backing for commercial paper, a guarantee or endorsement by a third party, or by the payment of an unsecured credit surcharge at the time of the purchase of the commercial paper. The combination of fees in the facility serve to build up a surplus that

[19] The announcement of the CPFF is found here:
http://www.federalreserve.gov/newsevents/press/monetary/20081007c.htm
Further details were provided on the same day on which the U.S. Treasury announced the Capital Purchase Program, and the Federal Deposit Insurance Corporation announced its Temporary Liability Guarantee Program.

acts as a portfolio margin, assisting in securing the facility to the Federal Reserve's satisfaction against possible losses on the commercial paper held by the SPV.[20]

Swap Lines[21]

One of the defining characteristics of the financial crisis has been the large demand for dollar funding by non-US financial institutions. The first swap lines (reciprocal currency arrangements) were announced along with the TAF on December 12, 2007. These lines allowed the ECB and SNB to run dollar auctions similar to TAF for institutions that had only limited or indirect access to Federal Reserve facilities. As the amount of funds available for the TAF was expanded the swap lines were also expanded.[22]

As the financial crisis intensified in the weeks following the bankruptcy of Lehman Brothers, the size of the existing swap lines were increased and swap lines with a number of other central banks were initiated.[23] These changes were followed by the use of subscriptions of funds at fixed interest rates for full allotments (constrained by the collateral posted by borrowing banks) at different maturities in several of the central banks. These changes were announced on October 13th.[24] The lending rate was set as a margin over the expected policy rate related to the term of the loan. Since then the range of central bank counterparties has been further increased and, as of November 10th, just under $550 billion of swap lines had been exercised.[25]

Many financial institutions outside the United States, especially in Europe, had substantially increased their dollar investments in recent years, including loans to nonbanks and purchases of asset-backed securities comprised of loans to U.S. residents. Also, the continued prominent role of the dollar in international trade, foreign direct investment, and financial transactions contributes to dollar funding needs abroad. While some financial institutions outside the United States have relied on dollars acquired through their U.S. affiliates, many others relied on interbank and other wholesale markets to obtain dollars.

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[20] See the Terms and Conditions of the CPFF here: http://www.newyorkfed.org/markets/cpff_terms_conditions.html

[21] Some of this material is taken from a speech by Ben Bernanke, *Policy Coordination Among Central Banks*, November 14, 2008. http://www.federalreserve.gov/newsevents/speech/bernanke20081214a.htm

[22] See the memo, *Foreign Central Bank Use of Federal Reserve FX Swap Lines* in the liquidity policies material for more details.

[23] On September 18, 2008, the Federal Reserve increased the size of existing swap lines with the ECB and the SNB, and announced newly established lines with the Bank of England, the Bank of Canada, and the Bank of Japan. http://www.federalreserve.gov/newsevents/press/monetary/20080918a.htm

[24] http://www.federalreserve.gov/newsevents/press/monetary/20081013a.htm

[25] See http://www.federalreserve.gov/newsevents/press/monetary/20081014d.htm , http://www.federalreserve.gov/newsevents/press/monetary/20081028a.htm , http://www.federalreserve.gov/newsevents/press/monetary/20081029b.htm for announcements of an increased size of the swap arrangement with the Bank of Japan, and the establishment of swap arrangements with the Reserve Bank of New Zealand, the Banco Central do Brasil, Banco de Mexico, Bank of Korea, and Monetary Authority of Singapore.

The reliance of non-domestic banks on the interbank market in U.S. dollars, known as the Eurodollar market, is riskier (even in ordinary times) than reliance by a domestic bank on the fed funds market. There are several reasons for this increased riskiness. The participants in the Eurodollar market don't have the advantages of the Federal Reserve intervening via open market operations to implement the target rate daily. In addition, there are no demand-smoothing institutions in the Eurodollar market, such as reserve maintenance periods, as there are in the federal funds market. Finally, non-domestic banks don't have access to the Federal Reserve's discount window. Under ordinary market conditions, arbitrage trades between participants in the federal funds market and the Eurodollar market would make these differences almost indiscernible. However, under the stressed conditions of increased credit and liquidity risks, the differences in these markets became more dramatic, and necessitated the extraordinary swap line program to direct adequate funding to non-domestic banks.

This collaborative approach to the injection of liquidity inherent in a swap line reflects more than the global, multi-currency nature of funding difficulties. It also reflects the importance of relationships between central banks and the institutions they serve. Under swap agreements, the responsibility for allocating foreign-currency liquidity within a jurisdiction lies with the domestic central bank. This arrangement makes use of the fact that the domestic central bank is best positioned to understand the mechanics and special features of its own country's financial and payments systems and, because of its existing relationships with domestic financial institutions, can best assess the strength of each institution and its needs for foreign-currency liquidity. The domestic central bank is also typically best informed about the quality of the collateral offered by potential borrowers.

Concluding remarks

The primary goal of many of the new facilities has been to stabilize the financial system during this unprecedented crisis period but many of the new lending facilities also overcome various frictions or imperfections that hinder the effectiveness of the monetary policy transmission. Each facility raises new challenges in its operation, including its pricing, communication of strategy, and possible long-term usefulness or long-term exit. Continued evaluation and study of these facilities will provide both the Federal Reserve and the public with increased understanding of the effects of these facilities and insight into how they may be best employed.

Why We Need an "Accord" for Federal Reserve Credit Policy: A Note

Marvin Goodfriend

The 1951 Accord between the Treasury and the Federal Reserve was one of the most dramatic events in U.S. financial history. The agreement liberated monetary policy from the commitment, dating from World War II, to support government bond prices. It reasserted the principle of Federal Reserve independence so that monetary policy might serve primarily as an instrument for macroeconomic stabilization.

The Federal Reserve, however, executes both monetary and credit policies, and no Accord has yet been established for its credit policies. The reason is that, until recently, fiscal concerns have not threatened the misuse of Fed credit policies in the way that bond price supports did for monetary policy. Large federal budget deficits, a deposit insurance crisis, or significant foreign exchange market intervention could change that.[1] Just as the 1951 Accord greatly improved monetary policy, an Accord for Fed credit policy established today, while fiscal concerns are still relatively small, could yield significant benefits in the future.

1. MONETARY VERSUS CREDIT POLICY

Distinguishing between monetary and credit policy is straightforward.[2] Monetary policy refers to changes in the stock of high-powered money, that is,

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[1] Fry (1993) reviews the fiscal activities that governments in a sample of twenty-six developing countries order their central banks to undertake.

[2] This distinction is used extensively by Goodfriend and King (1988).

currency plus bank reserves, accomplished by open market operations in domestic securities or foreign exchange. For example, a central bank takes a monetary policy action if it increases bank reserves by purchasing securities. Credit policy, on the other hand, changes a central bank's assets while holding the stock of high-powered money fixed. For example, a central bank takes a credit policy action when it uses funds obtained by selling Treasury securities to acquire other assets. Credit policies also include regulation and supervision of the banking system, but such aspects of policy will not be discussed here.

2. THE ACCORD PRINCIPLES FOR CREDIT POLICY

The 1951 Accord established the principle that monetary policy should be used to stabilize the macroeconomy, regardless of the fiscal concerns of the Treasury. It restored the idea that a fully independent central bank contributes importantly to economic stability.[3] Independence insulates the Fed from short-run inflationary pressures to stimulate employment and help finance the Treasury. It also frees the Fed from having to get Congressional or Treasury approval for its policy actions, enabling the Fed to react quickly to short-run macroeconomic or liquidity shocks.

Congress bestows such independence only because it is necessary for the central bank to do its job effectively. Hence, the presumption ought to be that the Fed should perform only those functions that *must* be carried out by an independent central bank. Monetary policy is both necessary and sufficient to pursue macroeconomic stabilization policy and to deter system-wide liquidity crises. Credit policy directs funds promptly to illiquid institutions when macroeconomic conditions do not call for a change in high-powered money.

This suggests the following Accord principles for Fed credit policy: (1) liquidity assistance should not fund insolvent institutions; (2) credit policy should not fund expenditures that ought to get explicit Congressional authorization; (3) Congress should not direct the Fed to transfer assets to the Treasury in order to reduce the Federal deficit.

Three Fed credit policies discussed below illustrate the above concerns. First, liquidity assistance potentially provides funds to insolvent institutions and raises the cost of deposit insurance. Second, Fed credit policy may inappropriately finance sterilized foreign exchange market intervention and some foreign expenditures of the Treasury. Third, the transfer of Fed surplus assets to the Treasury, as directed by Congress, potentially weakens Fed independence. In each case, an Accord for Fed credit policy would help implement the above principles.

[3] Stein (1969) contains an excellent discussion of events leading up to the 1951 Accord.

3. LIQUIDITY ASSISTANCE

As a rule, the Fed finances liquidity assistance to depository institutions with funds acquired by selling Treasury securities—leaving high-powered money unchanged. Thus, as mentioned above, liquidity assistance is a credit policy. In practice, the Fed fully collateralizes its discount-window lending. Its supervisory role enables it to value bank loans for purposes of collateral prior to any request for funds. Moreover, the Fed can lend on less than full assessed collateral value to further protect itself. Hence, discount-window lending has involved little risk for the Fed.

Discount-window credit can save a temporarily illiquid but solvent bank. But discount-window loans potentially allow a truly insolvent bank, by pledging collateral to the discount window, to more easily pay out uninsured depositors prior to being closed. Such lending imposes costs on the deposit insurer, when it delays a declaration of insolvency, by moving uninsured depositors from last to first in line.

Because Fed liquidity assistance must be extended promptly, it is impractical for Congress to authorize each provision. Without Congressional guidance, however, Fed lending may not take into account potential losses it might impose on the deposit insurance fund, or the taxpayer, if an illiquid bank to which it is lending turns out to be insolvent. Lending on acceptable collateral is safe from the Fed's point of view, but, as mentioned above, there are times when it may delay the closing of an insolvent bank by paying out uninsured depositors at the expense of the deposit insurance fund or the taxpayer.[4]

The 1991 Federal Deposit Insurance Corporation Improvement Act (FDICIA) recognized the need for a mechanism to encourage the Fed to withdraw its credit line soon enough to protect the insurer and the taxpayer. FDICIA provides incentives for the Fed not to lend to undercapitalized banks.[5] To the extent that capitalization continues to be measured largely on book rather than market valuation, however, there may be instances when the new law is less than fully effective.

An Accord could be arranged (with Congressional help) between the Fed, the Treasury, the deposit insurers, and the depository institution chartering agencies to better ensure that liquidity assistance does not delay the closure of insolvent banks. One possibility would be to have the Fed stop lending when, on its estimate of *market* values, a liquidity problem is judged to become a solvency problem. A second option would be to agree on a rule limiting the share of assets that a bank might pledge to the Fed. This would mimic

[4] Schwartz (1992) discusses numerous examples of discount-window lending to insolvent institutions. Garcia (1990) catalogs some nontraditional uses of the discount window.

[5] See *The Federal Reserve Discount Window,* 1994.

the "negative pledge clauses" in private bond covenants designed to protect bond holders against asset stripping by managers in the run-up to bankruptcy. Of course, if it seems feasible and desirable, an Accord could involve more elaborate coordination.

4. STERILIZED FOREIGN EXCHANGE MARKET INTERVENTION AND WAREHOUSING

Two agencies conduct official foreign exchange market intervention in the United States—the Treasury, through its Exchange Stabilization Fund (ESF), and the Federal Reserve, under the guidance of the Federal Open Market Committee—with intervention coordinated between the two. As a mechanical matter, intervention is simply a purchase of foreign currency, with U.S. dollars, in the foreign exchange market.

A Fed purchase of foreign exchange that increases high-powered money is monetary policy, but an acquisition of foreign exchange funded by selling dollar-denominated securities is credit policy. The latter is commonly known as *sterilized* foreign exchange intervention because its potential effect on high-powered money is offset by the sale of securities. The Fed undertakes sterilized intervention for its own account and for the ESF. Such intervention is sometimes undertaken in cooperation with foreign monetary authorities using reciprocal currency arrangements. These are, in effect, lines of credit giving central banks access to each other's currency.[6]

The ESF borrows dollars to buy foreign exchange by using its foreign exchange purchases as RP collateral at the Fed—a practice known as foreign exchange warehousing.[7] In effect, the ESF finances its foreign exchange portfolio much as, say, dealers use RPs to finance their security portfolios. The Fed routinely sterilizes the effect on high-powered money of its dollar-denominated lending to the ESF by selling an equivalent value of dollar-denominated securities. Whether or not sterilized foreign exchange intervention is carried out by the Fed for its own account or for the ESF, the net result is to substitute foreign-currency-denominated securities (or interest-earning deposits at a foreign central bank) for dollar-denominated securities on the Fed's balance sheet, without changing high-powered money.

There is little evidence that large-scale sterilized intervention has a sustained effect on the exchange rate.[8] In some situations, sterilized intervention may temporarily stabilize the exchange rate; or it may signal government resolve to follow up with monetary or fiscal policy actions that will powerfully

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[6] Fisher (1994), p. 4, lists the Federal Reserve's current reciprocal currency arrangements.

[7] See Crain (1990). The ESF also finances itself by other means, see Exchange Stabilization Fund *Annual Reports.*

[8] See, for example, Bordo and Schwartz (1990), Edison (1992), and Obstfeld (1988).

influence the exchange rate in the future. To the extent that such intervention needs to be carried out promptly, without public debate, it may be useful for an independent central bank to finance it. Nevertheless, in light of the ineffectiveness of sterilized intervention, Congress could explicitly limit the use of Fed credit policy for this purpose. Of course, the Fed and the Treasury could agree to keep sterilized intervention to a minimum in lieu of Congressional action.

Foreign Exchange Warehousing

In conjunction with the proposed limit on sterilized foreign exchange intervention, an end to warehousing would further implement the second Accord principle. The ESF has occasionally made loans, by short-term swap agreements and by other means, to heavily indebted countries for balance of payments purposes and to help manage their external debt.[9]

The ESF could clearly carry out such responsibilities without the help of the Fed. If need be, the ESF could be provided with additional funds borrowed by the Treasury itself, or the ESF could be given additional authority by Congress to borrow on its own account.

When the ESF finances itself by warehousing foreign exchange with the Fed, a sale of Treasury securities to the public is *also* the ultimate source of funds. The only difference is that the Treasury securities are not newly issued, but rather sold from the Fed's portfolio. It is, however, as if the debt *were* newly issued, since the Fed simply returns to the Treasury the interest it receives on the Treasury securities it holds.

The main difference between Fed financing, and financing by the Treasury itself, is that the former is arranged between Fed and Treasury officials without an explicit appropriation from Congress. A second difference is that Fed financing does not show up as a measured increase in the Federal deficit, since it does not involve *newly* issued debt.

Whatever financing method is adopted, loans made to help foreign governments finance their balance of payments deficits or to manage their external debt are clearly deficit-financed fiscal policy actions of the U.S. government. As is the case with any fiscal policy, the presumption is that Congress should authorize the spending and explicitly appropriate the necessary funds. Since Fed warehousing for the Treasury does not require Congressional authorization and obscures the funding, warehousing would not appear to be an appropriate use of Fed credit policy.

[9] See the "operations statements" in Exchange Stabilization Fund *Annual Reports.*

5. THE TRANSFER OF FED SURPLUS TO THE TREASURY

The Deficit Reduction Act passed by the U.S. Congress in 1993 contains a provision to take $213 million from the Fed's surplus account to help meet budget reconciliation targets in 1997 and 1998.[10] Surplus is a capital account on the Fed's balance sheet, a kind of retained earnings for contingencies. The transfer of surplus is tiny when compared to total Fed assets, which were approximately $370 billion at the end of 1992, about $330 billion of which were security holdings. In fact, the transfer is only about 7 percent of the Fed's $3 billion end-of-1992 surplus.

Although it is small, the transfer is important because it represents a kind of policy action that, if resorted to routinely in the future, could eventually shrink the volume of liquid assets in the Fed's portfolio enough to undermine the central bank's monetary and credit policy powers, and ultimately, its financial and political independence as well. Moreover, as we shall see below, although the transfer of Fed assets appears to provide supplementary funds to the Treasury, in fact, it provides no additional revenue. For these reasons, Congress should agree to an Accord not to transfer Fed surplus to the Treasury.

Historical Precedent for the Transfer of Fed Surplus

The Federal Reserve Act authorized the Fed to build up a surplus by retaining interest earned from its asset portfolio until surplus reached 40 percent of paid-in capital of member banks.[11] In 1919 the law was changed to allow surplus to be raised to 100 percent of subscribed capital (twice paid-in capital). In 1933, half of Fed surplus, $139 million, was used by Congress to capitalize the newly established Federal Deposit Insurance Corporation.

The 1959 Federal deficit of $13 billion was three times larger than any previous peacetime deficit and the next five years saw a string of deficits that generated Congressional pressure for the Fed to cut its surplus. In 1964 the Fed announced a voluntary reduction of surplus, reducing it to paid-in capital. That decision added $524 million to the amount that the Fed paid to the Treasury in 1965. The Fed has held surplus equal to paid-in capital since then. As a result of the new legislation, surplus will be kept equal to paid-in capital minus $213 million.

Budget Mechanics of the Transfer of Fed Surplus to the Treasury

The Fed will obtain the funds to make the required transfer by selling Treasury securities from its portfolio to the private sector. The Treasury will receive

[10] See the *Omnibus Budget Reconciliation Act of 1993.*

[11] The historical treatment of surplus is discussed in Goodfriend and Hargraves (1983), together with the history of Fed payments to the Treasury.

the $213 million as additional revenue in 1997–98, and thus record a smaller deficit for those years.

As long as the Treasury uses the supplementary revenue to cut back on borrowing or to finance additional spending, the transfer will not affect the stock of high-powered money in the hands of banks and the public. Hence, the transfer is not a monetary policy action. Rather it's a credit policy action that can be thought of as an interest-free loan from the Fed to the Treasury financed by a sale of securities from the Fed's portfolio, reflected in a shrinking of the Fed's capital account.

The transfer of assets to the Treasury is intended to provide it with a one-time supplemental source of funds to help narrow the Federal deficit. To see that it will not in fact do so, consider the Treasury securities the Fed will sell to get the $213 million for the transfer. When the Fed holds these securities, it is as if they are extinguished from the Treasury's point of view, because the Treasury pays the interest to the Fed and the Fed simply returns that interest to the Treasury. Once the Fed sells the securities to the public, however, the Treasury no longer gets back its interest payments.

In short, selling securities from the Fed's surplus account and transferring the proceeds to the Treasury is equivalent to the Treasury issuing new debt to borrow the funds directly from the public. The transfer of Fed surplus will have no effect on the *correctly* measured Federal deficit. The transfer of Fed assets to the Treasury will merely appear to reduce the Federal deficit because the sale of securities held by the Fed is not recorded as a *new* issue of Treasury debt.

The Role of Fed Surplus and Federal Reserve Independence

Surplus is employed in commercial enterprises as a reserve for contingencies such as absorbing losses or meeting expenses and dividends when earnings are low. The Fed employs its surplus in a similar manner. The most important contingencies are exchange rate revaluations of foreign-currency-denominated securities that the Fed holds for its own account. Since the Fed marks these assets to market monthly, an appreciation of the foreign exchange value of the dollar reduces the dollar value of the Fed's foreign-security holdings. The Fed carries its dollar-denominated securities at historical cost. But surplus is also used to absorb any realized losses on sales of domestic securities.

Currently, the Fed pays its interest earnings to the Treasury weekly. Starting from zero, the Fed accrues payments each week as so-called undistributed net income and turns it over to the Treasury with a week lag. In 1992, for example, net interest earnings averaged around $325 million a week, and at the end of the year the Fed held about $22 billion of foreign-currency-denominated

securities.[12] Although not all of the $22 billion was held for the Fed's own account, the magnitudes are such that a monthly appreciation of the dollar on the foreign exchange market could significantly offset net interest income in a given week.

As an accounting matter, undistributed net income is not allowed to go negative. Whenever a revaluation of foreign security holdings or a realized loss on the domestic portfolio causes it to do so, assets are moved from the surplus account to bring undistributed net income back up to zero. In the following weeks, no transfers are made to the Treasury until the Fed's assets are replenished and surplus is restored to the level of paid-in capital. In general, any gains or losses on foreign securities that the Fed holds for its own account show up as larger or smaller Fed payments to the Treasury. Profits or losses on warehoused foreign securities accrue to the ESF.

Surplus, then, serves as a buffer helping to protect paid-in capital and to insure that the Fed's liquid securities cover its high-powered money liabilities. Eliminating even the entire $3 billion surplus account would only reduce the Fed's portfolio of securities by about 1 percent, so it would certainly not impair the Fed's ability to conduct policy. The risk is that the elimination of surplus would undermine the principle that the Fed should retain possession of the interest earning assets it acquires through money creation. *That* might tempt Congress to order even more transfers in the future.

If carried far enough, stripping the Fed of its liquid assets would obviously interfere with its ability to conduct monetary and credit policy. Equally important, however, it would undermine the Fed's financial independence by denying it enough interest income to finance its operations without having to ask Congress for appropriations or resorting to inflationary money creation. The excess of Fed earnings over expenses has been large recently—the Fed paid about $17 billion to the Treasury in 1992.[13] But excess earnings could be reduced in the future if nominal interest rates come down, reserve requirements are reduced further, or interest is paid on required reserves. Meanwhile, the excess is simply returned to the Treasury.

Thus, surplus serves as a bulwark protecting both the financial independence of the Fed and its monetary and credit policy powers. Moreover, the Fed's financial independence is the foundation of its political independence, so respect for Fed surplus on the part of Congress would strengthen the Fed's determination to pursue noninflationary monetary policy.

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[12] Board of Governors of the Federal Reserve System *1992 Annual Report,* p. 262. The combined foreign exchange holdings of the Federal Reserve and the Treasury nearly reached $45 billion in December 1989 (Jacobson 1990).

[13] Board of Governors of the Federal Reserve System *1992 Annual Report,* pp. 276–77.

6. CONCLUSION

The Federal Reserve pursues both monetary and credit policies. Yet no Accord protects its credit policies from fiscal misuse the way the 1951 Accord protects monetary policy. With that in mind, the paper presented some principles for credit policy, and proposed Accords that would implement those principles for three prominent policies. The basic idea is that Congress has provided the Fed with the independence necessary to carry out central bank functions effectively, and the Fed should perform only those functions.

In effect, FDICIA already partially incorporates an Accord to limit the cost that liquidity assistance potentially imposes on the deposit insurance fund. That Accord may have to be strengthened, however, to more effectively restrict liquidity assistance to institutions that have become insolvent on a market value basis.

Since there is little evidence that sterilized foreign exchange intervention has more than a temporary effect on the exchange rate, the Fed and the Treasury could reach an Accord to keep such intervention to a minimum. Foreign exchange warehousing could also be ended by a simple agreement between the Fed and the Treasury. But Congress could explicitly limit the potential abuse that warehousing exemplifies: the use of Fed credit policy for off-budget funding without explicit Congressional authorization.

The last policy considered was the transfer of Fed surplus to the Treasury. This credit policy has budget consequences in appearance only. Nevertheless, it could set a harmful precedent for further stripping the Fed of assets that would ultimately weaken the central bank's independence and its ability to conduct policy.

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Effects of Federal Reserve Balance Sheet Changes on Interest and Fee Income

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This memo considers the effects on interest and fee income of recent changes in the Federal Reserve's balance sheet. First, I estimate interest and fee income year-to-date from nine liquidity facilities to be $7.6 billion, $4.0 billion higher than what the interest income would have been had the assets been invested in Treasury bills. Second, I estimate net annual interest and fee income going forward to be $50.3 billion, assuming the Fed's balance sheet looks as it did on November 5, 2008, $23.0 billion higher than estimated income going forward based on the August 8, 2007 balance sheet.

Year-to-Date Income Effects of Liquidity Facilities

I estimate interest and fee income year-to-date (through November 5) from the nine liquidity facilities listed below to be $7,639 million. This is $3,952 million higher than what the interest income would have been had the assets been invested in Treasury bills (earning the 3-month bill rate). Note that the interest foregone for the TSLF and TOP is $0, because the Fed continues to collect interest on securities lent through the programs while also collecting borrowing fees.

Year-to-Date Income Effects of Liquidity Facilities

Program	Interest/Fee Income	Interest Foregone	Difference
AMLF	259	84	176
Commercial Paper Funding Facility	212	22	190
Primary Credit (Discount Window)	367	187	180
Primary Dealer Credit Facility	427	169	258
Swap Agreements	1,911	790	1,121
Single-Tranche OMO Program	1,146	731	415
Term Auction Facility	2,744	1,704	1,040
Term Securities Lending Facility	569	0	569
TSLF Options Program	3	0	3
Total	7,639	3,687	3,952

Note: All figures are in millions of dollars.

Pro Forma Income Effects of Balance Sheet Changes

I estimate net annual interest and fee income going forward, based on the November 5, 2008 balance sheet, to be $50.3 billion. This is $23.0 billion higher than net interest income going forward based on the balance sheet of August 8, 2007, before any of the new liquidity programs had been introduced. In generating both sets of estimates, the Treasury coupon rate is assumed to be the 4.85% weighted average coupon rate of SOMA holdings as of

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October 22, 2008, other market rates and spreads are assumed to be the averages for the month ending November 5, and policy rates are assumed to be the current rates.

The net income differential reflects interest and fee income on Federal Reserve assets that is $31.6 billion higher with the November 5, 2008 balance sheet than the August 8, 2007 balance sheet ($59.0 billion vs. $37.4 billion, respectively). Partially offsetting this gross income differential is an interest expense differential of $8.6 billion ($8.7 billion vs. $0.1 billion), reflecting interest on reserves, interest on reverse RPs, and the cost of the Treasury Supplemental Financing Program.[1]

Pro Forma Income Effects of Balance Sheet Changes

	August 8, 2007		November 5, 2008	
Assets	Outstanding	Pro Forma Income	Outstanding	Pro Forma Income
Treasury coupons	514	24.9	458	22.2
Treasury bills	277	1.6	18	0.1
Agencies	0	0.0	13	0.3
Conventional RPs	19	0.1	0	0.0
Single-tranche 28-day RPs	0	0.0	80	1.3
TAF loans	0	0.0	301	3.1
Swap agreements	0	0.0	531	9.7
AIG loans	0	0.0	81	5.6
PDCF loans	0	0.0	72	0.9
PCF loans	0	0.0	109	1.4
AMLF	0	0.0	85	1.1
CPFF	0	0.0	243	8.8
Maiden Lane LLC	0	0.0	27	0.7
Other assets	59	0.8	58	0.8
TSLF (off balance sheet)	0	0.0	200	3.2
Total	869	27.4	Exc. TSLF: 2076	59.0
Liabilities				
Federal Reserve notes	777	0.0	827	0.0
Reverse RPs	30	-0.1	97	-0.4
Deposits				
Depository institutions	13	0.0	504	-5.0
Treasury general account	5	0.0	19	0.0
Treasury SFA	0	0.0	559	-3.3
Other liabilities	10	0.0	30	0.0
Total	836	-0.1	2035	-8.7
Net interest and fee income		27.3		50.3

Note: All figures are in billions of dollars.

[1] Interest costs incurred through the Supplemental Financing Program are incurred by the Treasury from its issuance of cash management bills, and not the Fed, but are imputed to the Fed here under the idea of a unified balance sheet.

Foreign Central Bank Use of Federal Reserve FX Swap Lines

Nick Klagge and Michael Fleming
Capital Markets Function, Research and Statistics Group
November 10, 2008

This memo considers foreign central bank use of reciprocal currency arrangements ("swap lines") established by the Federal Reserve in response to pressures in overseas US dollar funding markets. Under these agreements, the Fed swaps US dollars for foreign currency in order to finance US dollar tender operations by foreign central banks. The first swap lines, with the European Central Bank (ECB) and Swiss National Bank (SNB), were announced on December 12th 2007, but the Fed has recently undertaken a rapid expansion of the program.

Broadly speaking, the FX swap line program has progressed through three informal phases. During the first phase, from the beginning through September 17th 2008, the program remained relatively small and extended only to the European Central Bank and the Swiss National Bank. During the second phase, from September 18th 2008 through October 12th 2008, the program was extended to seven additional foreign central banks, available amounts were greatly increased, and foreign central banks began offering additional dollar liquidity at short maturities. During the third phase, beginning on October 13th 2008 and extending through the present, the Fed removed the caps on its swap lines with four foreign central banks, which began offering unlimited US dollar liquidity in fixed-rate tenders. In figures throughout this memo, we use black vertical bars to denote the dates separating these three phases.

Phase 1: December 12th 2007 – September 17th 2008

The Fed initially established FX swap lines with the ECB and SNB concurrently with the announcement of the Term Auction Facility (TAF). From the program's inception through September 17th 2008, the swap lines largely acted as an overseas extension of the TAF, with the ECB executing one-month, and later three-month, fixed-rate tenders at the stop-out rates established by TAF auctions (though the SNB conducted variable-rate tenders). For a period in February and March 2008, the ECB and SNB stopped conducting US dollar operations as pressures in dollar funding markets decreased, before re-instituting them at the end of March.

Phase 2: September 18th 2008 – October 12th 2008

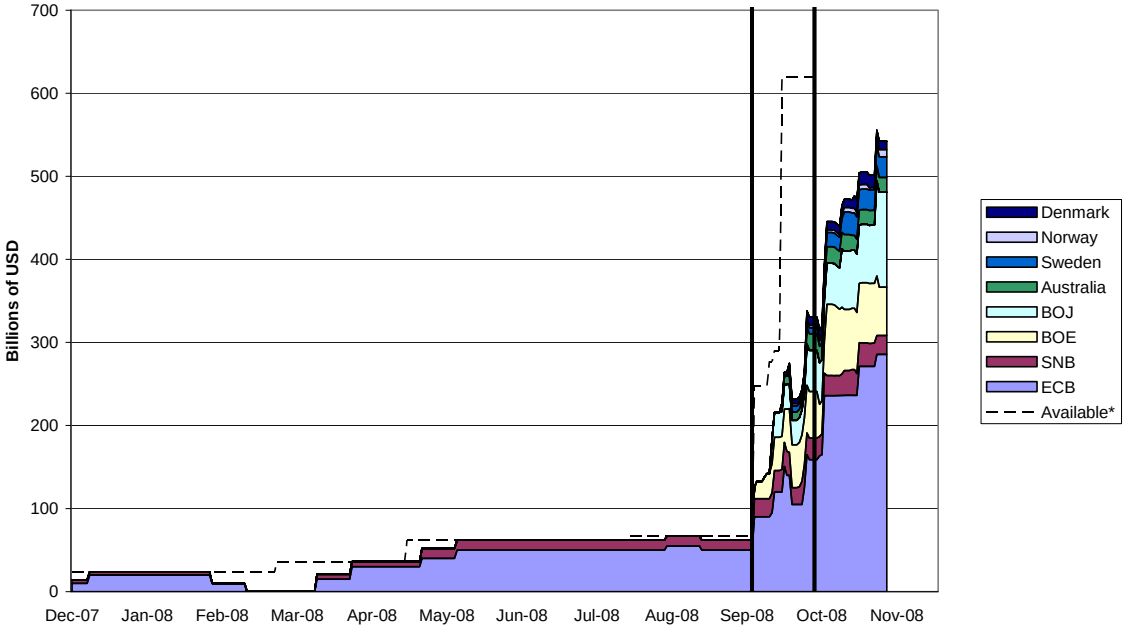
As market conditions deteriorated worldwide following the bankruptcy of Lehman Brothers, the Fed undertook the first rapid expansion of its FX swap line program. On September 18th, it extended swap lines to three new foreign central banks, followed by an additional four on September 24th. Table 1 below details the Fed's addition of new swap lines over the course of the program.

Table 1: Additions of New FX Swap Lines

Date	Swap Lines Opened
December 12, 2007	European Central Bank, Swiss National Bank
September 18, 2008	Bank of Japan, Bank of England, Bank of Canada
September 24, 2008	Australia, Sweden, Norway, Denmark
October 28, 2008	New Zealand
October 29, 2008	Brazil, Mexico, Korea, Singapore

In addition to expanding the number of available FX swap lines, the Fed aggressively expanded the total quantity of dollars made available to foreign central banks through the program. Over the course of the second phase, the Fed increased the available amount by nearly a factor of ten, from $67bn to $620bn. As shown in Figure 1 below, the Fed's expansion of available swap lines was accompanied by a significant increase in the quantity of US dollars actually loaned by foreign central banks under the FX swap agreements. By the end of the second phase, on October 12th, there was over $330bn in US dollar loans outstanding under the program.

Figure 1: FX Swap Line Amounts Outstanding by Foreign Central Bank

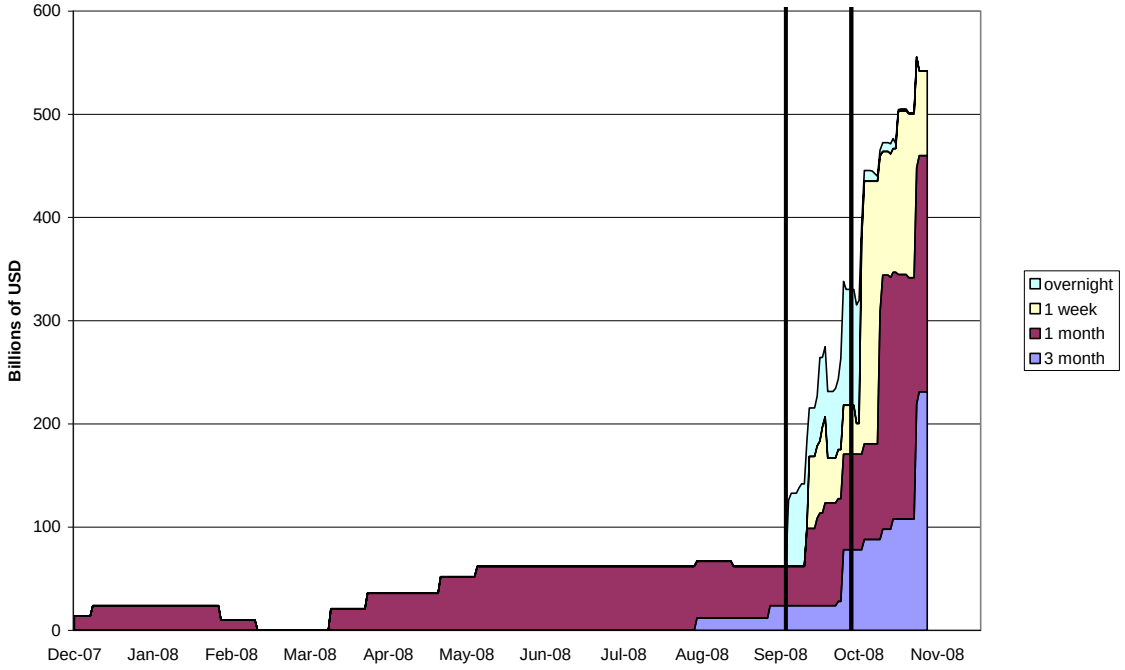


*Total available amount unlimited after 10/12/08 with removal of caps from ECB, SNB, BOE and BOJ swap lines.

As foreign central banks expanded the quantity of their US dollar loans during the second phase, they also expanded the terms of their lending, auctioning funds at a broader range of maturities. On September 18th, the ECB, SNB, and BOE supplemented the existing one- and three-month tenders with lending in overnight and one-week tenors. These

shorter-term loans were all conducted as variable-rate operations with stop-out rates set directly by auctions. With these operations, the foreign central banks were able to fine-tune US dollar liquidity to mitigate pressures surrounding the quarter-end, as well as to expand total dollar liquidity to address elevated pressures in funding markets. Figure 3 below shows total amounts outstanding under Fed FX swap agreements by loan term, highlighting these developments.

Figure 2: FX Swap Line Amounts Outstanding by Loan Term



Phase 3: October 13th 2008 - present

As financial market conditions continued to deteriorate, the Fed began a third phase of its FX swap program, expanding it aggressively once again. On October 13th, the Fed announced that it would remove the caps from its swap lines with the ECB, BOE, and SNB (as well as the BOJ the following day). In keeping with this announcement, these four central banks again altered the mechanism through which they provided the market with US dollar liquidity. They continued to provide a small amount of overnight funding through fixed-amount variable-rate auctions, but they also replaced their limited-amount tenders at 1- and 3-month maturities with fixed-rate tenders for unlimited amounts at one-week, one-month, and three-month tenors. The rates for these operations, rather than being drawn from the Fed's TAF operations, are set jointly by the participating central banks. Finally, the ECB also began offering US dollar liquidity through FX swaps executed directly with private sector firms.

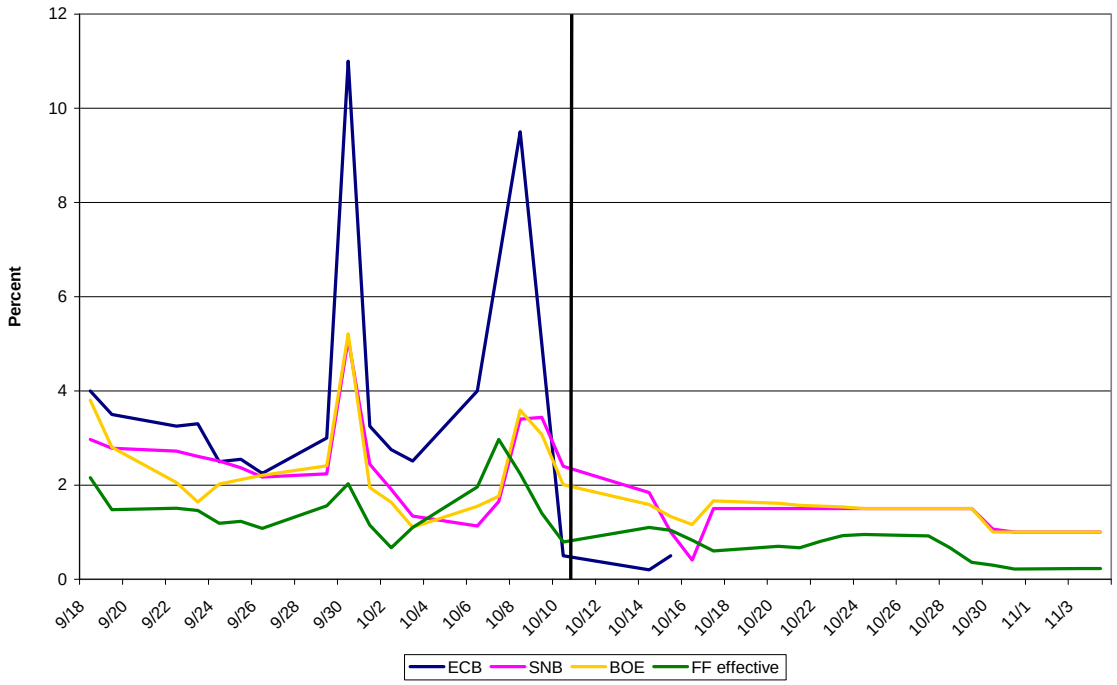
As foreign central banks made unlimited US dollar liquidity available, actual lending outstanding under the swap lines again jumped significantly, as shown in Figures 1 and 2

above. By November 10th, there was over $542bn in outstanding lending under the program. The Fed also opened swap lines with an additional five foreign central banks during this phase, as shown in Table 1 above.

Lending Rates in Foreign Central Bank Overnight US Dollar Operations

The ECB, SNB, and BOE all conducted overnight variable-rate tenders for US dollars during the second and third phases of the FX swap program, potentially providing some insight into pressures in overseas US dollar funding markets over this period. Figure 3 below shows the stop-out rates established by these auctions, as well as the daily Fed funds effective rate for comparison. The vertical line, as before, represents the division between the second and third phases of the program.

Figure 3: Overnight Rates, FCB Stop-outs vs. Fed Funds Effective

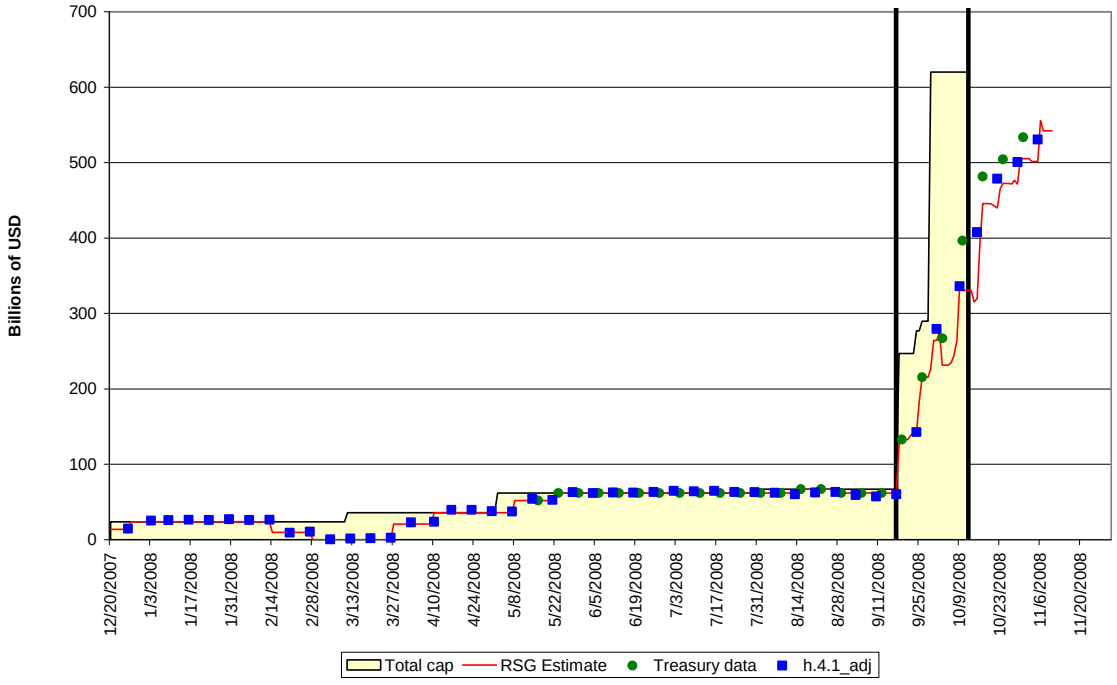


The stop-out rates shown in Figure 3 indicate elevated funding pressures at the end of September, with particularly high demand for funds covering the quarter-end on September 30th. Funding pressures again rose on October 7th and 8th, particularly in Europe. During the program's third phase, funding pressures appeared to relax. The ECB stopped overnight auctions after a series of low stop-out rates, while the SNB and BOE established minimum bid rates equal to the Fed funds target rate, resulting in a series of undersubscribed auctions that stopped out at the minimum bid rate.

Comparison of Available Data

The data used in this memo to derive daily amounts outstanding under the Fed's FX swap agreements are compiled from auction result announcements released by the individual foreign central banks. While these data are all publicly available, there is no single source documenting all foreign central bank operations in US dollars. Thus, it is desirable to cross-check the estimated amounts outstanding against other available data. There are two plausible sources for this. The first is the Treasury's weekly International Reserve Position report.[1] Table II, item 2(a) lists "Short positions in forwards and futures in foreign currencies vis-à-vis the domestic currency (including the forward leg of currency swaps)." The number given in this line includes any swaps the Fed has executed with foreign central banks. The second plausible source is the Fed's own weekly H.4.1 report ("Factors Affecting Reserve Balances")[2]. On the assets side of the Fed's balance sheet, executed swaps are included as part of "Other Federal Reserve assets." This number, however, includes assets other than swaps, so we adjust the series by subtracting from each week's number the average value of this item in the week ended December 19th, 2007 (just before the first swap-based tenders were executed). Figure 4 compares these two independent sources with the directly-computed series created for this memo.

Figure 4: Measures of FX Swap Line Amounts Outstanding



As Figure 4 demonstrates, the Treasury data (green circles), the adjusted H.4.1 data (blue squares), and the directly-computed data (red line) track one another very well for most

[1] http://www.ustreas.gov/press/international-reserve-position.html
[2] http://www.federalreserve.gov/releases/h41/

of the history of the FX swap lines, though they begin to track less closely following the aggressive expansion of the program in September and October. During the period when the series track less closely, the amounts reported by the Treasury and the H.4.1 are higher than the directly estimated figures. Given that the Treasury and H.4.1 data are supposed to measure total executed swaps, while the directly estimated data are supposed to measure the reported amount of US dollars that have actually been loaned out by foreign central banks, this finding is not inconsistent.

Monetary Policy

1. **Some measures of the current stance of monetary policy**

2. **Tracking Stress in the interbank funding market**

3. **Escalation Plan for Monetary and Fiscal Policy Gauti Eggertsson's personal views based on his research**

4. **Monetary Policy Implementation – Economic Policy Review Article**

Some Measures of the Current Stance of Monetary Policy

Marco Del Negro and Simon Potter

Three alternative measures of the stance of monetary policy are examined:

1. Prescriptions of contemporaneous feedback rules with response coefficients to output and inflation gaps taken from Taylor's original work. The 2008Q4 data values are set equal to the FRBNY central scenario projection.[1]

2. Prescriptions of forecast based rules with response coefficients to output and inflation gaps taken from Taylor's original work. The forecasts are set equal to either the FRBNY central scenario projection or the FRBNY forecast taking into account our risk assessment.

3. A counterfactual simulation of a Bayesian vector autoregression with a prior generated by a Dynamic Stochastic General Equilibrium. The model is estimated using data from the last 20 years on GDP and core PCE with the average target FFR in the 3rd month of the quarter as the policy rate. The counterfactual is constructed by setting the shock to the policy rate to zero after 2007Q4. The 2008Q4 data values for output and inflation are set equal to the FRBNY central scenario projection or the FRBNY forecast taking into account the projection from a global credit crunch scenario.

These measures are meant as illustrations and are not intended to span the prescription of all policy type rules, optimal policy or robust control.

In Taylor's original formulation the policy rate is moved by 1.5 times the size of the inflation gap and 0.5 times the size of the output gap. We use the Summary of Economic Projections to center the inflation gap at 1.75% for core PCE inflation. This leaves the value of intercept (often called the neutral rate) to be determined. It is difficult to obtain precise estimates of this time varying value. In the past we have assessed the plausible range of values to be between 3.0 to 5.5%. Because of the substantially tightening of financial conditions during the crisis, the neutral rate is likely in the lower part of this range or even well below 3%. Thus we focus on the policy prescriptions obtained using a range of 2.0 to 3.5% for neutral rate. A summary of the results is presented in the Table at the end of this note.

The contemporaneous feedback rule combined with our 2008Q4 projections prescribes a policy rate below the neutral rate: the positive inflation gap is dominated by the effect of output gap using Taylor's response coefficients. Using the forecast based rule with the FRBNY point projection for 2009, the prescriptions fall to about 200 bps below the neutral rate. Taking into account the balance of risks around the FRBNY projection prescribes an additional 100 bps of easing. Note this takes the nominal rate below the

[1] The central scenario does not assume further fiscal stimulus.

zero bound. Other methods of assessing the stance of policy that try to model directly the tightening of financial conditions can produce estimates of the target as low as -3%.[2]

The calculations above assume the policy rate is not adjusted in an inertial manner. The counterfactual generated by the estimated vector autoregression captures in its path some of the inertia policy rates observed over the last 20 years, the average neutral rate over this period and estimated response coefficients to inflation and output deviation. For 2008Q4 assume an average value of the target FFR of 1%. Under the central scenario projection this is about 100bps below the counterfactual prediction of the model for 2008Q4 and about 50bps below when the global credit crunch scenario is used. When the model is iterated forward to 2009Q4 the counterfactual prediction is 0.5% for the target under the central scenario and -1.5% under the global credit crunch scenario.

Policy Rule	**Rate Prescription**
Contemporaneous Feedback	1.0 to 2.5
Forecast Based	0 to 1.5
Forecast Based with Risks	-1.0 to 0.5
Counterfactual	0.5 to 2.0
Counterfactual with Credit Crunch scenario	-1.5 to 1.5

[2] The leading macroeconomic forecasting firm Macroeconomic Advisers recently ran a simple assessment that produced a target rate of between -2 to 0% in 2009.

Tracking stress in the interbank lending market

Joshua Rosenberg and Samuel Maurer[1]
Research and Statistics Group
October 8, 2008

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1. Introduction

In this memo, we develop an index of stress in the interbank lending market and use this index to track stress during the current financial crisis. Our index combines information on the credit risk in the banking sector, bank use of the Fed's lending facilities, and interbank funding costs.

What makes our approach unique is its focus on the interbank lending market rather than financial conditions in general (e.g., Swistin, 2008), liquidity across markets (e.g., Kerry 2008), or a combination of those factors (Illing and Kiu, 2006; Rosenberg, 2008).[2] An advantage of our methodology is that the components of the index are well-motivated by fundamentals, are easily interpretable, and are relevant to policy decisions related to the interdealer market.

Our main findings are:

- The interbank financial stress index is currently at a record high level, reflecting spikes in counterparty credit risk, funding demand, and funding costs.

- The stress index has historical peaks during the beginning of the credit crisis (August 2007), the tightening of short-term funding conditions preceding the TAF introduction (December 2007), and the Bear Stearns collapse (March 2008).

2. The three components of the stress index

Our index combines information on three key characteristics of the interbank lending market: (1) banking sector credit risk, which is a key determinant of the *supply* of funds, (2) Fed lending facilities use, which provides a measure of the *demand* for funds, and (3) credit spreads that directly measure of the *cost* of funds in the interbank market.

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[1] We are grateful to Tobias Adrian, Jennie Bai, Michael Fleming, Matthew Raskin, and Jennifer Roush for helpful suggestions.

[2] Kerry, William, 2008, Measuring Financial Market Liquidity, Journal of Risk Management in Financial Institutions, Vol. 1, No. 2, pp. 181–90. Swiston, Andrew J., 2008, A U.S. Financial Conditions Index: Putting Credit Where Credit is Due, IMF Working Paper No. 08/161. Mark Illing and Ying Liu, 2006, Measuring Financial Stress in a Developed Country: An Application to Canada, Journal of Financial Stability, Vol. 2, No. 3, pp. 243-265. Rosenberg, Michael, Financial Conditions Watch: Global Financial Market Trends and Policy, August 13, 2008, Vol. 1, No. 1.

2.1 Banking sector credit risk

The first index component, banking sector credit risk, is closely linked to the supply of funds in the interbank market. A negative shock to the banking sector is usually associated with an overall increase in credit risk. Higher credit risk can decrease the supply of credit if some lenders have a minimum credit quality threshold.

In addition, a rise in credit risk is often associated with increase in uncertainty about the credit risk of any individual firm, since the intensity of a credit shock typically varies across firms. As uncertainty about counterparty credit risk rises, some lenders may step back from lending if they have difficulty pricing credit. Alternatively, lenders may offer credit at rates that reflect the risk of their weakest counterparties, tightening credit conditions for all.

We create the banking sector credit risk component using measures of default risk from the equity market (equity index level and volatility), bond market (corporate bond spreads and commercial paper spreads), and credit default swap market (CDS spreads). The 2-year swap spread also incorporates a counterparty credit risk premium, so we include that as well. We do not, however, include any spreads that measure the direct cost of interbank borrowing; those are included in the funding cost index component.

Variables in the banking sector credit risk index are:

- S&P500 financials equity index level (negative)
- S&P500 financials implied volatility
- 5-year CDS spread for J.P. Morgan banks index
- 5-year CDS spread for J.P. Morgan financial services index
- Merrill Lynch banks corporate bond index option-adjusted spread
- Merrill Lynch brokerages corporate bond index option-adjusted spread

2.2 Fed lending facilities use

As the second component of the index, we track bank use of the Federal Reserve's lending facilities to proxy for frictions in the interbank market. For various reasons (including perceived stigma and potentially higher costs), banks utilize Fed facilities primarily when they are having difficulty accessing funds in the interbank market. Thus, the extent of borrowing through these facilities is a natural proxy for interbank market frictions.

Two of the Fed's liquidity facilities – the Term Auction Facility and the Term Securities Lending Facility – use an auction format. A simple measure of demand is the total dollar amount bid compared to the total dollar amount offered. The ratio of these two quantities is

referred to as the bid-to-cover ratio, which we use to measure excess demand for funds (or Treasury collateral).[3] We convert these intermittent series to a daily frequency by holding the values constant until the next auction.

We also consider demand for funds through the Fed's two standing primary credit facilities, the Discount Window and the Primary Dealer Credit Facility. We track the total amount of borrowing, which is reported as a weekly average in the Fed's H.4.1 data release.

Variables in the Fed lending facilities use index are:

- Bid-to-cover ratio, Term Securities Lending Facility schedule 1 auction[4]
- Bid-to-cover ratio, Term Securities Lending Facility schedule 2 auction
- Bid-to-cover ratio, Term Auction Facility
- Amount borrowed, Discount Window
- Amount borrowed, Primary Dealer Credit Facility

2.3 Cost of funds in the interbank market

The third component of the index, the cost of funds in the interbank market, is the equilibrium outcome of supply and demand effects. As stress increases, we expect that the cost of borrowing in the interbank market relative to a riskless benchmark will rise due to an increase in the quantity and price of credit and liquidity risk as well as higher demand for funds.

In this index, we only use credit spreads that directly reflect interbank borrowing. We focus on term borrowing, since the term market is more sensitive to disruptions in the supply of credit than the overnight market.

The variables included in the cost of funds index are: [5]

- 3-month LIBOR to 3-month overnight index swap spread
- 1-month term federal funds to 1-month overnight index swap spread

[3] The amount offered for each of these facilities has also increased over time. We do not currently incorporate this effect.
[4] There are two types of Term Securities Lending Facility auctions. Schedule 2 auctions accept a broader range of collateral.
[5] We originally used the three-month Eurodollar-U.S. dollar FX swap spread basis as a measure of dollar borrowing costs overseas, but this data is no longer available to us. We could also use stop out rate in ECB dollar auctions as an alternative proxy. We also originally included data on secured term lending spreads (Agency and Agency MBS to general collateral repo) but this data is not consistently available from Bloomberg.

- 1-week Agency repo rate to 1-week general collateral repo rate

2.4 Creating the indices

Each index is constructed so that a value of zero means that the stress level is equal to the average stress level in the period prior to the financial crisis. A value of 1 means that the stress level is 1 standard deviation higher than the average during the pre-crisis period.

We define the pre-crisis period as January 1, 2006 to August 8, 2007, because on August 10, 2007 the Federal Reserve announced it was providing liquidity because of "dislocations in money and credit markets." We normalize each series by subtracting the pre-crisis mean and dividing by the pre-crisis standard deviation.[6]

Each of the three index components is an equal-weighted average of its standardized variables. The overall interdealer funding stress index is an equal-weighted average of the three component indices.

3. Tracking stress in the interbank funding market

As shown in Figure 1, the interbank funding stress index is near zero through mid-2007. This indicates that stress levels over this period are close to the pre-crisis average.

Then, there is a rapid rise in stress at the beginning of the financial crisis in August 2007. The elevated level of stress persists until mid-September 2007, reaching a peak of 1.6 and then declining to 0.6 in October 2007. Stress rises again in November and December, reaching a second peak level of 2.8 around the tightening of short-term funding conditions preceding the TAF introduction at the end of 2007.[7]

Stress remains elevated for about two months, but then declines to as low as 1.5 in early February of 2008. The index climbs again in March 2008, reaching a peak of 3.2 following the collapse of Bear Stearns.

Stress levels decline again, this time to a low of 2.2 in May 2008. There is then a gradual rise in stress back up to a level of 3.2 just after the government takeover of Fannie Mae and Freddie Mac on 9/7. The index rises particularly sharply after the Lehman bankruptcy (9/15) and the AIG loan (9/17), spiking up from 3.5 on 9/9 to 7.3 on 9/18.

After the announcement of the Troubled Asset Relief Program on 9/18, the stress index briefly retreats (9/19-9/23). The index then rises steadily, reaching its latest peak of 10.2 on 10/10.

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[6] Because the TSLF was announced on March 11, 2008, we calculate the standard deviations for variables in the demand for funds index over the period from March 11, 2008 to July 31, 2008.

[7] The TSLF was announced on March 11, 2008, and the PDCF was announced on March 16, 2008 (Sunday). The TSLF and PDCF were justified under the Section 13(3) of the Federal Reserve Act. The Term Auction Facility (TAF) was announced on December 12, 2007.

The currently high level of the stress index is due to exceptionally high levels of all three index components (Figures 2, 3, and 4). How does this compare to other peaks in the interbank stress level? At the beginning of the financial crisis, the Fed had not yet expanded its range of liquidity facilities, so the funding demand component remained near zero (Figure 3) and the main measurable drivers of stress were from banking sector credit risk and funding costs. In contrast, the second stress peak in December 2007 reflected increases in all three components of the stress index.

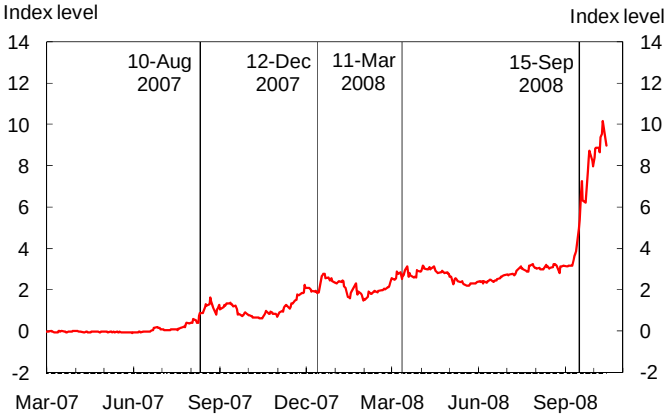
During the third peak around the Bear Stearns crisis, funding costs rose but did not reach the peak experienced around the announcement of the TAF (Figure 4). This may be because the Fed liquidity facilities had effectively contained the cost of funding for dealers. The main drivers of stress at that point were banking sector credit risk and funding demand.

4. Conclusions

There are a range of stress indices available, but for the most part, they are fairly general in terms of the range of variables included and the markets they cover. We introduce a new index of financial stress that focuses on the interbank lending market. The narrow definition of this index, we believe, is helpful because it is easier to interpret and potentially more valuable in making policy decisions related to conditions in the interbank market.

Figures

Fig. 1: Overall interbank funding stress index



Source: New York Fed calculations

Fig. 2: Banking sector credit risk

Source: New York Fed calculations

Fig.3: Fed lending facilities use

Source: New York Fed calculations

Fig. 4: Cost of funds in the interbank market

Source: New York Fed calculations

Escalation plan for monetary and fiscal policy

-- Gauti B. Eggertsson

This note outlines an escalation plan for monetary and fiscal policy, in the event the current crisis escalates into excessive deflation.

The plan draws on past research on the zero bound and recent research on the recovery from the Great Depression.

The plan is in 3 stages.

The first part relies exclusively on cutting interest rate. If the policy is successful inflation expectations remain in a positive territory.

The second part is a continuation of the policy in 2003 and tries to change expectations about *future* nominal interest rates. The main change relative to previous policy is to include a state-contingent commitment.

The last part is an emergency plan. It is written under the assumption that the second part lacks credibility. In this case monetary and fiscal policy are coordinated to increase the price level. This path of actions will require a "regime change" and temporary coordination of monetary and fiscal policy. I think it is unrealistic to expect that either the Fed or the Treasury are willing to follow this plan unless we have exhausted other options and seen a substantial fall in prices and output that qualifies as "depression".

Stage 1
Cut Fed funds rate to its lower bound. By taking relative aggressive action now, and increasing the risk of inflation somewhat, we are taking out an insurance against strong deflationary pressures. With nominal interest rate at 0-1 percent and inflation expectation hovering around 2-3 percent this allows for a negative real rate of 1-3 percent in the near-term which is quite likely to be enough to guard against deflationary pressures with normal financial market functioning. This stage does not include any forward looking language.

Stage 2
This stage assumes that deflationary pressures emerge: the CPI and core-inflation start to register negative readings and deflationary expectations start forming. In this case the real rate would be rising, and monetary policy would become contractionary absent further actions by the FOMC.

It is possible to cut the nominal interest rate to zero. Aggressive policy commitment, however, is possible even without going to the zero bound.

The main recommendation at this stage is that the Federal Reserve commits to keeping the interest rate low for a relatively long period of time. *It is not necessary, however, to*

commit to a specific time-frame. It makes more sense to make this commitment *state contingent*.

A simple form of policy commitment, for example, is to say:

"The Federal Funds rate will be kept below 1 percent *at least* until the price level is 5 percent higher than its current reading, as measured by core inflation. Further continuation of the low interest rate policy will be determined at that time, depending on financial condition, the level of employment, and the inflation rate."

I am just putting "5 percent higher" in there for illustration. We would need to study better what is the most suitable number. Based on our experience in 2003 this will probably do it. You never know, however, hence stage 3.

Stage 3
The nuclear option: Monetary and Fiscal coordination.

The assumption here is the relatively unlikely scenario that the policy commitment in stage 2 is not credible, i.e. that deflationary expectations persist and the market determines that the interest rate policy is "ineffective". Perhaps disagreement within the FOMC and the prospect of the term of the Chairmen expiring might also limit the credibility of the policy outlined in stage 2.

The proposal draws on the US experience during the Great Depression and WWII.

They key behind this policy proposal is to stir inflation expectation by "monetizing" budget deficits in a particular way.

The plan would go as follows.

The Federal Reserve commits to buy all Treasury bills issued at 0 interest rates (similar to the interest rate peg in WWII). This may require a change in law. This will effectively peg the Fed funds rate close to zero (one could alternatively allow for a peg at a higher rate of interest).

The Treasury will do aggressive deficit spending that is financed by Treasuries that the Fed buys by printing money. The Treasury should aim those spending on things that are likely to stimulate spending and inflation, such as public work projects.

They key for this policy to work on inflation expectation is appropriately manipulating expectations about when the interest rate peg is ***terminated*.**

Here is the proposal:
The peg on Treasury bills will be maintained until the FOMC, *with the approval of the Treasury and the President of the United States*, determine that

i) the price level has increased by some X percent (e.g. all the fall in the price level already experienced at that time. During the Great Depression the Administration talked about the price level of 1926 which was about 25 percent higher than the price level in 1933).
ii) employment, financial, and fiscal conditions do not warrant further continuation of this policy.

This is a foolproof way of increasing inflation expectations and the price level.

Todd Keister, Antoine Martin, and James McAndrews

Divorcing Money from Monetary Policy

- Many central banks operate in a way that creates a tight link between money and monetary policy, as the supply of reserves must be set precisely in order to implement the target interest rate.
- Because reserves play other key roles in the economy, this link can generate tensions with central banks' other objectives, particularly in periods of acute market stress.
- An alternative approach to monetary policy implementation can eliminate the tension between money and monetary policy by "divorcing" the quantity of reserves from the interest rate target.
- By paying interest on reserve balances at its target interest rate, a central bank can increase the supply of reserves without driving market interest rates below the target.
- This "floor-system" approach allows the central bank to set the supply of reserve balances according to the payment or liquidity needs of financial markets while simultaneously encouraging the efficient allocation of resources.

1. Introduction

Monetary policy has traditionally been viewed as the process by which a central bank uses its influence over the supply of money to promote its economic objectives. For example, Milton Friedman (1959, p. 24) defined the tools of monetary policy to be those "powers that enable the [Federal Reserve] System to determine the total amount of money in existence or to alter that amount." In fact, the very term *monetary policy* suggests a central bank's policy toward the supply of money or the level of some monetary aggregate.

In recent decades, however, central banks have moved away from a direct focus on measures of the money supply. The primary focus of monetary policy has instead become the value of a short-term interest rate. In the United States, for example, the Federal Reserve's Federal Open Market Committee (FOMC) announces a rate that it wishes to prevail in the federal funds market, where overnight loans are made among commercial banks. The tools of monetary policy are then used to guide the market interest rate toward the chosen target. For this reason, we follow the common practice of using the term *monetary policy* to refer to a central bank's interest rate policy.

It is important to realize, however, that the quantity of money and monetary policy remain fundamentally linked under this approach. Commercial banks hold money in the form of reserve balances at the central bank; these balances are used to meet reserve requirements and make interbank

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payments. The quantity of reserve balances demanded by banks varies inversely with the short-term interest rate because this rate represents the opportunity cost of holding reserves. The central bank aims to manipulate the supply of reserve balances—for example, through open market operations that exchange reserve balances for bonds—so that the marginal

[The] link between money and monetary policy can generate tension with central banks' other objectives because bank reserves play other important roles in the economy.

value of a unit of reserves to the banking sector equals the target interest rate. The interbank market for short-term funds will then clear with most trades taking place at or near the target rate. In other words, the quantity of money (especially reserve balances) is chosen by the central bank in order to achieve its interest rate target.

This link between money and monetary policy can generate tension with central banks' other objectives because bank reserves play other important roles in the economy. In particular, reserve balances are used to make interbank payments; thus, they serve as the final form of settlement for a vast array of transactions. The quantity of reserves needed for payment purposes typically far exceeds the quantity consistent with the central bank's desired interest rate. As a result, central banks must perform a balancing act, drastically increasing the supply of reserves during the day for payment purposes through the provision of *daylight reserves* (also called *daylight credit*) and then shrinking the supply back at the end of the day to be consistent with the desired market interest rate.

Recent experience has shown that central banks perform this balancing act well most of the time. Nevertheless, it is important to understand the tension between the daylight and overnight need for reserves and the potential problems that may arise. One concern is that central banks typically provide daylight reserves by lending directly to banks, which may expose the central bank to substantial credit risk. Such lending may also generate moral hazard problems and exacerbate the too-big-to-fail problem, whereby regulators would be reluctant to close a financially troubled bank.

The tension is clearest during times of acute stress in financial markets. In the days following September 11, 2001, for example, the Federal Reserve provided an unusually large quantity of reserves in order to promote the efficient functioning of the payments system and financial markets more generally. As a result of this action, the fed funds rate fell substantially below the target level for several days.[1]

During the financial turmoil that began in August 2007, the tension was much longer lasting. Sharp increases in spreads between the yields on liquid and illiquid assets indicated a classic *liquidity shortage*: an increased demand for liquid assets relative to their illiquid counterparts. By increasing the supply of the most liquid asset in the economy—bank reserves—the Federal Reserve could likely have eased the shortage and helped push spreads back toward more normal levels. Doing so, however, would have driven the market interest rate below the FOMC's target rate and thus interfered with monetary policy objectives. Instead, the Federal Reserve developed new, indirect methods of supplying liquid assets to the private sector, such as providing loans of Treasury securities against less liquid collateral through the Term Securities Lending Facility.

Recently, attention has turned to an alternative approach to monetary policy implementation that has the potential to eliminate the basic tension between money and monetary

It is important to understand the tension between the daylight and overnight need for reserves and the potential problems that may arise.

policy by effectively "divorcing" the quantity of reserves from the interest rate target. The basic idea behind this approach is to remove the opportunity cost to commercial banks of holding reserve balances by paying interest on these balances at the prevailing target rate. Under this system, the interest rate paid on reserves forms a *floor* below which the market rate cannot fall. The supply of reserves could therefore be increased substantially without moving the short-term interest rate away from its target. Such an increase could be used to provide liquidity during times of stress or to reduce the need for daylight credit on a regular basis.[2] A particular version of the "floor-system" approach has recently been adopted by the Reserve Bank of New Zealand.

It should be noted that adopting a floor-system approach requires the central bank to pay interest on reserves, something

[1] Intraday volatility of the fed funds rate remained high, with trades being executed far from the target rate, for several weeks. See McAndrews and Potter (2002) and Martin (forthcoming) for detailed discussions.

[2] This approach has been advocated in various forms by Woodford (2000), Goodfriend (2002), Lacker (2006), and Whitesell (2006b).

the Federal Reserve has historically lacked authorization to do. However, the Financial Services Regulatory Relief Act of 2006 will give the Federal Reserve, for the first time, explicit authority to pay interest on reserve balances, beginning on October 1, 2011. A floor system will therefore soon be a feasible option for monetary policy implementation in the United States.

In this article, we present a simple, graphical model of the monetary policy implementation process to show how the floor system divorces money from monetary policy. Our aim is to present the fundamental ideas in a way that is accessible to a broad audience. Section 2 describes the process by which monetary policy is currently implemented in the United States and in other countries. Section 3 discusses the tensions that can arise in this framework between monetary policy and payments/liquidity policy. Section 4 illustrates how the floor system works; it also discusses potential issues associated with adopting this type of system in a large economy such as the United States. Section 5 concludes.

2. An Overview of Monetary Policy Implementation

In this section, we describe a stylized model of the process through which many of the world's central banks implement monetary policy. Our model focuses on the relationship between the demand for reserve balances and the interest rate in the interbank market for overnight loans. Following Poole (1968), a variety of papers have developed formal models of portfolio choice by individual banks and derived the resulting aggregate demand for reserves.[3] Our graphical model of aggregate reserve demand is consistent with these more formal approaches. We first discuss the system currently used in the United States and then describe a symmetric channel system, as used by a number of other central banks.

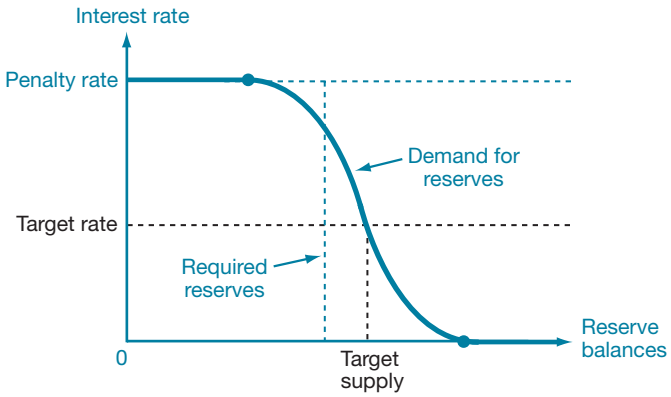
2.1 Monetary Policy Implementation in the United States

We begin by examining the total demand for reserve balances by the U.S. banking system. In our stylized framework, this demand is generated by a combination of two factors. First, banks face reserve requirements. If a bank's final balance is smaller than its requirement, it pays a penalty that is proportional to the shortfall. Second, banks experience unanticipated late-day payment flows into and out of their reserve account after the interbank market has closed. A bank's final reserve balance, therefore, may be either higher or lower than the quantity of reserves it chooses to hold in the interbank market. This uncertainty makes it difficult for a bank to satisfy its requirement exactly and generates a "precautionary" demand for reserves.

For simplicity, we abstract from a number of features of reality that, while important, are not essential to understanding the basic framework. For example, we assume that reserve requirements must be met on a daily basis, rather than on average over a two-week reserve maintenance period. Alternatively, one can interpret our model as applying to *average* reserve balances (and the average overnight interest rate) over a maintenance period. In addition, we do not explicitly include vault cash in the analysis, using the terms *reserve balances* and *reserves* interchangeably.[4]

Exhibit 1 presents the aggregate demand for reserves in our framework. The horizontal axis measures the total quantity of reserve balances held by banks while the vertical axis measures the market interest rate for overnight loans of these balances. The *penalty rate* labeled on the vertical axis represents the interest rate a bank pays if it must borrow funds at the end of

Exhibit 1
Monetary Policy Implementation in the United States



[3] Recent contributions include Furfine (2000), Guthrie and Wright (2000), Bartolini, Bertola, and Prati (2002), Clouse and Dow (2002), Whitesell (2006a, b), and Ennis and Weinberg (2007).

[4] Required reserves should therefore be interpreted as a bank's requirement net of its vault cash holdings. To the extent that vault cash holdings are independent of the overnight rate, at least over short horizons, including them in our model would have no effect. We also abstract from the Contractual Clearing Balance program, which allows banks to earn credit for priced services at the Federal Reserve by holding a contractually agreed amount of reserves in excess of their requirement; these contractual arrangements, once set, act much like reserves requirements.

the period to meet its requirement. One can interpret this penalty rate as the interest rate charged at the Federal Reserve's primary credit facility (the discount window), adjusted by any "stigma" costs that banks perceive to be associated with

The . . . demand for reserve balances will vary inversely with the market interest rate, since this rate represents the opportunity cost of holding reserves.

borrowing at this facility. The important feature of the penalty rate is that it lies above the FOMC's target interest rate.[5]

To explain the shape of the demand curve in the exhibit, we ask: given a particular value for the interest rate, what quantity of reserve balances would banks demand to hold if that rate prevailed in the interbank market? First, note that if the market interest rate were above the penalty rate, there would be an arbitrage opportunity: banks could borrow reserves at the (lower) penalty rate and lend them at the (higher) market interest rate. If the market interest rate were exactly equal to the penalty rate, however, banks would be willing to hold some reserve balances toward meeting their requirements. In fact, each bank would be indifferent between holding reserves directly and borrowing at the penalty rate as long as it is sure that late-day payment inflows will not leave it holding excess balances at the end of the day. As a result, the demand curve is flat—reflecting this indifference—at the level of the penalty rate for sufficiently small levels of reserve balances.

For interest rates below the penalty rate, each bank will choose to hold a quantity of reserves that is close to the level of its requirement; hence, aggregate reserve demand will be close to the total level of required reserves. However, as described above, banks face uncertainty about their final account balance that prevents them from being able to meet their requirement exactly. Instead, each bank must balance the possibility of falling short of its requirement—and being forced to pay the penalty rate—against the possibility that it will end up holding more reserves than are required. As no interest is paid on reserves, holding excess balances is also costly. The resulting demand for reserve balances will vary inversely with the market interest rate, since this rate represents the opportunity cost of holding reserves. The less expensive it is to hold precautionary reserve balances, the greater the quantity demanded by the banking system will be. This reasoning generates the downward-sloping part of the demand curve in the exhibit.

If the market interest rate were very low—close to zero—the opportunity cost of holding reserves would be very small. In this case, each bank would hold enough precautionary reserves to be virtually certain that unforeseen payment flows will not decrease its reserve balance below the required level. In other words, each bank would choose to be "fully insured" against the possibility of falling short of its requirements. The point in Exhibit 1 where the demand curve intersects the horizontal axis represents the total of this fully insured quantity of reserve balances for all banks. The banking system will not demand more than this quantity of reserve balances as long as there is some opportunity cost, no matter how small, of holding these reserves.

If the market interest rate were exactly zero, however, there would be no opportunity cost of holding reserves. In this limiting case, there is no cost at all to a bank of holding additional reserves above the fully insured amount. The demand curve is therefore flat along the horizontal axis after this point; banks are indifferent between any quantities of reserves above the fully insured amount when the market interest rate is exactly zero.

Needless to say, our model of reserve demand abstracts from important features of reality. Holding more reserves, for example, might require a bank to raise more deposits and subject it to higher capital requirements. Nevertheless, the model is useful because it lays out, in perhaps the simplest way possible, the basic relationship between the market interest rate and the demand for reserves that results from the optimal portfolio decisions of banks. Moreover, small changes in the shape of the demand curve would have no material effect on the analysis that follows.

The equilibrium interest rate in our model is determined by the height of the demand curve at the level of reserve balances supplied by the Federal Reserve. If the supply is smaller than the total amount of required reserves, for example, the equilibrium interest rate would be near the penalty rate. If, however, the supply of reserves were very large, the equilibrium interest rate would be zero. Between these two extremes, on the downward-sloping portion of the demand curve, there is a *liquidity effect* of reserve balances on the market interest

[5] The interest rate charged on discount window loans has been set above the FOMC's target rate since the facility was redesigned in 2003. The gap between the two rates was initially set at 100 basis points, but has since been lowered to 50 basis points (in August 2007) and to 25 basis points (in March 2008). In addition, there is evidence that banks attach a substantial nonpecuniary cost to borrowing from the discount window, as they sometimes borrow in the interbank market at interest rates significantly higher than the discount window rate. These stigma costs may reflect a fear that other market participants will find out about the loan and interpret it as a sign of financial weakness on the part of the borrowing bank.

rate: a higher supply of reserves will lower the equilibrium interest rate.[6]

As shown in the exhibit, there is a unique level of reserve supply that will lead the market to clear at the FOMC's announced target rate; we call this level the *target supply*. Monetary policy is implemented through open market operations that aim to set the supply of reserves to this target level. This process requires the Fed's Open Market Desk to accurately forecast both reserve demand and changes in the existing supply of reserves attributable to autonomous factors such as payments into and out of the Treasury's account. Forecasting errors will lead the actual supply to deviate from the target and, hence, will cause the market interest rate to differ from the target rate. In our simple model, the downward-sloping portion of the demand curve may be quite steep, indicating that relatively small forecasting errors could lead to substantial interest rate volatility. In reality, a variety of institutional arrangements, including reserve maintenance periods, are designed to flatten this curve and thus limit the volatility associated with forecasting errors.[7]

Monetary policy is implemented in the United States by changing the supply of reserves in such a way that the fed funds market will clear at the desired rate. In other words, the stock of "money" is set in order to achieve a monetary policy objective.

The key point of this discussion is that monetary policy is implemented in the United States by changing the supply of reserves in such a way that the fed funds market will clear at the desired rate. In other words, the stock of "money" is set in order to achieve a monetary policy objective. This direct relationship between money and monetary policy generates the tensions that we discuss in Section 3.

[6] See Hamilton (1997), Carpenter and Demiralp (2006a), and Thornton (2006) for empirical evidence of this liquidity effect.

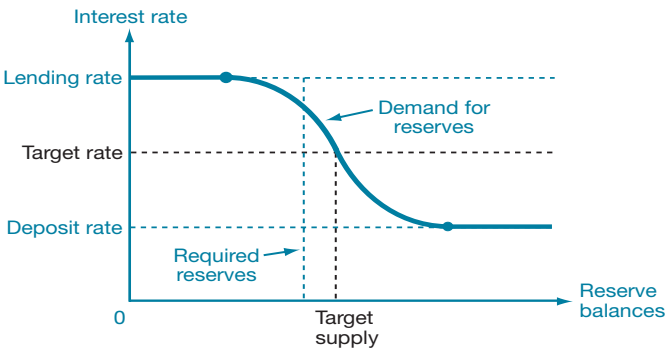
[7] See Ennis and Keister (2008) for a detailed discussion of interest rate volatility in this basic framework. See Whitesell (2006a) for a formal model of the "flattening" effect of reserve maintenance periods.

2.2 Symmetric Channel Systems

Many central banks use what is known as a symmetric *channel* (or *corridor*) system for monetary policy implementation. Such systems are used, for example, by the European Central Bank (ECB) and by the central banks of Australia, Canada, England, and (until spring 2006) New Zealand. The key features of a symmetric channel system are standing central bank facilities that lend to and accept deposits from commercial banks. The lending facility resembles the discount window in the United States; banks are permitted to borrow freely (with acceptable collateral) at an interest rate that is a fixed number of basis points above the target rate. The deposit facility allows banks to earn overnight interest on their excess reserve holdings at a rate that is the same number of basis points below the target. In this way, the interest rates at the two standing facilities form a "channel" around the target rate.

Exhibit 2 depicts the demand for reserve balances in a symmetric channel system. The curve looks very similar to that in Exhibit 1. There is no demand for reserves in the interbank market if the interest rate is higher than the rate at the lending facility.[8] For lower values of the market rate, the demand is decreasing in the interest rate—and hence the liquidity effect is present—for exactly the same reasons as before. Banks choose their reserve holdings to balance the potential costs of falling short of their requirement against the potential costs of ending with excess reserves. When the opportunity cost of holding reserves is lower, banks' precautionary demand for reserves will be larger.

Exhibit 2
A Symmetric Channel System of Monetary Policy Implementation



[8] The lending facility in a channel system is typically designed in a way that aims to minimize stigma effects. For this reason, we begin the demand curve in Exhibit 2 at the lending rate instead of at a penalty rate that includes stigma effects, as was the case in Exhibit 1.

The new feature in Exhibit 2 is that the demand curve does not decrease all the way to the horizontal axis, but instead becomes flat at the deposit rate. In other words, the deposit rate forms a *floor* below which the demand curve will not fall. If the market rate were below the deposit rate, an arbitrage opportunity would exist—a bank could borrow at the (low) market rate and earn the (higher) deposit rate on these funds, making a pure profit. The demand for reserves would be unbounded in this case; such arbitrage activity would quickly drive up the market rate until it at least equals the deposit rate.

The demand curve is flat at the deposit rate for the same reason it was flat on the horizontal axis in Exhibit 1. If the market rate were exactly equal to the deposit rate, banks would face no opportunity cost of holding excess reserves. Holding additional funds on deposit and lending them would yield exactly the same return. Banks would therefore be indifferent between any quantities of reserves above the fully insured amount. In other words, paying interest on excess reserves raises the floor where the demand curve is flat from an interest rate of zero (as in Exhibit 1) to the deposit rate (as in Exhibit 2).

[In a symmetric channel system,] the target interest rate determines, through the demand curve, a target supply of reserves, and the central bank aims to change total reserve supply to bring it as close as possible to this target.

The equilibrium interest rate is determined exactly as before, by the height of the demand curve at the level of reserve balances supplied by the central bank. Monetary policy is thus implemented in much the same way as it is in the United States. The target interest rate determines, through the demand curve, a target supply of reserves, and the central bank aims to change total reserve supply to bring it as close as possible to this target. Importantly, the link between money and monetary policy remains: the quantity of reserves is set in order to achieve the desired interest rate.

The symmetric channel systems used by various central banks differ in a variety of important details. The Bank of England and the ECB operate relatively wide channels, with the standing facility rates 100 basis points on either side of the target. Australia and Canada, in contrast, operate narrow channels, where this figure is only 25 basis points. Australia and Canada have no required reserves; in this case, the demand curve in Exhibit 2 shifts to the left so that the "required reserves" line lies on the vertical axis. The important point here, however, is that regardless of these operational details, a symmetric channel system links the quantity of reserves to the central bank's interest rate target, exactly as in the U.S. system.

3. Payments, Liquidity Services, and Reserves

The link between money and monetary policy described above can generate tension with central banks' other objectives, particularly those regarding the payments system and the provision of liquidity. Reserve balances are useful to banks, and to the financial system more generally, for purposes other than simply meeting reserve requirements. Banks use reserve balances to provide valuable payment services to depositors. In addition, these balances assist the financial sector in allocating other, less liquid assets. Since reserves are a universally accepted asset, they can be exchanged more easily for other assets than any substitute. Finally, reserve balances serve as a perfectly liquid, risk-free store of value, which is particularly useful during times of market turmoil. Because reserves play these other important roles, the quantity of reserve balances consistent with the central bank's monetary policy objective may at times come into conflict with the quantity that is desirable for other purposes. In this section, we describe some of the tensions that can arise.

3.1 Payments Policy

The value of the payments made during the day in a central bank's large-value payments system is typically far greater than the level of reserve balances held by banks overnight. (In the United States, for example, during the first quarter of 2008 the average daily value of transactions over the Fedwire Funds Service was approximately *185 times* the value of banks' total balances on deposit at the Federal Reserve.) The discrepancy has widened in recent decades as most central banks have adopted a real-time gross settlement (RTGS) design for their large-value payments system, which requires substantially larger payment flows than earlier designs based on netting of payment values.[9]

As a result, banks' overnight reserve holdings are too small to allow for the smooth functioning of the payments system

[9] See Bech and Hobijn (2007) for an analysis of the adoption of RTGS systems by various central banks.

during the day. When reserves are scarce or costly during the day, banks must expend resources in carefully coordinating the timing of their payments. If banks delay sending payments to economize on scarce reserves, the risk of an operational failure or gridlock in the payments system tends to increase. The combination of limited overnight reserve balances and the much larger daylight demand for reserves thus creates tension between a central bank's monetary policy and its payments policy. The central bank would like to increase the total supply of reserve balances for payment purposes, but doing so would interfere with its monetary policy objectives.

The value of the payments made during the day in a central bank's large-value payments system is typically far greater than the level of reserve balances held by banks overnight . . . . As a result, banks' overnight reserve holdings are too small to allow for the smooth functioning of the payments system during the day.

This tension has led to a common practice among central banks of supplying additional reserves to the banking system for a limited time during the day. These daylight reserves (also called *daylight credit*) are typically lent directly to banks. Many central banks provide daylight reserves against collateral at no cost to banks. The Federal Reserve currently supplies daylight credit to banks on an uncollateralized basis for a small fee.[10] In providing daylight reserves, a central bank aims to allow banks to make their payments during the day smoothly and efficiently while limiting its own exposure to credit risk.

Under normal circumstances, this process of expanding the supply of reserves during the day and shrinking it back overnight works well; banks make payments smoothly and the central bank implements its target interest rate. However, this balancing act is not without costs. Lending large quantities of reserves to banks each day exposes the central bank to credit risk. While requiring collateral for these loans mitigates credit risk, it is an imperfect solution. If collateral is costly for banks to hold or create, the requirement imposes real costs. Moreover, collateralizing daylight loans simply moves the central bank's claims ahead of the deposit insurance fund in the event of a bank failure, without necessarily reducing the overall risk of the consolidated public sector.

Routine daylight lending by the central bank may also create moral hazard problems, leading banks to hold too little liquidity and, perhaps, take on too much risk. In addition, such lending might make regulators more reluctant to close a financially troubled bank promptly, exacerbating the well-known too-big-to-fail problem. Even if each of these costs is relatively small in normal times, their sum should be considered part of the tension generated by the link between money and monetary policy.

3.2 Liquidity Policy

In times of stress or crisis in financial markets, the tension between monetary policy and central banks' other objectives can become acute. After the destructive events of September 11, 2001, the Federal Reserve recognized that the quantity of overnight reserves consistent with the target fed funds rate was too small to adequately address banks' reluctance to make payments in a timely manner. The FOMC released a statement on September 17, 2001, that, in addition to lowering the target fed funds rate, stated:

> The Federal Reserve will continue to supply unusually large volumes of liquidity to the financial markets, as needed, until more normal market functioning is restored. As a consequence, the FOMC recognizes that the actual federal funds rate may be below its target on occasion in these unusual circumstances.[11]

In this statement, the FOMC explicitly recognized the tension between maintaining the market interest rate at its target level and supplying more reserves to meet the demand for financial market settlements. On September 18 and 19, the effective fed funds rate was close to 1¼ percent while the target rate was 3 percent.

Exhibit 1 is again useful to help illustrate what happened. To meet the demand for reserves for financial settlements in various markets, the Fed increased the supply of reserve balances. A shift in the supply curve to the right implies that intersection with the demand curve will occur at a lower interest rate.[12] In this case, it was not possible to achieve simultaneously the interest rate target and the increase in overnight reserves necessary to ensure the efficient functioning

[10] See Board of Governors of the Federal Reserve System (2008b) for a proposal to change the Federal Reserve's method of supplying daylight reserves. Under this proposal, banks would be able to obtain daylight reserves either on a collateralized basis at no cost or on an uncollateralized basis for a higher fee. For a general discussion of the Federal Reserve's policies on daylight credit, see Board of Governors of the Federal Reserve System (2007).

[11] See <http://www.federalreserve.gov/boarddocs/press/general/2001/20010917>.

of financial markets in conditions of stress. The exact same tension would arise under a symmetric channel system. Note, however, that the channel places a limit on how far the market interest rate can deviate from the target—it cannot fall below the deposit rate.

During the events of September 2001, the fed funds rate was below its target for only a few days and thus likely had no impact on monetary policy objectives, as expectations were that the target rate would quickly be reestablished. It is an instructive episode, however, in that it demonstrates how increasing the supply of reserve balances available to the banking system can support market liquidity, and how this objective can interfere with the maintenance of the target interest rate.

The Federal Reserve faced a different type of liquidity issue during the financial market turmoil that began in August 2007. In this case, there was a sharp decline in . . . broad liquidity: the ease with which assets in general can be sold or used as collateral at a price that appropriately reflects the expected value of the asset's future dividends.

The Federal Reserve faced a different type of liquidity issue during the financial market turmoil that began in August 2007. In this case, there was a sharp decline in what Goodfriend (2002) calls *broad liquidity*: the ease with which assets in general can be sold or used as collateral at a price that appropriately reflects the expected value of the asset's future dividends. Goodfriend argues that increasing the supply of bank reserves can also support the level of broad liquidity in financial markets. This is especially true if the central bank uses the newly created reserves to purchase (or lend against) relatively illiquid assets, thereby increasing the total quantity of liquid assets held by the private sector. However, once again the link between money and monetary policy generates a tension; the central bank cannot pursue an independent "liquidity policy" using bank reserves. Any attempt to increase reserve balances for the purpose of providing additional liquidity would lead to a lower short-term interest rate and, hence, would change the stance of monetary policy.

Goodfriend (2002, p. 4) points out that central banks can use other, less direct methods of managing broad liquidity:

> To some degree, the Fed can already manage broad liquidity under current operating procedures by changing the composition of its assets, for example, by selling liquid short-term Treasury securities and acquiring less liquid longer term securities. However, the government debt injected into the economy in this way would not be as liquid as newly created base money. More importantly, the Fed's ability to affect broad liquidity in this way is strictly limited by the size of its balance sheet.

Interestingly, one of the new facilities introduced by the Fed in response to the market turmoil closely resembled the policy described by Goodfriend. The Term Securities Lending Facility, introduced in March 2008, provides loans of Treasury securities using less liquid assets as collateral.[13] These loans increase broad liquidity by raising the total supply of highly liquid assets (reserves plus Treasury securities) in the hands of the private sector and decreasing the supply of less liquid assets. However, as Goodfriend observes, the amount of broad liquidity that can be provided through such a facility is strictly limited by the quantity of Treasury securities owned by the central bank. Thus, while a central bank can pursue a policy based on changes in the composition of its assets, such a policy has inherent limitations. As we discuss in Section 4, alternative methods of monetary policy implementation allow the central bank to overcome this limitation by pursuing a liquidity policy based directly on bank reserves.

3.3 Efficient Allocation of Resources

Another tension generated by the typical methods of monetary policy implementation described earlier relates to efficiency concerns. These methods rely on banks facing an opportunity cost of holding reserves; their balances earn no interest in the U.S. system and earn less than the prevailing market rate in a symmetric corridor. This opportunity cost helps generate the downward-sloping part of the demand curve that the central bank uses to implement its target interest rate. The fact that

[12] Needless to say, the disruption in financial markets would also tend to increase the demand for reserves, shifting the curve in Exhibit 1 to the right. The FOMC's statement indicates a desire to more than compensate for this shift, that is, to increase reserve supply beyond the point that would maintain the target interest rate given the increased reserve demand.

[13] The Fed also introduced other facilities, including the Term Auction Facility and the Primary Dealer Credit Facility. Those facilities make loans of reserve balances. In order to maintain the target interest rate, however, the Fed uses open market operations to "sterilize" these loans, leaving the total supply of reserve balances unaffected.

holding reserves is costly, however, conflicts with another central bank objective: the desire to promote the efficient functioning of financial markets and the efficient allocation of resources more generally.

Remunerating reserve balances at a below-market interest rate is effectively a tax on holding these balances. (Box 1 discusses how this tax is distortionary when applied to required reserves.) Similar logic shows that a distortion arises when banks face an opportunity cost of holding *excess* reserves. In this case, the tax leads banks to invest real resources in economizing on their holdings of excess reserves, but these efforts produce no social benefit.

Reserve balances are costless for a central bank to create through open market operations, for example, that exchange newly created reserves for Treasury securities. If banks perceive an opportunity cost of holding reserves (relative to Treasury securities, say), then they will engage in socially inefficient efforts to reduce their use of reserves. In other words, the tax places a wedge between a private marginal rate of substitution and the corresponding social marginal rate of transformation. This type of distortion was emphasized by Friedman (1959, pp. 71-5), who argues that the central bank should pay interest on all reserve balances at the prevailing market interest rate.[14]

Another tension generated by the typical methods of monetary policy implementation . . . relates to efficiency concerns.

One might be tempted to suppose that the distortions created by this tax must be small because the quantity of excess reserves held by banks is currently fairly small in the United States, around $1.5 billion. Such a conclusion is not warranted, however: the fact that the tax base is small does not imply that the deadweight loss associated with the tax is insignificant. The deadweight loss includes all efforts banks expend to avoid holding excess reserves, including closely monitoring end-of-day and end-of-maintenance-period balances so that any

[14] This logic is central to the well-known *Friedman rule*, which calls for the central bank to eliminate the opportunity cost of holding all types of money (see especially Friedman [1969]). One way to implement this rule is by engineering a deflation that makes the real return on holding currency equal to the risk-free return. In this case, no interest needs to be paid on any form of money; the deflation generates the required positive return. In practice, there are a variety of concerns about deflation that keep central banks from following this approach. When applied to the narrower question of reserve balances held at the central bank, however, Friedman's logic simply calls for remunerating all reserve balances at the risk-free rate.

Box 1

Required Reserves

Although this article emphasizes the similarities in monetary policy implementation procedures across countries, there are a number of differences. One notable difference is in the use of reserve requirements. Banks in the United States and the Euro zone are required to hold reserves in proportion to certain liabilities. In other countries, including Australia and Canada, banks are not required to hold any reserves; the only requirement is that a bank's reserve account not be in overdraft at the end of the day.

In the simple framework we describe, it is immaterial whether banks face a positive reserve requirement or the requirement is effectively zero. In reality, however, there are important differences between these approaches. One such difference is that reserve requirements allow the central bank to implement reserve averaging, whereby banks are allowed to meet their requirement on average over a reserve maintenance period rather than every day. As shown in Whitesell (2006a), reserve averaging tends to flatten the demand curve for reserves around the central bank's target supply on all days of a maintenance period except the last one; this flattening tends to reduce volatility in the market interest rate.[a] Another important difference is the extent of the distortions associated with bank reserve holdings. When required reserve balances do not earn interest, as is currently the case in the United States, the requirement acts as a tax on banks. This *reserve tax* raises banks' operating costs and drives a wedge between the price of banking services and the social cost of producing those services, creating a deadweight loss. The reserve tax also gives banks a strong incentive to find ways to decrease their requirements, such as by sweeping customers' checking account balances on a daily basis into other accounts not subject to reserve requirements. The efforts invested in these reserve-avoidance activities are clearly wasted from a social point of view.

Paying interest on required reserves at the prevailing market rate of interest, as the European Central Bank does, eliminates most of these distortions. The Bank of England goes a step further by having banks set *voluntary* balance targets. Once set, these targets can be used to implement monetary policy exactly the same way that reserve requirements are. However, because the targets are chosen by the individual banks, rather than being determined administratively, their creation generates none of the distortions associated with traditional reserve requirements.

[a] See Ennis and Keister (2008) for a detailed discussion of reserve averaging in the type of framework used here.

excess funds can be lent out, as well as actually lending the funds out. A substantial fraction of activity in the fed funds market is precisely of this type, and it is not clear whether these indirect costs associated with the tax are small.

The issues created by the reserve tax are sometimes described as a "hot potato" problem. Participants all try to get rid of excess reserves because holding them is costly. However, the supply of excess reserve balances is fixed by the central bank and, at any point in time, someone must be holding them. Extending this analogy a bit, the fact that the potato itself (that is, the quantity of excess reserve balances) is small does not imply that that the efforts spent passing it along are also small. This is especially true if the potato is very hot, that is, if excess reserve balances earn much less than the market rate of interest.

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Lucas (2000, p. 247) describes the deadweight loss associated with the inflation tax in a similar way:

> In a monetary economy, it is in everyone's private interest to try to get someone else to hold non-interest-bearing cash and reserves. But someone has to hold it all, so all of these efforts must simply cancel out. All of us spend several hours per year in this effort, and we employ thousands of talented and highly trained people to help us. These person-hours are simply thrown away, wasted on a task that should not have to be performed at all.

Any system of monetary policy implementation that relies on banks facing an opportunity cost of holding reserves necessarily creates deadweight losses. The approaches described in the previous section thus conflict with a central bank's desire to promote an efficient allocation of resources in the economy.

We summarize by noting that a central bank's payments policy, liquidity policy, and desire to promote efficient allocation may all come into conflict with its monetary policy objectives. The tension created by these conflicts tends to be particularly strong during periods of stress in financial markets. These tensions would be reduced or would disappear altogether if banks did not face an opportunity cost of holding overnight reserves that leads them to economize on their holdings. In the next section, we describe an approach to implementing monetary policy that removes this opportunity cost and discuss some of its implications.

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4. Divorcing Money from Monetary Policy

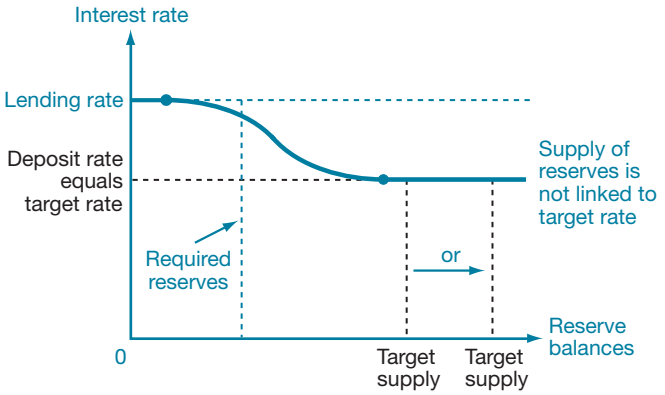
The tensions we described all arise from the fact that, under either current U.S. practice or a symmetric channel system, the quantity of reserve balances must be set to a particular level in order for the central bank's interest rate target to be achieved. There are, however, other approaches to monetary policy implementation in which this strict link between money and monetary policy is not present. Here we discuss one such approach, which can be described as a *floor-target channel system*, or simply a *floor system*. This approach is a modified version of the channel system described above and has been advocated in various forms by Woodford (2000), Goodfriend (2002), Lacker (2006), and Whitesell (2006b). A particular type of floor system has recently been adopted by the Reserve Bank of New Zealand.

4.1 The Floor System

Starting from the symmetric channel system presented in Exhibit 2, suppose that the central bank makes two

Exhibit 3

A Floor System of Monetary Policy Implementation



modifications. First, the deposit rate is set *equal to* the target rate, instead of below it. In other words, in this system the central bank targets the *floor* of the channel, rather than some point in the interior. Second, the reserve supply is chosen so that it intersects the flat part of the demand curve generated by the deposit rate (Exhibit 3), rather than intersecting the downward-sloping part of the curve. Supply and demand will then cross exactly at the target rate, as desired.[15]

The key feature of this system is immediately apparent in the exhibit: the equilibrium interest rate no longer depends on the exact quantity of reserve balances supplied. Any quantity that is large enough to fall on the flat portion of the demand curve will implement the target rate. In this way, a floor system "divorces" the quantity of money from the interest rate target and, hence, from monetary policy. This divorce gives the central bank two separate policy instruments: the interest rate target can be set according to the usual monetary policy concerns, while the quantity of reserves can be set independently.

If the quantity of reserves is no longer determined by monetary policy concerns, how should it be set? In general, the supply of overnight reserve balances could be used to ease any of the tensions described earlier. For example, Lacker (2006) suggests that increasing the supply of overnight reserves could reduce banks' use of daylight credit without impairing their ability to make timely payments. In fact, he argues that if overnight reserve balances are increased by the maximum amount of current daylight credit use, then "in principle, any pattern of intraday payments that is feasible under the current policy would still be feasible" even in the extreme case where access to daylight credit is eliminated altogether. Note that restricting access to daylight credit will tend to increase the demand for overnight reserves, shifting the curve in Exhibit 3 to the right. The proposal in Lacker (2006) thus calls for increasing the supply of reserves enough to ensure that it falls on the flat portion of the demand curve even after this shift is taken into account.[16]

Goodfriend (2002) takes a different view, proposing that the supply of reserve balances could be used to stabilize financial markets. The central bank could, for example, "increase bank reserves in response to a negative shock to broad liquidity in banking or securities markets or an increase in the external finance premium that elevated spreads in credit markets" (p. 4). More generally, he suggests that the supply of reserves could be set to provide the optimal quantity of broad liquidity services.[17] It should be noted that there may be complementarity between payments policy and liquidity policy with respect to reserve balances; increasing the reserve supply to support broad liquidity can simultaneously reduce the use of daylight overdrafts, which might be particularly desirable during times of market turmoil.

A floor system "divorces" the quantity of money from the interest rate target and, hence, from monetary policy. This divorce gives the central bank two separate policy instruments: the interest rate target can be set according to the usual monetary policy concerns, while the quantity of reserves can be set independently.

The floor system also promotes a more efficient allocation of resources. Not only does this approach eliminate the reserve tax, it also removes the opportunity cost of holding *excess*

[15] The fact that these supply and demand curves cross at the target rate does not imply that trades in the interbank market would occur at exactly this rate. A bank would require a small premium, reflecting transaction costs and perhaps credit risk, in order to be willing to lend funds rather than simply hold them as (interest-bearing) reserves. As a result, the measured interest rate in the interbank market would generally be slightly above the deposit rate. The target rate could instead be called the *policy rate* in order to make this distinction clear.

[16] See Ennis and Weinberg (2007) for a formal analysis of the relationship between daylight credit and monetary policy implementation, including the ability of a floor system to reduce daylight credit usage.

[17] Determining this optimal quantity is a nontrivial task, however, and would likely require more research on the notion of broad liquidity and its role in the macroeconomy. The quantitative easing policy in place in Japan from 2001 to 2006 can be viewed as an attempt to use the supply of bank reserves to influence macroeconomic outcomes.

reserve balances. This is true for any quantity of reserve balances large enough to lie on the flat portion of the demand curve in Exhibit 3. At such points, banks are indifferent at the margin between reserves and other risk-free assets. As a result, they no longer have an incentive to invest real resources in order to economize on their reserve holdings, and the deadweight loss associated with the systems described in Section 3 disappears.

Woodford (2000) points to another advantage of the floor system. Suppose that innovation in financial markets were to undermine the demand for reserve balances that is at the heart of our model in Section 2. In particular, suppose that a perfect substitute for central bank reserves were developed and that banks were able to avoid reserve requirements completely. In such a situation, the demand for reserves would fall to zero if there were *any* opportunity cost of holding them; banks would instead use the substitute private instrument for payment and other liquidity purposes. If the central bank supplied a positive quantity of reserves, under the current system in the United States the market interest rate would fall to zero.

The Reserve Bank of New Zealand recently became the first central bank to implement a floor system. While it is too early to evaluate the effects of this change properly, some benefits—such as improved timeliness of payments—have already been observed.

Woodford argues that even in this extreme situation, the central bank can still implement its target interest rate by using a floor system. Banks would again demand zero reserves at any interest rate higher than the target rate in this situation. However, under a floor system, the demand curve would be flat at the target rate for exactly the same reasons as described above. By setting a positive supply of reserves, therefore, the central bank could still drive the market interest rate to the target value. In this way, a floor system would enable the central bank to meet its monetary policy objectives even if technological changes eliminated the special role currently played by reserves; the key once again is divorcing money from monetary policy.

The Reserve Bank of New Zealand recently became the first central bank to implement a floor system (Box 2). While it is too early to evaluate the effects of this change properly, some benefits—such as improved timeliness of payments—have already been observed. To be sure, the experience of a smaller country like New Zealand with this type of system may not be directly applicable to other central banks. Nevertheless, it will be instructive to observe this experience and, in particular, to see how it compares with the simple framework we present.

4.2 Discussion

While a floor system could potentially relieve or even eliminate the tensions between central bank objectives, there are several important concerns about how such a system would operate in practice and its potential effects on financial markets. One concern is that a floor system would likely lead to a substantial reduction in activity in the overnight interbank market, as banks would have less need to target their reserve balance precisely on a daily basis. In particular, since banks with excess funds can earn the target rate by simply depositing them with the central bank, the incentive to lend these funds is lower than it is under the other approaches to implementation discussed above. Nevertheless, an interbank market would still be necessary, as institutions will occasionally find themselves short of funds. How difficult it would be for institutions to borrow at or near the target rate is an important open question.

In addition, some observers argue that the presence of an active overnight market generates valuable information and that some of this information would be lost if market activity declined. For example, market participants must monitor the creditworthiness of borrowers. If the overnight market were substantially less active, such monitoring may not take place on a regular basis; this in turn could make borrowing even harder for a bank that finds itself short of funds. Such monitoring may also play a socially valuable role in exposing banks to market discipline. It is important to bear in mind, however, that the

While a floor system could potentially relieve or even eliminate the tensions between central bank objectives, there are several important concerns about how such a system would operate in practice and its potential effects on financial markets.

Box 2

The Reserve Bank of New Zealand's Floor System

In July 2006, the Reserve Bank of New Zealand (RBNZ) began the transition from a symmetric channel system of monetary policy implementation to a floor system. We describe some reasons for the change and some features of the new regime, drawing heavily on Nield (2006) and Nield and Groom (2008).

From 1999 to 2006, the RBNZ operated a symmetric channel system with zero reserve requirements. It targeted a supply of NZD 20 million overnight reserve balances every day. All reserve balances were remunerated at a rate 25 basis points below the RBNZ's target interest rate, called the official cash rate (OCR). Payments system participants could borrow reserves overnight against collateral at the overnight reserve repurchase facility (ORRF), at a rate 25 basis points above the OCR. Finally, participants could obtain reserves intraday, against collateral, at an interest rate of zero using a facility called Autorepo.

The RBNZ's decision to change the framework for monetary policy implementation followed signs of stress in the money market. The Government of New Zealand had been running a fiscal surplus for a number of years and government bonds had become increasingly scarce. The scarcity of government securities available to pledge in the Autorepo facility led to delayed payments between market participants. For the same reason, there had been an increase in the levels of underbid open market operations and, consequently, in the use of the bank's standing facilities at the end of the day. Finally, the implied New Zealand dollar interest rates on overnight credit in the foreign exchange (FX) swap market—the primary market by which banks in New Zealand traded overnight—were volatile and often significantly above the target rate desired to implement monetary policy.

The Reserve Bank of New Zealand conducted a review of its liquidity management regime in 2005 and announced the new system in early 2006. Under this system, the RBNZ no longer offers daylight credit. In other words, there is no distinction between daylight and overnight reserves. The target supply of reserves has been vastly increased to allow for the smooth operation of the payments system; the new level currently fluctuates around NZD 8 billion. This represents an increase of 400 times the level under the previous regime. Reserves are now remunerated at the OCR. It is still possible to obtain overnight funds at the ORRF, but at a rate 50 basis points above the OCR.

The bulk of the transition to this new system occurred in four steps over a twelve-week period between July 3 and October 5, 2006. During that time, the target supply of reserves increased gradually to its current level. At each step, the rate earned on reserves and the rate at which funds could be borrowed at the ORRF were increased relative to the OCR in increments of 5 basis points up to their current levels. The set of securities eligible as collateral for Autorepo was reduced until the facility was discontinued on October 5.

Since the new framework was introduced, the RBNZ has implemented two changes. First, banks are now allowed to use a wider set of assets to raise cash from the central bank. In particular, a limited amount of AAA-rated paper is eligible.[a] Second, a tiered system of remuneration was introduced in response to episodes in which the market interest rate rose substantially above the OCR. The RBNZ now estimates the quantity of reserves a bank needs for its payment activity and, based on this estimate, sets a limit on the quantity that will be remunerated at the OCR. Any reserves held in excess of that limit earn a rate 100 basis points below the OCR. This policy is designed to provide an incentive for banks to recirculate excess reserve positions and to prevent them from "hoarding" reserves.

In principle, the RBNZ could have addressed this problem by increasing its supply of reserves instead of by implementing a tiered system. If the market interest rate is significantly higher than the policy rate in a floor system, increasing the supply of reserves should drive the market rate down (see Exhibit 3 in the text). However, the RBNZ uses FX swaps to increase the supply of reserves, and it found that the price in this market was moving against it; the more reserves the RBNZ created, the more costly it became to create those reserves. It is worth noting that this problem would not arise in a country with a large supply of government bonds or with a central bank that can issue its own interest-bearing liabilities. In such cases, increasing the supply of reserves need not be costly and could be an attractive alternative to a tiered system.

While it is too early to evaluate with great confidence all of the effects of the RBNZ's changes, it appears that the transition went smoothly overall. There were, of course, occasional signs of stress in money markets, mostly attributable to the learning process experienced by the Bank and its payments system participants. There are, however, definite positive signs that the liquidity of the interbank market has improved. Notably, payments have been settling significantly earlier since the transition began, suggesting a reduction in the constraints previously attributable to the scarcity of collateral available to pledge in the Autorepo facility. In addition, the implied New Zealand dollar interest rates in the FX swap market are now much less volatile and are well within the 50 basis point band between the official cash rate and the ORRF. Finally, the RBNZ conducts open market operations much less frequently, and the operations are no longer subject to the underbidding that had led to excessive use of overnight facilities.

[a] See the Reserve Bank of New Zealand's May 2008 Financial Stability Report for more details.

market for overnight loans of reserves differs from other markets in fundamental ways. As we discussed, reserves are not a commodity that is physically scarce; they can be costlessly produced by the central bank from other risk-free assets. Moreover, there is no role for socially useful price discovery in this market, because the central bank's objective is to set a particular price. Weighing the costs and benefits of a reduction in market activity is therefore a nontrivial task and an important area for future research.

If desired, the floor system could be modified in ways that encourage higher levels of activity in the overnight interbank market. For example, the central bank could limit the quantity of reserves on which each bank earns the target rate of interest and compensate balances above this limit at a lower rate. Such limits would encourage banks that accumulate unusually large balances over the course of the day to lend them out. By setting lower limits, the central bank would encourage more activity in the interbank market while marginally increasing the distortions discussed above.[18] Whitesell (2006b) presents a system in which banks are allowed to determine their own limits by paying a "capacity fee" proportional to the chosen limit. In this case, the central bank would set the fee schedule in a way that balances concerns about the level of market activity with the resulting level of distortions.

If desired, the floor system could be modified in ways that encourage higher levels of activity in the overnight interbank market.

Another interesting issue is the extent to which a floor system would allow the central bank to restrict access to daylight credit, if it so desired. If access to daylight credit is substantially restricted or removed, the smooth functioning of the payments system may require banks to acquire funds in the market on a timely basis during the day. In principle, this could be accomplished by the development of either an intraday market for reserve balances or a market for precise time-of-day delivery of reserves (see McAndrews [2006] for a discussion of such possibilities). Whether such markets would actually develop and how efficiently they would operate are important open questions.

Going forward, the experience of New Zealand's floor system will provide valuable information on these issues and others that might arise. However, the differences between the financial system of New Zealand and those of economies like the United States will make it difficult to draw definite conclusions. For this reason, it is important to employ the tools of modern economic theory to develop models that are capable of addressing these issues.

5. Conclusion

This article highlights the important similarities in the monetary policy implementation systems used by many central banks. In these systems, there is a tight link between money and monetary policy because the supply of reserve balances must be set precisely in order to implement the target interest rate. This link creates tensions with the central bank's other objectives. For example, the intraday need for reserves for payment purposes is much higher than the overnight demand, which has led central banks to provide low-cost intraday loans of reserves to participants in their payments systems. This activity exposes the central bank to credit risk and may generate problems of moral hazard. The link also prevents central banks from increasing the supply of reserves to promote market liquidity in times of financial stress without compromising their monetary policy objectives. Furthermore, the link relies on banks facing an opportunity cost of holding reserves, which generates deadweight losses and hinders the efficient allocation of resources.

Our study also presents an approach to implementing monetary policy in which this link is severed, leaving the quantity of reserves and the interest rate target to be set independently. In this floor-system approach, interest is paid on reserve balances at the target interest rate. This policy allows the central bank to increase the supply of reserves, perhaps even significantly, without affecting the short-term interest rate. While the floor system has received a fair amount of attention in policy circles recently, there are important open questions about how well such a system will work in practice. Going forward, it will be useful to develop theoretical models of the monetary policy implementation process that can address these questions, as well as to observe New Zealand's experience with the floor system it implemented in 2006.

[18] Ennis and Keister (2008) describe a related approach based on "clearing bands," where banks face a minimum requirement and earn the target rate of interest on balances held up to a higher limit. This approach could be used to encourage activity in the interbank market on the borrowing side (by banks that find themselves below the minimum requirement) as well as on the lending side (by banks that find themselves above the higher limit).

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