

Pragmatic monitoring of financial stability

William Nelson and Wayne Passmore¹

1. Introduction

Early identification of a financial crisis is, almost by definition, difficult. Financial markets are forward looking and, to the degree events can be foreseen, these markets react to the anticipation of a crisis, often defusing or solving the possible crisis in the process. Forward-looking financial markets make it unlikely that a central bank will predict a financial market crisis before, or independently of, financial market participants. However, certain conditions - reduced liquidity, overly restrictive lending policies, increased debt burdens carried by firms or households - are associated with a heightened potential for a financial crisis, and more severe or prolonged financial crises. Thus, both central banks and participants in financial markets have an interest in monitoring these conditions. In addition, some crises might require action by the central bank even when markets are fully informed about the nature and scope of the crisis.

In this paper, we review recent theoretical models of how financial crises can unfold, even when capital markets function well. These different theories suggest the conditions under which such crises are more likely, and which policy responses available to central banks may prove most effective. We then relate these recent theories to the monitoring currently undertaken by the Federal Reserve of financial market activity in the US domestic economy for indications of an elevated potential for a financial crisis.² In the final section we review several episodes of heightened risks of financial instability in the United States during the past decade, relating these periods to the types of crises identified by the formal models, and describing the sources of information the Federal Reserve used to judge the condition of financial markets and the steps the Federal Reserve took in response.

2. Recent theoretical innovations

Before turning to modelling a financial crisis, we should focus first on a definition of a financial crisis. We define a financial crisis, in contrast to an economic crisis, as one where financial institutions associated with the extension of credit to households and businesses are no longer willing to provide credit to investments with positive net present value (as calculated prior to the crisis). For example, if investors rapidly withdraw from the stock market because they no longer have confidence in their ability to model future earnings, then many profitable projects may go unfunded because of this financial market uncertainty. In contrast, if investors withdraw from the stock market because they foresee that future earnings are declining due to a negative economic shock, then only projects with negative present value go unfunded. In this case, the economic crisis may be associated with a stock market collapse, but it is not a financial crisis because the collapse was driven by a lack of profitable investments.

Of course, disentangling a “financial” from an “economic” crisis may well be impossible during a time when the financial markets are in turmoil. However, the role of the central bank is different depending on whether the crisis is economic or financial. In the former case, the central bank is concerned with aggregate demand management, and would probably pursue a policy of monetary easing. In the latter, the central bank is focused on the troubles of particular financial markets or institutions, which may be met by easing monetary policy, but also might be handled by more targeted actions.

¹ The views expressed here are those of the authors and do not necessarily represent those of the Board of Governors or the staff of the Federal Reserve System.

² While the Federal Reserve also monitors international financial developments, we choose to focus exclusively on US domestic markets, both because the literature related to foreign exchange markets is voluminous and somewhat separate from the literature discussed here, and because domestic financial markets are our area of expertise.

In theoretical models the causes of financial crisis fall into three broad groups: investor uncertainty, financial linkages and moral hazard. These divisions are somewhat arbitrary, as many models incorporate elements of all three. However, each suggests a different focus to central bank monitoring.

2.1 Investor uncertainty

The research on financial crises during the 1980s and early 1990s focused on the consequences of the ability of investors to withdraw on demand certain types of bank deposits. This focus arose mainly because the moral hazard associated with deposit insurance had played a major role in the United States' savings and loan debacle.³ Diamond and Dybvig (1983) developed a much lauded model of depositor behaviour, based on depositors' uncertainty about their own need for liquidity. Because of this uncertainty, depositors demand a financial instrument that can be converted to cash on demand. Bank borrowers, meanwhile, desire longer-term loans to finance fundamentally illiquid capital projects. This mismatch in horizons creates both a need for a financial intermediary and the possibility of a financial panic because if many depositors liquidate their deposits early, other depositors who come to the bank later will not receive their promised return.

The possibility of a financial panic in the Diamond and Dybvig model depends on the assumption that banks service each customer in the order they arrive at the bank. Banks promise a certain return in each period of a depositor's life and fulfil this promise for each depositor that comes to the bank and demands early redemption, until the bank's resources are exhausted. If the price of the deposit contract immediately adjusted to reflect the value of the underlying assets as depositors withdrew funds, then a bank run could not materialise.⁴ In addition, as shown by Diamond and Dybvig, with deposit insurance bank runs are eliminated, suggesting that, if bank runs are key to a financial crisis, deposit insurance has solved the problem.

In the Diamond and Dybvig model, bank runs are a "sunspot" phenomenon, meaning that the financial crisis can take place without any reference to and perhaps without any consequence for, economic activity.⁵ If depositors can simply be convinced that their deposits are safe, regardless of the true state of the world, there can be no financial panic. To the degree that a banking crisis is key to financial instability, then this theory would suggest that a central bank can add little in financial crisis management, once a country has a deposit insurance programme. However, the fact that deposit insurance is commonplace among industrialised countries, yet financial crises still occur, suggests that models of bank runs are insufficient for understanding modern financial crises. In addition, as long as illiquid depository institution assets are allowed to be funded with short-term, and in many cases uninsured, liquid instruments, then the traditional role of the central bank as lender of last resort has economic import, regardless of the availability of deposit insurance or other liability guarantees.

Furthermore, households in the United States hold a significant fraction of their portfolios in deposit-like mutual funds. The government cannot credibly guarantee the value of all financial instruments that are similar to demand deposits. One solution, advocated by proponents of "narrow banking" and also by those who desire to extend government guarantees to liabilities beyond deposits, would be to require that investments funded by demand-deposit-like instruments be restricted to short-term assets with readily identified market values. However, under fairly general conditions, the loss of economic output from not funding longer-term, illiquid investments would exceed gains associated with absolute safety (Wallace, 1996). There are significant gains from trade that occur when illiquid assets are financed by the savings of uncertain (and, therefore, risk-averse) investors who desire liquid assets.

³ Of course, bank runs by depositors have been postulated as a source of financial crisis in the United States since the Great Depression of the 1930s. However, some of the empirical evidence seems to weigh against such an interpretation of the causes of the Great Depression (Cole and Ohanian, 1999).

⁴ Furthermore, if depositors are convinced that other depositors will not find it in their interest to withdraw funds from the bank, a bank run cannot develop. Green and Lin (2000) demonstrate that in Diamond and Dybvig's model, the design and maintenance of such an optimal arrangement is straightforward.

⁵ Empirically, banking crises do seem to occur with reference to the macroeconomy, and the effect of banking crises on macroeconomies seems to be mixed, with most such crises seeming to have little effect on the economy, while a few have major consequences (Boyd et al, 2000).

Investors' uncertainty over their needs for liquidity is only one type of uncertainty. If investors have other forms of uncertainty, then other constraints in the Diamond and Dybvig model - particularly the sequential service constraint - may not be needed to generate sunspot equilibria. One example is Lehnert and Passmore (1999), where investors lack full information about the likelihood of investment outcomes. This uncertainty over the probability distributions of investment returns implies investors are pessimistic, meaning that investors are cautious about investing in risky assets. If investors become more pessimistic, they will tend to invest less in risky, productive assets and invest more in safe assets. If the increase in pessimism is sufficient, then a "flight to quality" can develop, resulting in positive expected net present value investment projects being left unfunded.

Like bank runs due to depositor concerns about the liquidity of their deposit, the flight to quality can be a sunspot phenomenon. Investors' fears that investment in the productive sector will be insufficient to generate adequate returns can become self-fulfilling. In the Lehnert and Passmore model, the central bank can offset flights to quality by lowering the return on short-term, safe assets by reducing real interest rates (by lowering nominal rates in the short run, and in the long run by generating inflation). This strategy succeeds in reversing the flight to quality as long as the underlying economy is healthy.

A different way to model investor uncertainty is to assume that investors may have full knowledge of possible investment outcomes, but have poor signals of those outcomes. In traditional theories, investors determine stock prices by discounting cash flows. However, if investors use stock market prices as signals of future cash flows, then positive or negative feedback loops (referred to as "cascades") can be created, where some investors watch and react to the actions of other investors (Subrahmanyam and Titman, 2000). If important sectors of the economy are characterised by increasing returns to scale and large spillover effects (for example, the manufacture of computer software has high fixed costs and low marginal costs, and the profitability of producing the software may be dependent on its acceptance by other software manufacturers), then a drop in a stock price can create a negative cascade, as uninformed investors see the drop as a signal of poorer future returns. As these uninformed investors withdraw their investments, informed investors realise that the industry will suffer negative spillover effects and may fail to maintain needed scale for production. As more investors withdraw, a "race for the exit" is created, and a financial panic ensues.

Models based on investor uncertainty suggest that all financial markets, not just the banking system, should be monitored by the central banks. These theories suggest that investor uncertainty may be measured by studying the spread between the interest rates on risky and risk-free assets and the volatility of asset prices. If the spread between interest rates widens sharply because of either a decline in the risk-free rate or an increase in the rate on the risky asset (or both), these models suggest that investor uncertainty has increased. If so, productive investment may be hindered and, if such spreads are not reversed, economic activity may slow. The "race for the exit" models focus on stock market valuations. Both types of models suggest that financial asset price volatility, to the degree that it reflects underlying investor uncertainty, is an important indicator of financial market stability.

2.2 Financial linkages and contagion

Many economists find sunspot models, such as those described above, unsatisfactory because they fail to link the bank run or the flight to quality to a real economic shock. In such models, small shocks become big problems only because investor views about the economy are changed, not because investors are rationally reacting to an economic shock that might spiral out of control. (Indeed, in Lehnert and Passmore, the probability of a bad economic outcome without an investor flight to quality is zero.)

With a desire to move away from sunspot models, Allen and Gale (2000a) propose a model of an economy composed of different regions. A small real economic shock can cause agents in a particular region to unexpectedly demand additional liquidity. When regions are separated from each other, a small shock might cause a financial crisis in a given region. To the degree regional shocks are imperfectly correlated, banks can insure each other against small regional shocks by holding claims on other banks in other regions. But while cross-holdings can provide insurance against most regional shocks, they cannot increase liquidity in the banking system as a whole. Thus, the use of bank cross-holdings as insurance against a financial crisis in a particular region lessens the probability of a crisis in that region, but creates a way regional shocks can be transmitted to other regions and increases the possibility of a system-wide crisis when multiple regions each attempt to use their cross-holdings in response to an economic shock.

Another way to link investor actions and real economic shocks is through investors' use of leverage and their desire to diversify portfolios (Lagunoff and Schreft, 1998; Kodres and Pritsker, 2000; Pritsker, 2000). These models generate contagion without explicitly modelling a banking sector. Instead, the mechanism of transmission is investor efforts to reallocate (for diversification) their portfolios after some projects in the real economy default (because of some exogenous and random shocks). These efforts by investors to regain their optimal asset mix may have the effect of causing other projects in the economy to default, causing a chain reaction that results in a financial crisis (as well as a significant contraction in real economic activity).

Even though the initial reactions of banks or investors in these financial contagion models are prompted by a default in the real economy, these so-called defaults are not formally modelled and enter these models exogenously. One could easily interpret them as defaults of specific firms or liquidity crises in particular regions created purely by investor reactions. In this sense, these models are also sunspot models. In contrast to sunspot models, however, these models explicitly model a transmission mechanism for the propagation of shocks, suggesting the channels the monetary authority might monitor to beware of developing financial problems.

2.3 Moral hazard and financial crises

In contrast to the models described so far, most theories that link moral hazard to financial crises focus on government actions. In general, these models begin with government actions or guarantees encouraging "excessive" lending, either by banks or by government enterprises.⁶ Such lending encourages a boom in economic activity, which usually ends because private borrowers invest in projects with low probabilities of success and then default. These defaults create the fear that banks are insolvent or cause government lending programmes to contract. In either case, lending to solvent, profitable borrowers is cramped as lending institutions struggle to recover.

The savings and loan crisis in the United States during the 1980s is often cited as the archetypical crisis created by moral hazard. Here, government guarantees of deposits were used by privately managed but undercapitalised thrifts to aggressively raise funds and extend loans in commercial real estate and residential housing development. With little of their own money at risk, US savings and loan extended credit to projects that depended on rapid real estate price appreciation to be viable (because the savings and loan lent more than 100% of the current value of the collateral, creating negative equity). When such price appreciation did not materialise, these institutions went bankrupt, leaving the US government with about \$150 billion of losses (in 1989 dollars) on insured deposits (what little capital private shareholders had in these institutions was lost as well).

The macroeconomic effects of crises generated by moral hazard problems, even for relatively large ones like the US savings and loan crisis, are often small. In the case of the savings and loan crisis, there was little financial market reaction and, beyond commercial real estate and speculative housing development, little macroeconomic consequence. Thus, while the source of the crisis may have been government guarantees, the failure of the crisis to propagate to other sectors suggests more is needed to call such events a systemic failure. Indeed, as long as there is a diversity of financial intermediaries in the economy, the failure of any one group seems to have limited consequences.

Indeed, an event in the United States that perhaps had more macroeconomic consequence was the so-called "credit crunch" in the early 1990s. In this episode, banks sharply contracted lending at the beginning of a recession, as economic prospects for borrowers dimmed and as investors and regulators encouraged banks to build up their capital, partly in response to the earlier problems associated with the savings and loan industry. However, whether moral hazard caused this problem is less clear, as there is little evidence that banks had taken advantage of deposit insurance or other government guarantees to overextend credit. In fact, during the credit crunch period, some bank regulators pushed banks to lend more, and the banks resisted these calls for easier credit.

More recently, several large studies of banking crises have called into question the link between banking crises and macroeconomic problems (Boyd et al, 2000; Gourinchas et al, 1999). Generally, other elements beyond the banking crisis must be present to create more systemic crises. However,

⁶ While government guarantees usually provide the clearest cases of moral hazard, other government actions, such as those that create uncertainty about the availability of credit, can have similar effects (Allen and Gale, 2000b).

the quality of lending by banks is one element of a central bank's prudential monitoring of possible financial problems.

3. Monitoring financial stability

The Federal Reserve monitors a broad range of financial indicators to assess the susceptibility of the economy to financial disturbances and, when financial disturbances occur, to judge the implications of those disturbances for the non-financial sector. Many of these indicators are measures of financial strength, that is, measures of the ability of households or businesses to weather a financial shock without greatly contracting their spending. Other measures focus on market participants' assessments of, and tolerance for, risk.

The measures used by the Federal Reserve are taken from a variety of sources, and are available at a wide range of frequencies. Some, such as asset prices, are market-based and can be calculated daily, if not even more frequently. Others, such as financial stocks and flows, are aggregated from individual institutions on a weekly, monthly or quarterly basis. Finally, some measures are based on surveys, both formal and informal, of market participants, and are gathered on an ongoing basis. The Board of Governors is provided with updates about financial market developments often (at least weekly and sometimes more frequently). The Federal Open Market Committee, which sets the overnight interbank (federal funds) rate in the United States, is provided with information on financial conditions before each FOMC meeting, although many measures are provided to the Committee members on a more frequent basis. Of course, financial market commentary and statistics are available to the public (and thus the Board and other policymakers) on an almost continuous basis from many different private sources.

3.1 Asset prices and interest rate spreads

The models of investor uncertainty outlined above highlight the importance of asset prices and interest rate spreads. Because these prices and rates are determined by the supplies and demands of forward-looking investors and savers, they react nearly instantaneously to judgments about financial conditions. And because many prices and rates are available virtually instantaneously and continuously, the Federal Reserve monitors a broad range of rates and asset prices for prompt information on market liquidity and market participants' attitudes towards risk.

3.1.1 Liquidity spreads

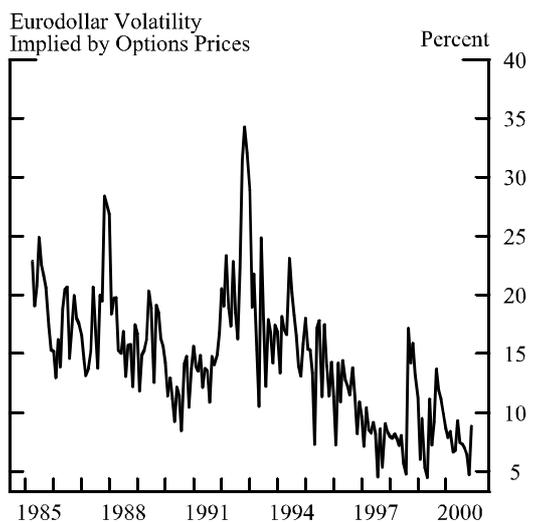
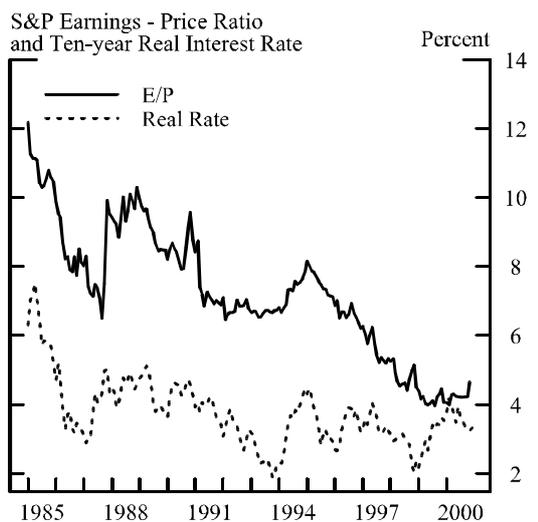
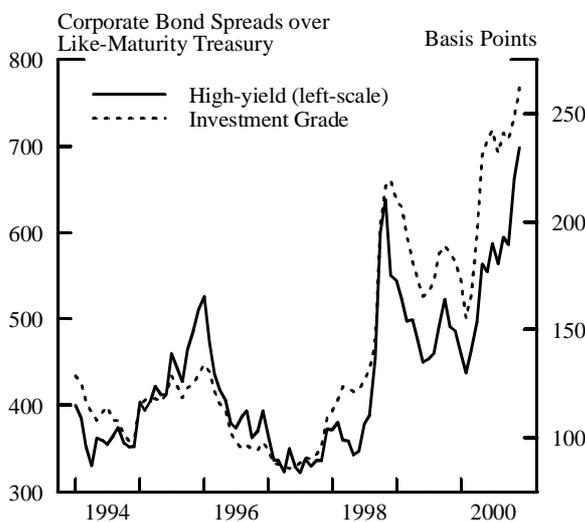
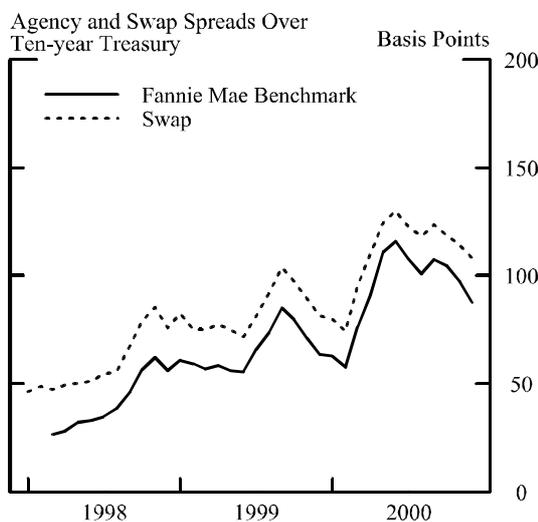
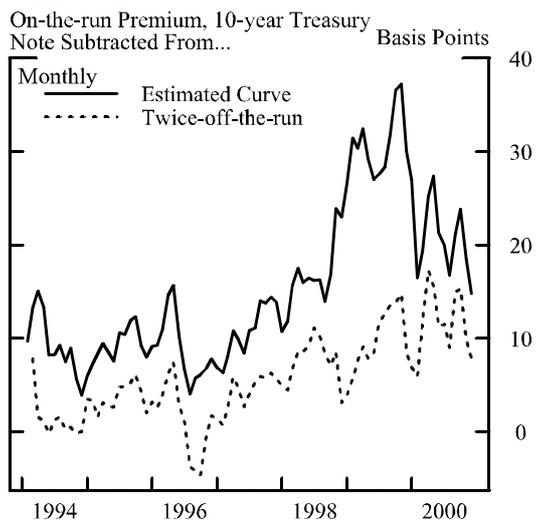
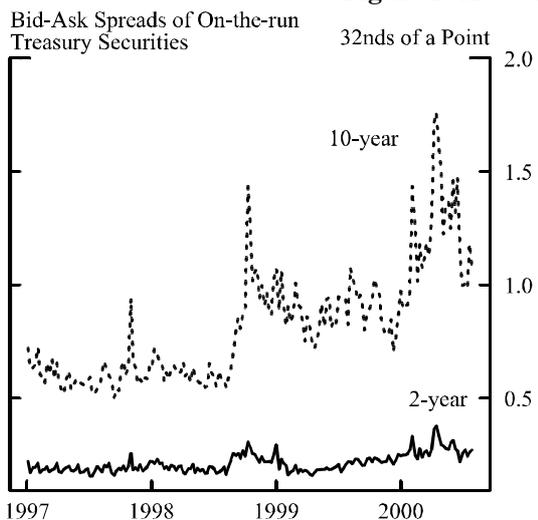
Measures of market liquidity provide information on the ability of financial markets to process large transactions without large changes in prices, and also on the premiums investors are willing to pay to hold more liquid assets. Federal Reserve staff assess the liquidity of the market for US Treasury securities in part using bid-ask spreads (Figure 1, upper-left panel).⁷

However, during the financial turmoil in late 1998, and over the century date change, the Federal Reserve augmented these data with surveys of primary securities dealers. The surveys provided a sense of the market not completely measured by the bid-ask spreads. For example, at times in 1998 the dealers were not willing to make a market at all in certain securities.

In addition to bid-ask spreads, Federal Reserve staff also follow liquidity premiums, defined as the yield on a highly liquid security minus the yield on a less liquid but otherwise similar security. Highly liquid securities - those traded in liquid markets, with unquestioned credit quality, and often with short maturities - provide investors with the confidence that, if necessary, they can be sold rapidly and at a known price. The amount investors are willing to pay for that comfort in the form of lower yields relative to other rates may rise rapidly during financial market difficulties, particularly when the source of such difficulties is heightened investor uncertainty. Because these spreads may react rapidly to financial difficulties, and are available at high frequency, Federal Reserve staff review them often.

⁷ Fleming (2000) provides an assessment of the performance of various measures of the liquidity of the markets for Treasury securities.

Figure 1: Asset-Price Based Measures



The theories of investor uncertainty outlined above suggest that liquidity spreads are important, but do not deal directly with the difficult problem of how to construct measures of such spreads. Liquidity spreads measured using Treasury securities have the advantage of being uncontaminated by premiums charged for default risk. The most recently issued of any given type of security - the on-the-run-issue of that security - are much more liquid than other Treasury securities. Securities that are not the most recently issued - off-the-run issues - are less liquid but otherwise nearly identical, so the off-the-run, on-the-run spread is often considered a good measure of a liquidity premium (Figure 1, upper-right panel). However, this value of this measure often varies with the choice of off-the-run security. To mitigate this problem, staff also construct an estimate that compares the yields of on-the-run securities to the yields implied by a smoothed yield curve estimated from less liquid Treasury securities.

Federal Reserve staff track a number of other spreads that are influenced in part by liquidity. These include the spreads between the yields on less liquid but still relatively low-risk instruments, such as the yields on agency securities or swap yields, relative to yields on Treasury securities (Figure 1, middle-left panel). However, in the past year, upward revisions to the outlook for federal budget surpluses have raised the prospect that Treasury securities will be in increasingly short supply in coming years. As a result, investors have become willing to pay premiums to acquire Treasury securities. The movements in Treasury yields arising from variations in these scarcity premiums have reduced the information content in spreads calculated relative to them about liquidity demands and, as mentioned below, about attitudes towards risk.

3.1.2 Risk premiums on market debt instruments

As suggested by economic theory, expected yields on debt instruments and equities relative to those on riskless assets vary with investors' assessments of risk and willingness to bear risk. The spreads between the yields on riskier and less risky securities widen when investors judge their relative risks to have increased, and also when investors demand a higher premium for a given amount of risk. Thus, these spreads will increase when investor uncertainty increases or financial conditions worsen, and a sharp widening of these spreads has often been a component of financial turmoil.

Like liquidity spreads, measurement of investors' risk premiums is not straightforward. The Federal Reserve follows risk spreads on a variety of forms of business debt. The spread between the most highly rated commercial paper and the next most highly rated varies importantly with investors' perceptions of risk, as does the spread between US corporations' investment grade bonds and like-maturity Treasury bonds (Figure 1, middle-right panel). The Federal Reserve also follows closely the spread on high-yield bonds over Treasury bonds or high-grade corporate bonds because the appreciable risk on these securities makes this spread particularly sensitive to changes in the economic outlook for less creditworthy corporations and to changes in investors' attitudes towards risk. Riskier securities are also generally less liquid than safer securities, so a widening of the risk spreads on corporate debt also often indicates a reduction in the relative liquidity of the market for the riskier instruments. More recently, staff have also monitored the spreads of corporate bond yields over swap rates and yields on US agency debt, as opposed to the spreads over Treasury securities, because of the distorting effect of scarcity premiums paid for Treasury securities.

3.1.3 Equity prices

Equity prices vary with changes in investors' appetite for risk; in investors' expectations for, and uncertainty about, future economic outcomes; and in the clarity of information available to investors. To invest in equities, investors demand a premium over bond yields because the return on bonds is generally more predictable. Federal Reserve staff assess the equity premium in a number of ways, including by comparing the earnings-price ratio of the S&P 500 to the real level of the 10-year Treasury rate (Figure 1, lower-left panel). The earnings-price ratio is calculated using analysts' expectations for earnings during the upcoming year. The real 10-year interest rate is calculated by subtracting a survey-based measure of long-term inflation expectations from the nominal 10-year Treasury rate. The real rate is difficult to measure precisely because the survey measure is only an approximate estimate of inflation expectations and, recently, because scarcity premiums have distorted the nominal rate.

Unfortunately, interpreting changes in this measure of the equity premium is difficult. For example, a decline in the earnings-price ratio relative to the real interest rate may reflect new economic information that raises investors' expectations of future earnings growth. Or it may reflect that investors have better information or greater certainty about economic outcomes or an enhanced

appetite for risk. Comparisons of analysts' expectations about longer-term earnings growth to the staff's forecast of earnings permit some judgments about reasons for changes in the earnings-price ratio, but such analysis embodies a great degree of uncertainty.

Economic crises, as well as financial crises, might be assessed, in part, by changes in equity prices. To the degree that stock prices reflect future earnings, negative economic shocks that lower the net present value of future projects and that might be difficult to observe directly, such as a slowing in the rate of growth of productivity enhancements, might be first reflected in stock prices. Similarly, stock prices of financial intermediaries, such as bank stock price indices, are leading indicators of financial institution performance, and thus are sensitive to concerns about financial turbulence to the degree such concerns affect future earnings.

3.1.4 Option prices and implied volatilities

The Federal Reserve uses option prices to measure investors' assessment of the likely volatility of interest rates and equity prices. These measures have proven to be useful and timely indicators of investor uncertainty and information precision, as well as of the probability distribution of underlying economic outcomes. For example, options on eurodollar futures provide a measure of the expected volatility of the interest rate on eurodollar deposits, which rises when investors become more uncertain about the future path of near-term monetary policy (Figure 1, lower-right panel). This measure of eurodollar volatility has risen significantly in recent periods of financial stress, probably because during those periods investors have placed increased odds on the possibility of a financial crisis and therefore placed an increased value on insuring against extreme outcomes.

Options-based measures of equity price volatility, which provide information on the odds that corporate cash flows will be lower than expected, have proven to be useful for forecasting default rates on corporate debt. These forecasts, in turn, help Federal Reserve staff judge, albeit imprecisely, how changes in risk premiums have been affected by changes in expected default rates.

3.2 Depository institutions

As outlined earlier, some theories of financial crises argue that the banking sector plays a key role in the evolution of financial crises. In particular, banks can act as transmission mechanisms of crises because they may sharply contract credit in response to depositor demands for early and quick redemption of funds. On the other hand, with deposit insurance, depository institution liabilities might rise with heightened demand for safety and liquidity.

3.2.1 Data on bank credit and monetary aggregates

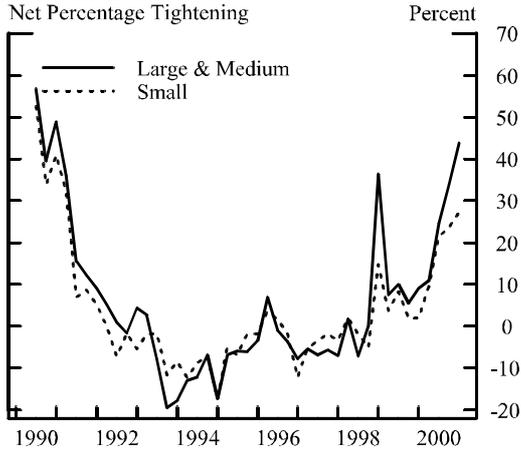
The Federal Reserve collects weekly data on bank credit and the monetary aggregates. To some extent, these data can be used to monitor financial problems. For example, rapid growth in bank business loans may indicate substitution away from unreceptive capital markets. Similarly, the monetary aggregates may grow more rapidly when investors shift funds out of bond and stock mutual funds and into safer and more liquid bank deposits or money funds.

3.2.2 Senior Loan Officer Survey on Bank Lending Practices

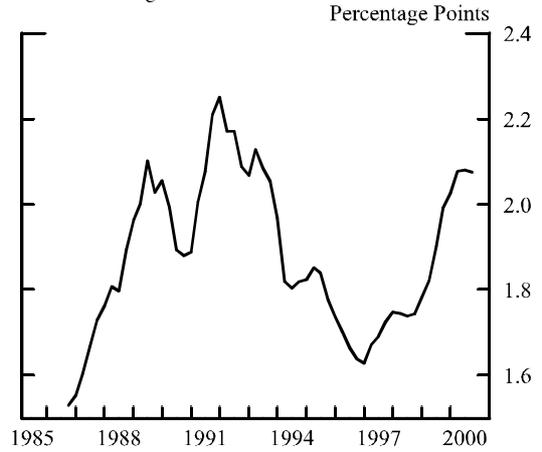
In the past, both aggressive lending practices and the contraction of lending at banks have been cited as the mechanism for transmission of financial problems to non-financial businesses and households. The Federal Reserve collects information from commercial banks before every other FOMC meeting on the standards and terms on, and demand for, loans to businesses and households in its Senior Loan Officer Survey on Bank Lending Practices. The Senior Loan Officer Survey poses a broad range of questions to loan officers at 60 large domestic banks and 24 US branches of foreign banks. On the topic of banks' tolerance for risk, the survey asks about changes in risk premiums on business loans, and about changes in business loan standards (Figure 2, upper-left panel).

Figure 2: Depository Institutions

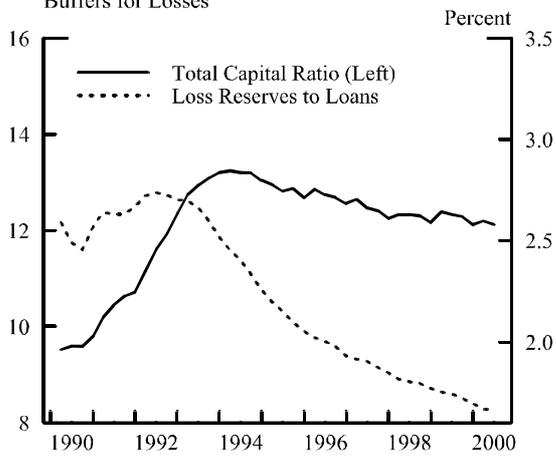
Senior Loan Officer Survey
Standards on C&I Loan
Net Percentage Tightening



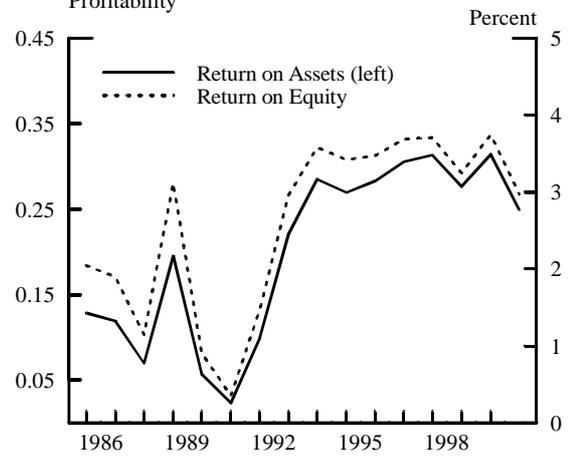
Survey of Terms of Lending: Loan Rate on
C&I Less Targeted Fed Funds Rate



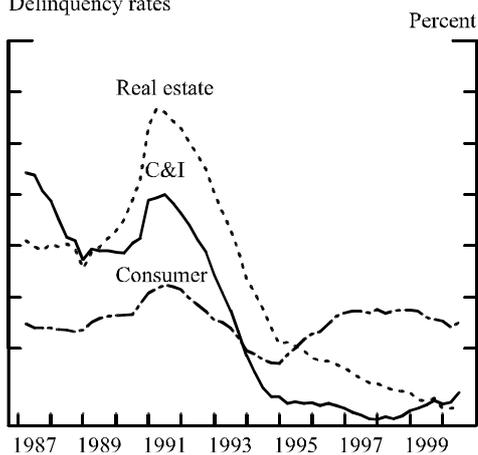
Buffers for Losses



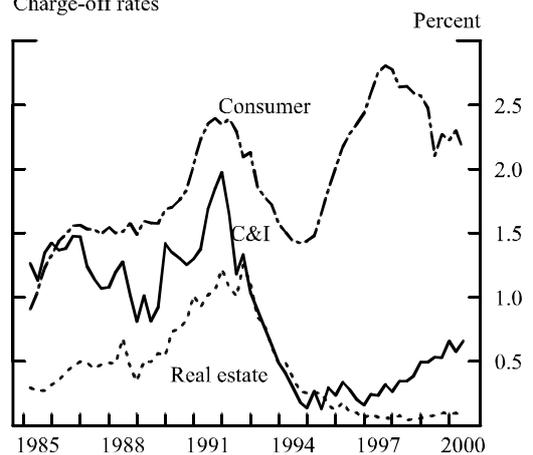
Profitability



Delinquency rates



Charge-off rates



Although these surveys are not frequent enough to use for monitoring a quickly unfolding financial crisis, the core set of questions have been asked on each survey since 1990, and the responses to those questions, expressed as the net percentage of respondents tightening standards or terms, have proven to be a useful measure of financial conditions and a correlate of economic activity. In addition, the responses to specific, targeted questions during periods of financial stress have helped the Federal Reserve gauge the degree of difficulties and their implications. Finally, although the surveys are typically conducted quarterly, the Federal Reserve has authority to conduct up to six surveys a year, and has done special surveys when warranted by financial conditions, most recently in autumn 1998.

3.2.3 Quarterly bank data

Federal Reserve staff also use the quarterly balance sheet and income statements of commercial banks to monitor capital, profitability, asset quality and loan loss reserve adequacy (Figure 2, middle panels). Each variable measures both the health of the banking system and the propensity for moral hazard problems to arise. In addition, data on loan delinquency and charge-off rates relate to both the financial condition of banks and the financial health of the borrowers (Figure 2, bottom panels). However, at a quarterly frequency and with long reporting lags, these data are of limited value for monitoring a quickly unfolding financial crisis, but may provide information on the susceptibility of the banking sector to shocks.

Similarly, the Federal Reserve collects data on the rates banks charge for business loans with the Survey of Terms of Bank Lending (Figure 2, upper-right panel). About 300 domestic banks and US branches of foreign banks participate in the survey. Each bank provides a number of details on the terms of every commercial and industrial loan it makes for one week out of each quarter - a total of about 40,000 for each survey. The terms include, among other things, the loan size, rate, maturity and, since 1996, the level of risk. The average rates for each risk rating allow for an estimate of the risk premiums on bank loans. These data are useful for monitoring possible moral hazard problems or shifting views of the riskiness of bank borrowers, but, like balance sheet data, are not sufficiently timely to provide contemporaneous information in a financial crisis.

3.2.4 Bank supervision and regulation

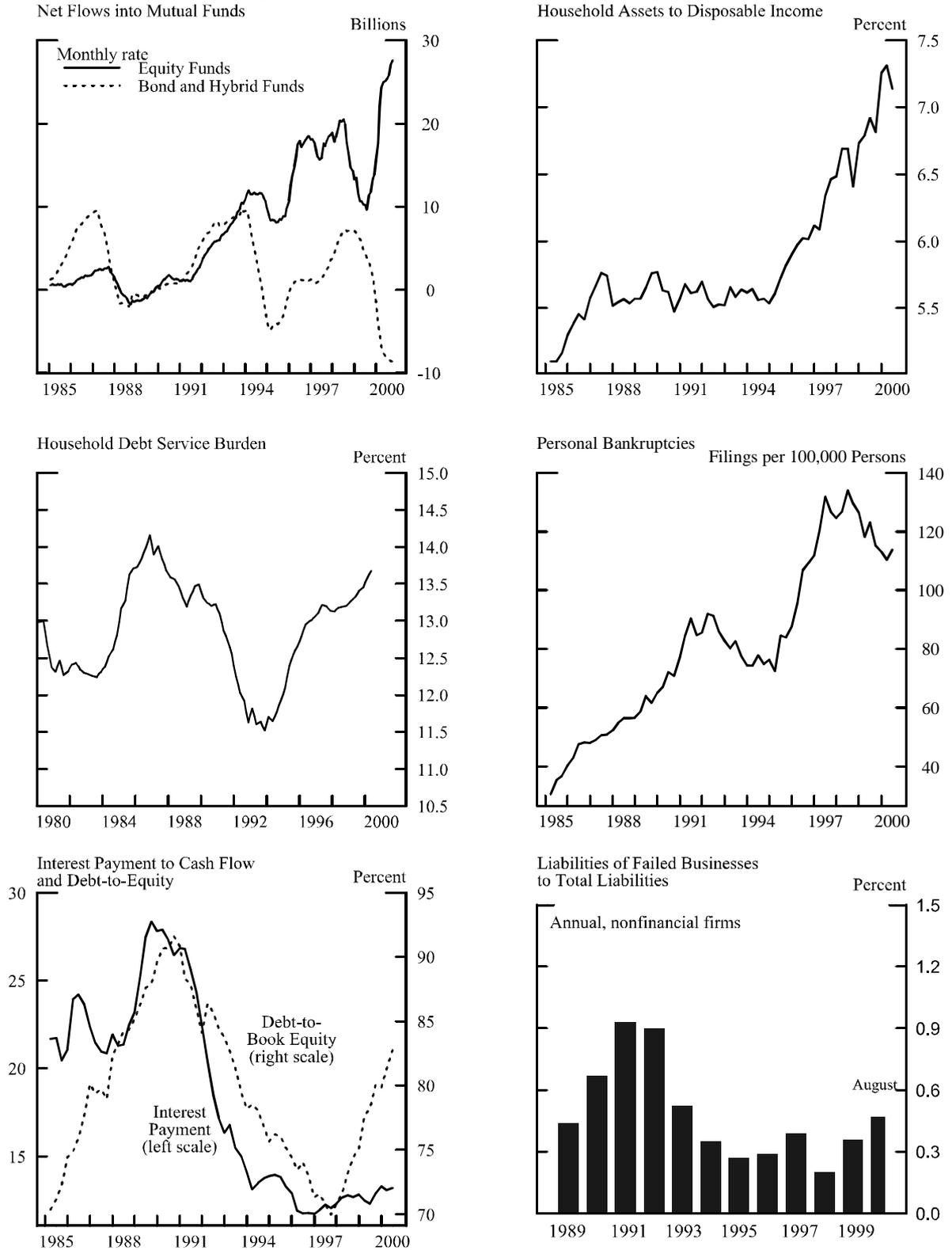
The Federal Reserve is the umbrella regulator for financial services holding companies, the primary regulator of bank holding companies, US branches of foreign banks, and state-chartered banks that are members of the Federal Reserve System. Federal Reserve regulatory staff also maintain close contacts with the other regulators of financial institutions. Through its supervisory role, the Federal Reserve learns about the condition and behaviour of commercial banks, and acts to maintain the soundness of these institutions. During periods of financial turmoil, the familiarity with these intermediaries deepens the Federal Reserve's understanding of developing conditions. In addition, the supervisory staff provide a lever through which the Federal Reserve can act when it needs to respond quickly to developments during a financial crisis.

3.3 Mutual fund flows

Investors' feelings about risk and demand for liquidity are reflected not just in the prices of financial assets, but also in change in the holdings of those assets. When confidence increases, households tend to move assets from more liquid, less volatile assets such as deposits and money funds into less liquid assets such as stock and bond mutual funds and direct holdings of securities (Figure 3, upper-left panel).

Mutual funds can provide timely data about such flows. The Federal Reserve reviews weekly data on investments in money market and stock and bond mutual funds. The data, which are provided by private vendors, contain details on the type of fund, including, in the case of stock mutual funds, whether the funds are oriented towards growth or income and whether the investments are in domestic or foreign equities. Bond funds are broken out by high-yield corporate bonds, investment-grade corporate bonds and municipal securities. Flows into relatively higher-risk funds tend to fall off quickly when investors' confidence or appetite for risk declines. Similar changes in flows occur at pension funds, insurance companies and hedge funds, but data for such institutions are either not readily available, or only available with a long delay.

Figure 3: Household and Business Balance Sheets



3.4 Household and business financial health

The ability of a financial crisis to spread depends in part on the financial wherewithal of economic agents. The Federal Reserve constructs and monitors measures of financial soundness for both households and businesses. For households, indebtedness is tracked, in part, using debt-to-asset ratios and debt burden ratios (Figure 3, upper-right and middle-left panels). The latter are calculated as the ratio of quarterly payments of interest and required principal to household disposable income.

Federal Reserve staff measure business leverage in terms of the ratio of debt to the book value of equity (Figure 3, lower-left panel) and debt to the market value of equity. Staff evaluate businesses' capacity to meet payments, in part, using the ratio of interest payments to cash flow. The financial stress on businesses is also evaluated using the payment performance of business debt. Data for these measures are quarterly and come from the Federal Reserve's flow of funds accounts, the national income accounts, regulatory reports and private vendors.

The Federal Reserve also examines delinquency and charge-off rates on bank loans to businesses and households, default rates on corporate bonds, upgrades and downgrades of corporate bonds, and household and business bankruptcy rates (Figure 3, middle-right and lower-right panels). Payment problems in one sector of the economy can spill into other sectors for a variety of reasons. Such problems may reflect underlying economic problems, may provide noisy signals to investors about the economic outlook, or may simply spread because of poorly designed or reckless financial contracts. Data on payment problems with specific corporate securities are available relatively quickly. In contrast, aggregated statistics on business and household financial conditions are often available only with a substantial delay. For households, balance sheet information is often supplemented with more timely surveys of household sentiment.

3.5 Federal Reserve Banks

Financial contagion can be contained if short-term liquidity is provided to fund profitable but illiquid assets. The Federal Reserve provides credit to depository institutions through the 12 Federal Reserve Banks. In recent years this credit has almost exclusively been extended to meet short-term liquidity needs or seasonal borrowing needs and has not had much bearing on financial stability. However, during periods of financial instability arising from depository institution difficulties, the discount officers (the Reserve Bank staff in charge of lending) gather information about the liquidity and solvency of borrowers and potential borrowers.

Actual or potential discount window lending to depository institutions has also been a channel through which the Federal Reserve, in its role as lender of last resort, assuages financial crises. That channel was narrowed somewhat by the FDIC Improvement Act of 1991, which established guidelines for Federal Reserve discount window assistance to troubled institutions. While not prohibiting lending to troubled institutions, the guidelines are designed to place any such lending under greater scrutiny, and deviations from the guidelines can make the Federal Reserve Board liable for a portion of any consequent increases in FDIC insurance costs. The Federal Reserve also has the statutory authority in unusual and exigent circumstances to be a lender of last resort to entities other than depository institutions, although no such loans have been made since the 1930s.

As suggested above, the timeliness of data is often a problem, particularly for the management of financial problems. The Federal Reserve Banks provide assessments of regional conditions in advance of each FOMC meeting that are compiled in the Beige Book. These assessments are based on informal surveys of business leaders in the private sector, as well as on available regional data.

3.6 Other financial market regulators

Regulation of financial markets in the United States is fragmented, and thus the Federal Reserve consults regularly with other depository institution and financial market regulators. An important venue for such contacts in recent years has been the President's Working Group on Financial Markets, a group initially established to study the October 1987 stock market crash. Since then, the Working Group has been a primary vehicle for sharing information and coordinating policy responses to financial disturbances. Its membership includes the Secretary of the Treasury, the Chairman of the Federal Reserve Board, the Chairman of the Commodity Futures Trading Commission and the Chairman of the Securities Exchange Commission. Other supervisors of financial institutions and financial market policymakers also attend meetings of the Working Group. The principals meet a few

times each year to discuss financial policy issues that cross lines of responsibility. In addition, the staffs of these organisations meet biweekly to discuss financial market developments.

3.7 Market contacts

Again, in an effort to obtain more timely information, the Federal Reserve draws extensively on the views of market participants for information on the condition of financial markets and intermediaries. The anecdotal information gleaned from these contacts is often as important as more structured measures in forming the Federal Reserve's assessment of financial market fragility.

There are several different regular meetings between the Board of Governors and leaders in various financial sectors: the Bond Market Association for investment banks, mutual funds and other fixed income investors; the Federal Advisory Council for commercial banks; and the Thrift Institution Advisory Council for savings institutions and credit unions. Each of these groups consists of chief executive officers or other high officials from institutions of each type, who meet quarterly to discuss recent developments of significance for their sector. The Board members also meet frequently with trade associations for banks and other financial institutions to discuss issues of concern for their members.

The staff of the Federal Reserve Bank of New York (FRBNY) collect information on the conditions of financial markets from the primary dealers, the 29 financial firms with which the Federal Reserve conducts its open market operations. A willingness and ability to contribute such information is one condition of becoming a primary dealer. The FRBNY also speaks regularly with contacts in the money market and the markets for other securities that it maintains as the executor of Federal Reserve open market operations. Similarly, the staff of the Federal Reserve Bank of Chicago maintain close contacts with participants in the derivatives markets located in Chicago. The staff of the Board of Governors also talk regularly with a broad range of financial market participants.

4. Prudential monitoring in practice

4.1 The credit crunch of the early 1990s

During the 1980s, aggressive lending policies by savings and loan associations, which had little of their own money at risk, and by commercial banks allowed households and businesses to accumulate large amounts of debt. Throughout the 1980s, balance sheet measures concerning depository institutions that are now taken to indicate increased moral hazard, such as a depository institution's capital-to-asset ratio, were at low levels.

With the onset of the 1990-91 recession, the optimistic nature of borrower expectations concerning asset price appreciation (particularly for real estate) became apparent, and many borrowers defaulted. Real estate prices had initially declined in the southwestern United States in the late 1980s and, with the onset of recession, in California and the northeastern United States. US economic growth was then retarded by the efforts of depository institutions, businesses and households to rebuild their balance sheets strained by high levels of leverage and defaults. Measures of debt burdens (for both household and businesses) reached record highs during the early 1990s, and then fell rapidly as delinquencies and bankruptcies increased.

The period might be described as one with financial difficulties (it is difficult to use the word crisis for such a prolonged period) because efforts to stimulate growth through monetary policy were hindered by what was referred to as "financial market headwinds". Investors seemed unwilling to take on risk and depository institutions to extend credit, even though it appeared to many economists that economic conditions had improved markedly by 1992. Part of this resistance by investors and banks may have reflected a heightened uncertainty, and associated pessimism, about future economic prospects arising, in part, from inconsistent behaviour of political leaders, both during the savings and loan crisis and during efforts to trim the federal budget deficit. These "headwinds" manifested themselves, in part, through sluggish growth in M2, contributing to the assessment of the FOMC that the economic recovery remained anaemic. To overcome this pessimism, the Federal Reserve

engaged in an aggressive monetary easing that continued almost two years beyond the formal end of the economic recession.

4.2 The policy tightening of 1994

By 1994, however, these headwinds had largely disappeared - both the Senior Loan Officer Survey and anecdotal reports pointed to eased lending standards, albeit from fairly tight levels. Furthermore, major equity indices rose 10 to 20% in 1993, risk spreads on corporate bonds narrowed considerably, and issuance of equities and bonds occurred at a record pace. This issuance was supported in part by strong inflows into stock and bond mutual funds. This evidence, as well as other indicators, suggested that financial markets and depository institutions were once again providing adequate funding to promising investments.

In February 1994, the FOMC began a series of policy tightenings that, over the course of the year, raised the targeted federal funds rate to 6% from 3%, where it had stood for 17 months. At the outset of the tightening, the FOMC was concerned that, after such a long period of low and declining interest rates, any increase in rates would provoke heightened uncertainty and rapid unwinding of investors' positions. Largely for these reasons - as well as the difficulty of discerning the size of the increase in interest rates needed to slow economy activity - the FOMC opted to raise the federal funds rate gradually even while recognising that additional tightening would probably be required.

Initially, the Committee raised short-term rates 75 basis points in three moves over a three-month period. In reaction, longer-term interest rates rose substantially and major stock price indices declined sharply. Inflows into stock and bond mutual funds fell off or reversed, as investors reacted to the greater uncertainty by seeking safer or more liquid investments. Corporate issuance of securities also fell off, with credit demands met in part by more rapid growth in bank loans. However, by May the FOMC, by reviewing many of the measures discussed above, judged that market participants had made the needed adjustments to the new environment, and that it could take more aggressive steps to tighten policy without destabilising markets. Consequently, it raised the federal funds rate by 50 basis points in May and August, 75 basis points in November, and another 50 basis points the following February.

The rise in interest rates that occurred in 1994-95 created stresses on some organisations, particularly those that had made substantial - and incorrect - bets on the direction of interest rates. Several large mutual funds that specialised in holding mortgage-backed securities went bankrupt, and the mortgage-backed securities market was in turmoil most of the year. In addition, Orange County, a large suburban county in California, filed for bankruptcy protection after its investment fund lost money on leveraged investments in the debt of federally sponsored agencies. But in these cases, the unwinding of the assets following these bankruptcies proceeded in an orderly manner and financial market turmoil was minimal.

4.3 Credit spreads and lending standards in the mid-1990s

Many financial measures indicated that, in the middle of the 1990s, US investors judged the amount of risk to be low or had increased appetites for bearing risk. Measures of the equity premium expected by stock market investors suggested that, even while large amounts of household savings flowed into stock markets, the additional returns from holding stocks compared to Treasury securities were declining rapidly. Similarly, anecdotal and supervisory reports raised concerns that depository institutions were significantly lowering their lending standards. From the Federal Reserve's perspective, the problem was determining whether or not this apparent investor confidence reflected difficult-to-observe changes in the economy that would boost future corporate earnings or Pollyannaish behaviour by investors inappropriately extrapolating forward the gains that had accumulated over the preceding years. As stated by Chairman Greenspan in 1996:

"Clearly, sustained low inflation implies less uncertainty about the future, and lower risk premiums imply higher prices of stocks and other earning assets. We can see that in the inverse relationship exhibited by price/earning ratios and the rate of inflation in the past. But how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade? And how do we factor that assessment into monetary policy? We as central bankers need not be concerned if a collapsing financial asset bubble does not threaten to impair the real economy, its production, jobs, and price

stability. Indeed, the sharp stock market break of 1987 had few negative consequences for the economy. Thus, evaluating shifts in balance sheets generally, and in asset prices particularly, must be an integral part of the development of monetary policy.” [Greenspan, 1996]

Using such evaluations, the Federal Reserve pursued a course of action that relied mainly on “jawboning” lenders and financial markets to exercise prudence when extending credit. The Federal Reserve did raise interest rates in early 1997 in response to heightened macroeconomic activity and the potential for the acceleration of inflation. To the degree that stock market valuations were influencing households and businesses to spend more, one might argue that the Federal Reserve did respond indirectly to the run-up in stock valuations. However, the Federal Reserve did not, contrary to the wishes of many outside observers, use monetary policy to deflate or “prick” a so-called asset bubble. Internally, the Federal Reserve made intensive efforts to determine if an asset bubble was actually occurring or whether investors were assessing future corporate earnings rationally, evaluating many of the measures discussed above and discussing market perceptions and decisions with a wide variety of market participants.

By spring 1998, risk spreads had widened somewhat and lending standards, reportedly, had tightened to some extent. While equity prices remained elevated by many measures, it was increasingly clear that the US economy was undergoing a profound shift in the direction of a “new economy” including an acceleration of productivity, and that many investors had foreseen the potential for these developments to raise future corporate earnings. This episode highlights the risks of conditioning monetary policy on an assumption that market participants are acting irrationally. With hindsight, it appears that, had the Federal Reserve acted to lower asset prices, it could have unnecessarily risked interrupting the current expansion.

4.4 Financial turmoil in autumn 1998

In August 1998, amidst lingering concerns about the previous year’s difficulties in many Asian economies, the default by Russia on certain government obligations and the devaluation of the rouble led to sharp declines in the market value of the debt of many emerging market economies, resulting in substantial losses for some investors. Many investors appeared to revise upwards their assessments of the riskiness of various counterparties and investments and to become less willing to bear risk. The reduced willingness to bear risk manifested itself in several ways. Yields on US Treasury securities declined to levels not seen for many years. Spreads of corporate bonds, particularly high-yield bonds, over Treasury yields widened sharply. High-yield bond mutual funds and equity mutual funds posted strong outflows, and there were inflows into government bond funds. Many financial institutions, including several large commercial banks, posted large losses, and trimmed their risk exposures. As a result, liquidity in many markets declined sharply. Bid-ask spreads widened in many markets, and on-the-run premiums on Treasury securities increased.

Conditions in US financial markets deteriorated further following the revelation in mid-September of the magnitude of the positions and the extent of the losses of Long-Term Capital Management (LTCM). With world financial markets already suffering from heightened risk aversion and illiquidity, a precipitous unwinding of LTCM’s portfolio following a default might have imposed potentially large losses, not just on LTCM’s creditors and counterparties, but also, through spillovers to asset prices, on other market participants not directly involved with LTCM. In an effort to avoid these difficulties, the Federal Reserve Bank of New York facilitated a discussion among LTCM’s creditors that led to an agreement by the private sector parties to provide additional capital in return for a 90% equity stake in the firm.

Even though the arrangement allowed for the positions of LTCM to be reduced in an orderly manner, the actual and anticipated unwinding of LTCM’s portfolio, and of the portfolios of other similarly placed investors, itself seemed to contribute to the tremendous financial market volatility in mid-October. Many of the indicators of illiquidity and an unwillingness to bear risk discussed above - bid-ask spreads, liquidity and risk premiums - worsened further, and expectations of future volatility as measured by option prices rose appreciably.

To cushion the US economy from the effects of the financial strains, and potentially to help reduce those strains as well, the Federal Reserve, in mid-October, decided to ease monetary policy and communicated to the markets that it would work to stabilise market conditions. Overall, the Federal Reserve eased monetary policy on three occasions in the autumn, reducing the targeted federal funds rate by a total of 75 basis points. Despite concerns about financial difficulties in Brazil in November,

and some heightened year-end pressures, financial markets became more orderly. Nevertheless, by many measures, market liquidity and risk tolerance have still not returned to their levels before autumn 1998.

Throughout this time, the Federal Reserve intensified its monitoring of financial market conditions. Beginning in October, staff distributed to Board members a daily package of charts and tables summarising a broad range of risk and liquidity premiums. Weekly measures of capital market issuance and bank credit evinced the crucial role played by banks as providers of credit to businesses temporarily shut out of the securities markets. In addition, the Federal Reserve conducted a special Senior Loan Officer Survey in October to provide more qualitative information on the lending stance of commercial banks. Staff also spoke daily with market participants about the condition of the markets in which they were active.

4.5 Y2K

In the months leading up to the century date change, the behaviour of financial market participants and households was similar to that in other episodes of financial instability. Uncertainty about the future rose, demand for liquid assets increased, and some markets became relatively illiquid. Even while judging that the risks of significant computer-related problems were slight, the Federal Reserve, along with many others, was concerned that fears about financial turmoil could become self-fulfilling (a sunspot equilibrium). Consequently, there was a heightened potential for a financial crisis. In response, the Federal Reserve acted to increase financial market liquidity and monitored the condition of financial markets closely.

The demand for liquid assets took its most primitive form in increased household demand for currency, prompted by concerns that other payment mechanisms could be disrupted. In anticipation of that demand, the Federal Reserve printed and shipped an additional \$100 billion in currency. The prospect also existed that even a few depositories running out of currency might prompt a run on other depositories. To address this possibility, special currency inventories were strategically placed around the country, to be delivered rapidly if the need arose. In the event, demand for currency rose less than expected and most of the additional currency remained in bank vaults.

The Federal Reserve also took several steps to increase depository institutions' readiness and willingness to use the discount window as a backstop source of funds. Streamlined procedures for pledging collateral, an expanded range of acceptable collateral, and outreach efforts by Federal Reserve Bank staff resulted in many depository institutions filing the documents necessary to borrow, and a significant rise in the amount of collateral pledged. In addition, during the period around the rollover, the Federal Reserve added a discount window lending facility charging an above-market rate, but placing few restrictions on reasons for borrowing or use of funds. The facility was offered in part to increase depository institutions' willingness to extend lines of credit by raising their confidence that funding would be available if such lines were drawn down.

The Federal Reserve made changes to its open market operations to increase market liquidity. The maximum maturity on repurchase agreements was lengthened from 60 to 90 days, and the collateral accepted for those agreements was extended to include mortgage-backed securities. The Federal Reserve also sold options on overnight repurchase agreements for the days around year-end, to help further build confidence that funding would be available at reasonable rates.

In addition, Federal Reserve officials made frequent public statements to increase confidence in the financial system. In these, officials described the efforts to enhance liquidity, and also reported the high degree of readiness of financial institutions. While the FOMC tightened policy in November, it adopted a symmetric directive at that meeting. The FOMC left rates unchanged at its December meeting and again adopted a symmetric directive, indicating in its accompanying statement that it did so to make clear that the immediate focus of policy was ensuring a smooth transition into 2000.

The monitoring efforts of the Federal Reserve took many forms. Internally, staff prepared daily updates on market indicators of financial stress, including many of the same indicators evaluated during autumn 1998. In addition, staff monitored term premiums that widened out as financial institutions sought to lock in funding over year-end. The Senior Loan Officer surveys in 1999 concentrated on banks' assessments of their, and their customers', readiness for the century date change, and banks' willingness to extend funds and lines of credit into 2000. Staff also followed the readiness of depository institutions to use the discount window and, on rare occasions, the actual borrowing of funds.

The Federal Reserve also communicated regularly with financial market participants, with other domestic financial regulators, and with the central banks and regulators of other countries. Such communication became hourly, and indeed around-the-clock, in the final days of December.

5. Conclusion

A pragmatic approach to monitoring financial stability seems appropriate given the many different types of financial stress illustrated by theoretical models and experienced in recent history. In the United States, policy responses to episodes of heightened risks of financial instability have taken a variety of forms, depending on the nature of the risks. On rare occasions, such as in 1994, interest rate adjustments may have been moderated or delayed because of concerns about financial fragility. More commonly, public statements or procedural adjustments were directed at increasing market participants' confidence in the soundness of the financial system. Regardless, the use of a wide range of measures seems to be needed, both on theoretical and practical grounds, to monitor financial stability adequately.

References

- Allen, Franklin and Douglas Gale (2000a): "Financial Contagion", *Journal of Political Economy*, Vol 108, No 1.
- (2000b): "Bubbles and Crises", *The Economic Journal*, Vol 110, No 460.
- Boyd, John H, Pedro Gomism, Sungkyu Kwak and Bruce D Smith (2000): "A User's Guide to Banking Crises", mimeo.
- Cole, Harold L and Lee E Ohanian (1999): "The Great Depression in the United States from a Neoclassical Perspective", *Federal Reserve Bank of Minneapolis Quarterly Review* (Winter).
- Diamond, Douglas W and Philip H Dybvig (1983): "Bank Runs, Deposit Insurance and Liquidity", *Journal of Political Economy* 91(3), 401-19.
- Fleming, Michael J (2000): "Treasury Market Liquidity", mimeo.
- Green, Edward J and Lin Ping (2000): "Diamond and Dybvig's Classic Theory of Financial Intermediation: What's Missing?" *Federal Reserve Bank of Minneapolis Quarterly Review* (Winter).
- Greenspan, Alan (1996): Remarks at the Annual Dinner and Francis Boyer Lecture of the American Enterprise Institute for Public Policy Research, Washington, DC (December).
- Gourinchas, Pierre-Olivier, Oscar Landerretche and Rodrigo Valdes (1999): "Lending Booms: Some Stylized Facts", mimeo.
- Kodres, Laura E and Matthew Pritsker (2000): "A Rational Expectations Model of Financial Contagion", mimeo (August).
- Lagunoff, Roger and Stacey Schreft (1998): "A Model of Financial Fragility", mimeo (September).
- Lehnert, Andreas and Wayne Passmore (1999): "Pricing Systemic Crises: Monetary and Fiscal Policy when Savers are Uncertain", *Federal Reserve Board working paper* 1999-33.
- Pritsker, Matthew (2000): "The Channels for Financial Contagion", Board of Governors of the Federal Reserve System, mimeo.
- Subrahmanyam, Avanidhar and Sheridan Titman (2000): "Feedback from Stock Prices to Cash Flows", mimeo (July).
- Wallace, Neil (1996): "Narrow Banking Meets the Diamond-Dybvig Model", *Federal Reserve Bank of Minneapolis Quarterly Review* (Winter).