

FINANCIAL INSTABILITIES AND RISK MANAGEMENT
BY CENTRAL BANKS

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Abstract: Among the various shocks that may cause financial instabilities, the bursting of asset bubbles has received most attention during the last decade. This paper discusses the risk management of financial instabilities caused by asset price crashes and evaluates the appropriate role of central banks. After an asset bubble crashes, central banks typically ease monetary policy to dampen the negative impact of the bust on economic activity. In this paper we address the question of why central bankers behave asymmetrically. Our answer to this question has three parts. First, simulations of theoretical models which include bubbles give an ambiguous answer as to whether or not central banks should try to target asset prices along with inflation and the output gap. Second, the historical episodes of asset price booms and busts suggest that using restrictive monetary policy to dampen bubbles may not work and in addition may destabilize the economy. Finally the central bankers are likely to be politically prevented from increasing interest rates solely to deflate an asset price boom. The paper also reviews the recent subprime mortgage crisis that was partially caused by the bursting of the housing bubble to emphasize the wide range of financial instability episodes that are included in the risk management responsibilities of central banks.

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1. Introduction

In this paper we plan to discuss the role of financial instabilities with special emphasis on the role of asset bubbles. When the economy is stable, monetary policy concentrates on promoting economic growth without inflation. However when serious economic shocks occur, central banks embrace risk management approaches to re-establish financial stability. Major among various recent economic shocks have been the twin bubbles of the U.S. internet and housing markets.

Episodically asset prices boom and crash. After asset prices decline significantly, central bankers are often taken to task for not having raised interest rates high enough during the formation of the bubble, as booms are called after they bust, and thus prevent the negative economic impact of a popping (or hissing in the case of real estate) bubble. Usually in setting monetary policy, central bankers act asymmetrically, that is, they do not attempt or attempt unsuccessfully, to target asset prices independent of other goals such as inflation and the output gap. After an asset price bust, however, central banks typically ease monetary policy to dampen the negative impact of the bust on economic activity.

In this paper we address the problem of financial instability often caused by bubbles but also by other economic shocks. We evaluate the question of why central bankers behave asymmetrically as elaborated in Hayford and Malliaris (2006). Our answer to this question has three parts. First, the simulation of New Keynesian models which include

asset price bubbles give an ambiguous answer at best to the question of whether or not central banks should try to target asset prices along with inflation and the output gap. Second, the historical episodes of asset price booms and busts and the response of monetary policy suggest that using restrictive monetary policy to dampen bubbles may not work and in addition may destabilize the economy. Finally, the political constraints faced by central bankers in setting monetary policy likely exclude the possibility of increasing interest rates solely to deflate an asset price boom. We conclude that it is not surprising that central bankers, who are chosen to be prudent, typically do not attempt to pop asset prices using restrictive monetary policy. We also acknowledge that when an economy such as the U.S. experiences a sequence of asset bubbles in various markets, the Fed's asymmetric response becomes problematic. Filardo (2006) argues convincingly that the dramatic decrease in Fed funds engineered by the Fed to contain the financial instability caused by the NASDAQ crash of 2001, triggered the housing bubble and the subprime mortgage crisis of the mid-2007.

In what follows, we first discuss the traditional role of monetary policy and the deviations from the norm, called the risk management approach, necessitated by various crises. We also rapidly review the concept of financial instability and then concentrate on few historical episodes to describe the risk management approach of the Fed to asset bubbles. We conclude by evaluating the most recent episode of the credit crisis of 2008 to argue that both a theoretical hypothesis and policy strategy are needed to avoid future financial instabilities.

2. How is Monetary Policy Set

The Taylor monetary policy rule provides a useful characterization of US monetary policy for the past 25 years. According to this rule the Fed sets the target for the Federal funds rate in an attempt to keep the output gap close to zero and keep inflation close to an implicit core inflation target (between 1% and 2%). The Taylor rule is consistent with the Fed's policy mandate of maintaining price stability and maximum sustainable growth as elaborated in Poole (2007). Targeting the Federal funds rate according to the Taylor rule minimizes the impact of money demand shocks on the economy as in Poole (1970) and prevents negative aggregate supply shocks from permanently increasing inflation. It also offsets spending shocks and stabilizes real GDP around potential. Episodes where the Fed deviates from the Taylor rule may be explained using a risk management approach to monetary policy (Greenspan (2003 and 2004) and Hayford and Malliaris (2005b)). When setting the Federal funds target, forward looking monetary policy involves weighing the possibility of low probability events with potentially large negative impacts to the economy such as the financial instability in fall of 1998 or the possibility of deflation as in the early 2000s.

This approach to monetary policy, characterized by the Taylor rule supplemented with risk management, has been responsible at least in part for the "Great Moderation" i.e. the reduction both in inflation and the variability of real GDP growth in the past quarter century.

Ironically at the same time that monetary policy has been successful in at least contributing to stability of the real economy, financial markets have not become more stable. For example the US stock market experienced a boom then bust from the mid 1990s to 2000 and the real estate experienced a boom then a bust from 2000 to 2007.

These episodes of financial instability have led a number of economists to argue that central banks should try to prevent asset price booms from occurring. However, most central bankers are not convinced that the benefits of attempting to “pop” an asset price boom are greater than the costs.

3. Financial Instability

Defining financial instability or stability is challenging. Financial stability can broadly be distinguished between ‘micro-stability’, which involves conditions of individual financial institutions, and ‘macro-stability’, which focuses on the efficient functioning of the financial system as a whole. In a more intuitive sense, financial stability means the avoidance of financial shocks that are large enough to cause economic loss to the real economy. Kaufman (2004) gives a detailed analysis about macroeconomic stability and links it to bank soundness. Here we view macroeconomic financial stability as influenced not only by banks and other financial institutions but also affected by the volatility of asset prices. Numerous authors address domestic financial stability in contrast to global instabilities in capital flows, currency devaluations or even country defaults.

The relation between monetary policy and financial stability has been long debated in the literature, but there is still no clear consensus on how exactly one affects the other and, in particular, what are the trade-offs and synergies between them. Broadly speaking, monetary policy is propagated to the real economy through financial markets. In this respect, a well-functioning financial system that is robust to shocks is crucial for the effectiveness of monetary policy. Financial globalization has naturally led to new

developments in monetary policy instruments and to the way monetary policy is conducted. Issing (2002) argues that as market-based financing has expanded during the last decade, asset prices have gradually gained in importance and monetary policy transmission mechanisms have become more diversified and complex. As a result, a change in asset prices might have a huge impact on financial system stability and economic activity in general and hinder the effectiveness of monetary policy.

This situation has prompted the authorities to separate the different goals and instruments of economic policy. In this context, monetary policy has been clearly assigned the objective of maintaining price stability through inflation targeting and the use of policy interest rates.

How do the objectives of price stability and financial stability fit together? One important lesson of the '70s and '80s has been that price stability contributes to financial stability. Low and stable inflation rates reduce uncertainty and promote sound economic decisions. By helping to remove market distortions in price signals and by anchoring inflation expectations, risk premia in interest rates are reduced, along with the likelihood of misperceptions about future asset returns. Ferguson (2002), Papademos (2006), Plosser (2008), Kohn (2008) and Mishkin (2008) carefully discuss the interplay among price stability, financial stability and the effectiveness of monetary policy. Greenspan (2004, 2005) has also reflected on the issue of price stability producing a decrease in real volatility but paradoxically an increase in financial volatility. Furthermore, the more predictable the monetary policy response, the greater its contribution to financial stability is.

However, the issue is more complex. Indeed, the '90s taught us that price stability is necessary but not sufficient condition to safeguard financial stability. Prior to the Asian crisis, large imbalances were built up in the real estate and other asset markets in Southeast Asia, although inflation was relatively low. This showed that confidence based on sound economic performance tends to drive up credit and asset prices.

This is at the centre of the potential conflict between price stability and financial stability. A credible monetary policy may succeed in achieving its primary objective of price stability, yet it still might facilitate the conditions for financial imbalances to develop, as it creates low inflationary expectations, reducing firms' costs and uncertainty. As a result profits accelerate, as do stock prices, building up financial imbalances. As indicated earlier, Greenspan (2004) acknowledged that "perhaps the greatest irony of the past decade is that the gradually unfolding success against inflation may well have contributed to the stock price bubble of the later part of the '90s."

The reverse is also true: financial instability may reduce the effectiveness of monetary policy. Papademos (2006) argues that a reduction, for example, of interest rates may have weaker effects than under normal conditions if the financial system is unstable, because increasing risk premia may prevent lending rates from falling, or because of credit rationing arising from a general unwillingness on the part of banks to lend. A striking example of this sort has been the asset price bubble in Japan in the late '80s. Plummeting asset prices and rising non-performing loans have undermined the solvency position of banks, making them unwilling to lend. The extremely accommodating policy stance, with interest rates close to zero percent, could not reopen the bank lending channel (Bakker, 2002).

From the above, it is apparent that an adequate monetary policy is a fundamental prerequisite for the smooth functioning of the financial cycles and can act as a stabilizer. The reverse is also true. Nevertheless, monetary policy alone cannot guarantee the stability of financial systems. Ferguson (2002) carefully explores whether financial stability should be made an explicit objective of central banks and Cihak (2006) reviews in detail how central banks consider the role of financial stability. A summary of Cihak's findings are presented in Table 1.

Domestic financial stability is also closely interrelated to the global monetary system. Mishkin (1999, p. 6) carefully develops a conceptual framework for global monetary instability and concludes by proposing the following definition: Financial instability occurs when shocks to the financial system interfere with information flows so that the system can no longer do its job of channeling funds to those countries with productive investment opportunities.

Brock and Malliaris (1989) present a comprehensive exposition of the technical concept of stability and its applications to economics. They define stability as the special property of an economic system that allows it to return quickly to its original state after an exogenous shock. Following Mishkin, and Brock and Malliaris, we use the concept of financial instability to mean any shock in the economic system that prevents the economy's GDP from recovering quickly. The role of the Fed as the agency responsible for stable economic growth implies a broader definition of economic stability that includes both low inflation and optimum economic growth. Table 1 lists various definitions of stability adopted by various central banks.

Table 1: Financial Stability As An Explicit Central Bank Objective Among Other Countries	
Bank of Canada	<p>“regulate credit and currency in the best interest of the economic life of the nation, to control and protect the external value of the national monetary unity and to mitigate by its influence fluctuations in the general level of production, trade, prices and employment so far as may be possible within the scope of monetary action, and generally to <i>promote the economic and financial welfare of Canada.</i>”</p>
Bank of England	<p>“Objectives of the Bank of England shall be (a) to maintain price stability, and (b) subject to that, to support the economic policy of Her Majesty’s Government, including its goals for economic growth and employment.”</p> <p><i>Note: There is a memorandum of understanding between the Bank of England and the government that delineates the Bank’s responsibilities in the area of financial stability. It assigns the Bank of England responsibility in three broad areas including stability of the monetary system, stability of financial system infrastructure particularly in the area of payment systems, and monitoring of the financial system as a whole.</i></p>
Bank of Japan	<p>“The objective of the Bank of Japan, as the central bank of Japan, is to issue bank notes and to carry out currency and monetary control.”</p> <p>“In addition to what is prescribed by the preceding Paragraph, the Bank’s objective is to ensure smooth settlement of funds among banks and other financial institutions, <i>thereby contributing to the maintenance of an orderly financial system.</i>”</p> <p>“(Currency and monetary control shall be aimed at, through the pursuit of price stability, contributing to the sound development of the national economy.)”</p>
ECB	<p>“the primary objective of the ESCB shall be to maintain price stability. Without prejudice to the objective of price stability, it shall support the general economic policies in the Community with a view to contributing to the achievement of the objectives of the Community.”</p> <p><i>“the basic tasks to be carried out through the ECSB shall be....to promote the smooth operation of the payment systems.”</i></p> <p><i>“The ECSB shall contribute to the smooth conduct of policies pursued by the competent authorities relating to the prudential supervision of credit institutions and the stability of the financial system.”</i></p>
Reserve Bank of New Zealand	<p>“The primary function of the Bank is to formulate and implement monetary policy directed to the economic objective of achieving and maintaining stability in the general level of prices.”</p> <p>“In formulating and implementing monetary policy the Bank shall--- (a) <i>Have regard to the efficiency and soundness of the financial system.</i>”</p>
Riksbank	<p>“The objective of the Riksbank’s operations shall be to maintain price stability.”</p> <p><i>“In addition, the Riksbank shall promote a safe and efficient payment system.”</i></p>

Calvo and Reinhart (2000) use a similar logic to argue that floating exchange rates can have destabilizing effects on emerging markets. These authors and we, in this paper, understand instability to be the movement of an economy to a lower level of economic activity without an automatic recovery. The shock usually influences the exchange rate, which in turn causes other economic variables to change, such as interest rates, prices, bank loans, real investment, consumption, possibly GDP, and finally, national welfare. Bacchetta and Wincoop (2000) develop a general equilibrium framework to study the effect of the exchange rate system on trade and welfare. They show that trade and welfare implications of currency instabilities depend on variables such as preferences and monetary policy rules, and that one cannot a priori assign higher welfare to higher trade.

In contrast to the current instabilities, the international monetary order established by the Bretton Woods system was the last systematic attempt to promote global financial stability at the world level as a tool for promoting trade growth. The aim of the agreement was to make the independent conduct of national economic policies compatible with the maintenance of stable international economic conditions. Restricting short-term capital movements was an essential element of the system. Economic historians Bordo and Eichengreen (1993) document that the system worked remarkably well during the decade of the 1950s and contributed to the restoration of both the European and Japanese economies. However, the system collapsed at the beginning of the seventies when the two conditions that had ensured its success in the preceding three decades ceased to hold. These conditions were stable macroeconomic policies in the country issuing the reserve currency, and capital mobility that was effectively controlled.

The oil crisis and the accommodating monetary policies by the U.S. Federal Reserve contributed to high and persistent inflation during most of the 1970s. Exchange rate flexibility restored the effectiveness of subsequent tight monetary policies introduced by Fed Chairman Volcker in controlling inflation but did not prevent the emergence of severe unemployment, economic stagnation, and losses in economic welfare in the late 1970s and early 1980s. The

restrictive monetary policies pursued during the early 1980s have produced a lasting reduction in inflation and a curbing of wage pressures. The conviction has grown that the internal and external value of each currency depends on the confidence of investors in the economy's potential to grow with price stability.

It would nonetheless be simplistic to imagine that each country's effort to stabilize its economy is sufficient to ensure stable economic and monetary conditions at the international level. An important part of the international banking system, and more generally of financial markets, operates outside national borders. The quantity of money and credit created and exchanged is beyond the direct control of any international authority. Furthermore, it is hard for uncoordinated national policies to prevent fluctuations in the prices of financial assets from imparting destabilizing impulses to the real economy. The high degree of financial and trade integration means that every country can be hit by the shock waves emanating from other regions.

This rapid bibliographical survey and the adoption of economic stability as an important responsibility of central banks that is much broader than the narrowly defined monetary policy leads to asking what theories are available to explain financial instability. Actually there is only one theory proposed by Hyman Minsky (1986) who cites numerous economic episodes as evidence that economic systems do not always conform to neoclassical assumptions of achieving stable growth. Minsky called his theory the Financial Instability Hypothesis. Minsky argues that in a modern capitalist economy with expensive capital assets and a complex and sophisticated financial system actual economic activity is greatly influenced by firms' expectations of future profits and financing decisions by banks and other financial institutions. Minsky proposes a credit cycle model of five stages: displacement, boom, euphoria, profit taking and panic. For example during the mid-1990s a displacement occurred with the invention of the internet and the computer revolution. This led to the boom of technology and internet stocks and was followed by the general euphoria that the new economy could generate rapid wealth and high productivity for a long time. A certain group of investors started taking profits in 1999 and early 2000 and when the

much anticipated Y2K crisis did not fuel further profits for the technology stocks, a panic selling in 2000-2001 caused NASDAQ to crash by around 80%.

4. Should Central Banks Target Asset Prices? Simulation Literature

A number of researchers have used simulations of stochastic dynamic macroeconomic models to address the issue of whether a central bank should set monetary policy to target asset prices as well as inflation and the output gap. This literature essentially reaches the conclusion that central bankers should target interest rates based on inflation and output gaps and not directly on asset prices.

One strand of this literature starts with Bernanke and Gertler (1999) and is then followed by Cecchetti, Genburg, Lipshy and Wadhvani (2000), Bernanke and Gertler (2001) and Cecchetti, Genberg and Wadhvani (2002). These papers report simulations of dynamic new Keynesian models with stock prices determined by both economic fundamentals and a bubble. The bubble component captures the feedback effect that occurs when investors base their buying decision solely on observing rising prices in the past. Monetary policy is specified by a Taylor rule which sometimes is augmented with asset prices. Hayford and Malliaris (2001, 2004, 2005a) have followed this approach. The simulation results reported in these various papers indicate that a central bank should include asset prices in the Taylor rule if two conditions are met: 1) The central bank can identify if a bubble exists, i.e. knows if an asset price boom is driven by non-fundamentals, and 2) the central bank knows exactly when the bubble will burst. Since these conditions are not likely to be met in practice, particularly the second condition, the simulation results suggest that central banks should focus solely on inflation and the output gap when setting monetary policy and not directly consider asset prices.

Filardo (2000, 2001) explores the role of monetary policy in an economy with asset bubbles by developing a small-scale macroeconomic model and running various simulations. He finds that if there is no uncertainty about the role of asset prices in determining output and inflation then monetary policy should respond to asset prices. In a later paper Filardo (2004) suggests that in dealing with asset price bubbles the use of both fiscal policy and financial regulation (prudential policies) should be considered along with monetary policy.

Blanchard (2000) and Bordo and Jeanne (2002) use a dynamic New Keynesian framework in which asset price bubbles lead to excessive capital or debt accumulation which when the asset price bubble bursts result in a prolonged slump. Bordo and Jeanne argue that more restrictive monetary policy will dampen an asset price bubble at a cost of lower output during the bubble. The benefits of such a monetary policy are higher output than otherwise would have been the case when the bubble bursts from a lower level. However Bordo and Jeanne are skeptical about whether in the real world central bankers can actually identify bubbles accurately and assess the inter-temporal trade offs involved in attempting to dampen an asset price bubble. Greenspan (2004) is skeptical that monetary policy can successfully dampened asset price bubbles while at the same time maintaining output stability. This sentiment is consistent with Cogley (1999), Bullard and Schaling (2002) and Goodfriend (2002) who conclude that using monetary policy to attempt to pop asset price bubbles is likely to result in greater economic instability than waiting for bubbles to pop on their own.

In sum the weight of the simulation literature suggests that whether monetary policy should react to an asset price bubble depends on whether central bankers can distinguish

between stock price booms driven by economic fundamentals and those driven by bubbles. Bernanke and Gertler (1999, 2001) think that in the real world central bankers cannot make this separation and hence should set interest rates to target inflation and the output gap. Cecchetti et al (2000, 2002) on the other hand, think that central bankers may be able separate bubbles from fundamentals depending on the circumstances. However attempting to pop asset price bubbles has a cost. As stated by Greenspan (2004) “the notion that a well-timed incremental tightening could have been calibrated to prevent the late 1990s bubble while preserving economic stability is almost surely an illusion.”

5. A Simple Model of Monetary Policy and Bubbles

We now develop a simple framework for thinking about the issues facing central bankers setting monetary policy during an on going bubble. Following the notational convention in DeLong and Olney (2006) we write following functions for consumption (C) and investment (I):

$$C = C_0 + C_y(1-t)Y + C_B B$$

$$I = I_0 - I_r r + I_B B$$

where X_0 is the autonomous level of spending for variable $X = C, I, B$ and $X_j \geq 0$ is the partial derivative of X with respect to $j = y, B, r$. Of course Y is real GDP, t is the tax rate and r is the real interest rate. The bubble (B) potentially has both wealth effects on consumption C_B and a financial-accelerator effect on investment, I_B . The bubble is assumed to follow the following process which is roughly consistent with the rational bubble specification of Blanchard and Fisher (1989) which was also used by Bernanke and Gertler (1999):

$$B = \begin{cases} 0 & \text{before and after the bubble} \\ B_0 - B_r r & \text{while the bubble is on going} \end{cases}$$

The parameter B_r measures how sensitive the bubble is to real interest rates and hence to monetary policy.

Using the national income identity to solve for real GDP results in the familiar (except perhaps for the bubble term) “IS curve”:

$$Y = \begin{cases} \mu\{C_0 + I_0 + G - I_r r\} & \text{before and after the bubble} \\ \mu\{C_0 + I_0 + G + (I_B + C_B)B_0 - [I_r + (I_B + C_B)B_r]r\} & \text{while the bubble is on going} \end{cases}$$

where $\mu = (1 - C_y(1 - t))^{-1}$ is the multiplier and G is government purchases. We close the model by assuming that in the long run the real interest rate equals the natural real interest rate r_n which solves the IS equation for real GDP equal to potential, Y_p (for simplicity assumed to be constant), while in the short run the central bank can set the real interest. Of course in the short run real GDP can deviate from potential.

We start the economy in a long run equilibrium with no bubble (so, $Y = Y_p$ and $B = 0$). In figure 1 this corresponds to point 1. Then the bubble starts. The bubble has two effects on the IS curve: First due to the wealth and financial-accelerator effects the IS curve shifts right by the amount: $\mu\{(I_B + C_B)B_0 - [(I_B + C_B)B_r]r_n\}$. The second effect is that the IS curve gets flatter due to the bubble potentially making spending more sensitive to interest rates. That is the slope of the IS curve $\Delta r / \Delta Y$ changes from $-[\mu I_r]^{-1}$ to $-[\mu(I_r + (I_B + C_B)B_r)]^{-1}$. Where the economy locates on the new IS curve depends on the response of monetary policy. If the central bank keeps real interest rates unchanged

after the bubble starts, then the bubble pushes real GDP above potential in the short run (point 2 in figure 1). Then extent to which real GDP increases above potential depends on the magnitudes of the wealth and financial accelerator effects (C_B and I_B), the size of the bubble B_0 and the interest sensitivity of the bubble B_r .

Suppose the central bank sets the real interest rate according to the Taylor rule with the economy initially in long run equilibrium so real GDP equals potential and inflation equals the inflation target. Then the central bank responds indirectly to the bubble by increasing real interest rates to prevent inflation from increasing and to keep real GDP equal to potential. That is the economy will end up at point 3 in figure 1. By increasing real interest rates the central bank will decrease the size of the bubble by $-B_r \Delta r$. In this case the central bank is responding solely to the potential positive output gap rather than responding directly to the asset price bubble. When the bubble pops so that $B = 0$, the IS shifts back left and if real interest rates remain unchanged the economy is at point 4. Notice that the size of the negative to spending when the bubble pops is smaller the higher are real interest rates prior to the pop. Once the bubble pops the central bank, following Taylor's rule, will cut real interest rates and push the economy back to a long run equilibrium back at point 1.

Alternatively we can imagine a central bank which sets the real interest rate to keep the bubble equal to zero. In this case rather than going from point 2 to point 3, the economy will go from point 2 to point 5: setting the bubble equal to zero has the side effect of decreasing real GDP below potential in the short run. Further the amount real GDP falls below potential will be greater the smaller is the sensitivity of the bubble to the real interest rate, B_r . At point 5, the bubble is just suppressed. When the bubble pops the

IS pivots around point 5. Then by cutting real interest rates, the central bank can return the economy to its long run equilibrium at point 1.

If explicit dynamics were added to the model, then following the Taylor rule in the face of an asset price boom and bust (no bubble, bubble, no bubble) would result in the economy cycling from points 1 to 2, to 3 to 4 and back to 1. If the central bank sets real interest rates to attempt to stop the bubble entirely, the economy cycles from points 1 to 2, to 5 and back to 1. Hence this simple framework is consistent with Bernanke and Gertler (1999) and others who argue that the economy will be more stable if the central bank focuses solely on inflation and the output gap when setting monetary policy.

6. The Fed and the Stock Market in The 1920s

U.S monetary policy in the 1920s up to end of 1930 provides a case study of how a central bank responded to an apparent stock market bubble and the economic consequences of its response. Bordo and Jeanne (2002) argue that the 1920s and 1930s are an example of a boom-bust cycle in stock prices that was very costly in terms of loss of output. They suggest if monetary policy could have "...diffused the stock market boom in 1928 rather than following the policies that it did, the outcome would have very different. In contrast Cogley (1999) in reviewing the 1920s argues that "...rather than illustrating the dangers of standing on the sidelines, the events of 1928-1930 actually provide a case study of the risks associated with a deliberate attempt to puncture a speculative bubble." We conclude, with Cogley, that the 1920s up to the end of the 1930 illustrates the risks and difficulties faced by central bankers who attempt to pop a stock price bubble.

Figure 2 shows the key macroeconomic variables from 1920 to 1930. The quarterly data are from Balke and Gordon (1986) and the monthly data are from the NBER historical macro series database or FRED. The top two graphs of the Figure 2 show two measures of output: industrial production and real GNP. The shaded areas correspond to NBER dates for four economic contractions in the 1920s: January 1920 to July 1921, May 1923 to July 1924, October 1926 to November 1927 and finally August 1929 to March 1933. Industrial production (which the Fed measured at the time) and real GNP (which was not measured at the time) are highly correlated and match the NBER business cycle dates.

Though there were four recessions during the period, the 1920s were a period of impressive economic growth. Real GNP grew from 1921:1 to the peak in 1929:3 (August), at an average rate of 4.7%. The level of real GNP increased 160%. Over the same period the year to year growth rate of industrial production averaged 5.7% with the level increasing 197%. The economic growth was fueled in part by the new technologies of electric appliances and the automobile, the real costs of which were falling over the period. These new technologies provided credence to the idea of a “new economy era.”

The lower left graph in figure 2 shows log of the price level during the period. There is no sustained inflation during this period as there is after WWII but rather the price level fluctuates rather dramatically. Inflation associated with WWI is followed by deflation in the early 1920s. From 1922 on, the price level has an upward trend until the beginning of the Great Depression.

Figure 3 shows the path of the Dow-Jones Industrial stock price index from 1919 to 1933. The U.S. stock market boomed from 1925 to 1929. The business press in the 1920s

was optimistic about the future growth prospects of the economy and echoed the “new era” language used to describe the stock market boom of the 1920s. In addition, there was an optimistic belief in Federal Reserve System’s ability to stabilize the economy described in Shiller (2000). The 1926-27 recession did not stop the boom and after the economy started expanding again in November 1927, the boom accelerated. Cogley (1999) argues, using the historic average of the price earnings ratio, that “...stock prices were not obviously overvalued at the end of 1927”. Galbraith (1958) and Kindleberger (1989) claim the bubble began in March 1928 and beginning in 1928 the Fed became concerned about what it perceived to be excessive stock market speculation.

Figure 4 shows four measures of monetary policy: the discount rate, monetary base, gold reserves (part of the monetary base at the time) and the M2 measure of the money supply. During 1920s the monetary policy of the Federal Reserve System was influenced by both international and domestic events and the Fed’s responses to these events were filtered through the ideology of the gold standard and the real bills doctrine.

While the U.S. had remained on the gold standard during WWI its European trading partners had not. The ideology of the gold standard held that leaving the gold standard to fight a war was temporary and not a change of policy regime (Temin (1989)). After a war it was assumed that countries would return to gold. In 1925 the United Kingdom chose to return to gold at the pre-war parity rate. At the pre-war parity rate the British pound turned out to be over-valued relative to the franc and the dollar and consequently Britain ran balance of payment deficits with France and the United States. Historical accounts of the period suggest the Federal Reserve System helped Britain’s return to gold by lowering its discount rate prior to 1925. From the NBER historical data, (see figure 4) the

average monthly discount rate at the Federal Reserve Bank of New York has a downward trend from 1920 to end to 1924. But the downward trend stops in 1925 the year Britain returned to gold with an increase from 3% to 3.50% by March 1925. From 1926 to February 1928 the discount rate fluctuated between 3.50% and 4%. The historical accounts of monetary policy in this period also focus on the influence of the Fed's gold reserves on the setting of the discount rate. For example the loss of gold reserves in 1925 stopped the downward trend of the discount rate. The Fed was willing to help the Bank of England so long as it did not lose too much gold.

Consistent with historical accounts, figure 4 clearly that monetary policy turns contractionary in 1928: the discount rate increases by over 200 basis points from 1927 to September 1929 and the growth rate of the monetary base and M2 goes from positive to essentially zero during this period.

The switch to contractionary policy by the Fed is attributed by economic historians to two reasons (Temin 1989, Eichengreen 1996). The first reason for the switch in policy was to stop the decline in gold reserves. This reason is consistent with the gold standard ideology of maintaining sufficient gold reserves to insure convertibility to gold. The second reason was to stop speculation in the stock market. This reason is in line with the real bills doctrine, at the time an influential monetary theory that held that bank loans should only be made to finance real economic activity and not to finance financial speculation. By the 1927 the Fed had become concerned with what it thought was excessive bank loans to finance speculation in the stock market which conflicted with the real bills doctrine (Eichengreen 1996). The New York Fed responded in March 1928 by increasing the discount rate in a series of steps peaking in October 1929 at 6%. The Fed

also discouraged banks from lending to finance speculation. The result can be seen in the measures of monetary policy in figure 4. The growth rate of the monetary base and M2 essentially goes to zero. According to Hamilton (1987), "...in terms of magnitudes consciously controlled by the Federal Reserve, it would have been difficult to design a more contractionary policy" than the monetary contraction of 1928.

What is particularly interesting for the issues of monetary policy and the stock market is that the contractionary monetary policy beginning in 1928 did not arrest the stock market boom. In fact the DJIA continued to increase for an additional 19 months, with the DJIA increasing by 77% after the shift to a contractionary monetary policy. In addition, figure 2 shows that the economy boomed along with the stock market in 1928. Industrial production peaked in August 1929 and the stock market crashed in October 1929. Hence the impact of monetary policy on real economic activity occurred, as always, with a lag. Interestingly in this case, with the slower growth in the economy showing up a couple of months prior to the stock market crash, the economy led the stock market.

The Fed responded to the stock market crash by cutting the discount rate to 150 basis points by the end of 1929. If such an expansionary monetary policy had continued there is good chance that the Great Depression may have just been another recession. Instead a series of monetary and fiscal policy mistakes led to the Great Depression. Friedman and Schwartz (1963) and Temin (1989) present a detailed analysis of these events.

The evidence we presented above supports the position that the 1920s show the risks of using monetary policy to try to stop speculative stock price bubbles. The late 1920s serve as an example of a central bank responding to a perceived speculative bubble by

enacting a contractionary monetary policy. The fact that the stock market continued to expand dramatically for nineteen months after the monetary policy turned contractionary is consistent with the theoretical bubble literature that suggests that monetary policy cannot pop bubbles. The contractionary monetary policy eventually caused a recession that began in August 1929 and only after the economy started contracting did the stock market crash of October 1929 occur. Hence attempting to stop the stock market bubble in the late 1920s, resulted in a recession that due to other subsequent monetary and fiscal policy mistakes evolved into what is now called the Great Depression. The stock market bubble popped only after the recession began.

7. Japan in the 1980s

There is widespread consensus that the Japanese stock market experienced a bubble from 1985 to the end of 1989. Figure 5 gives the path the Nikkei 225 from 1980 to 2004. During the bubble period the Nikkei 225 increased 225% from approximately 12,000 to a peak of 39,000. In the beginning of 1990 the Japanese stock market crashed. As of April 2004, the Nikkei was back to around 12,000. Here we review the economic and financial developments in Japan during the bubble period and focus on the questions: 1) what caused the bubble in Japan, 2) what role if any did monetary policy play in causing the bubble and 3) what role did monetary policy play in the popping of the bubble.

As in the case of U.S. in the 1920s, Japan's monetary policy in the 1980s was influenced by international events. High U.S. interest rates in the 1980s, perhaps due to the U.S. government budget deficits, strengthened the U.S. dollar relative to the Yen and led to increased U.S. imports from Japan. Figure 6 gives the Yen dollar exchange rate

from 1980 to 2004. According to Eichengreen (1996) and others, the appreciation of the U.S. \$ from the early 1980s to June 1984 was consistent with the relatively higher interest rates in the United States. However from June 1984 to August 1985, the continued appreciation of the dollar was not consistent with macroeconomic fundamentals, indicating the possibility of a speculative bubble in the exchange rate. The apparent speculative bubble in the exchange rate along with rising protectionist pressures due to the large U.S. trade deficit with Japan, led to the “Plaza Accord” in which the G5 finance ministers and central bankers agreed to try to make the dollar depreciate. The dollar having peaked in February 1985 at 260 Yen/\$ was already falling. When the Plaza accord was made public the dollar continued its depreciation until 1987. The depreciation occurred even though there was little intervention in the foreign exchange market by G5 central banks.

The rapid depreciation of the U.S. dollar relative to the Yen from 1985 to 1987 (from 260 to 128 Yen/\$) induced the Bank of Japan (BOJ) to follow a policy of monetary ease to offset the impact of an appreciating Yen on domestic demand. Figure 7 gives two measures of BOJ monetary policy, the call rate and the official discount rate (ODR). The call rate plays a role similar to the Federal funds rate in the US and the official discount rate is similar to the Fed’s discount rate. By these interest rate measures of monetary policy, the BOJ followed a policy of continual ease in the 1980s up until 1987.

The beginning of the stock bubble in Japan corresponds to the popping of the apparent bubble in the U.S. dollar. The monetary ease in response to the U.S. dollar depreciation by the BOJ from 1985 to 1987 helped the Japanese economy boom during this period. Figure 8 gives the level and growth rate of Japan’s real GDP from 1980 to

2004. From 1985 to 1987, output grew above trend productivity growth with no signs of inflation (see figure 9).

While easy monetary policy is neither necessary nor sufficient for the emergence and growth of a stock market bubble, the easy Japanese monetary policy from 1985 to 1987, along with low inflation, rapid growth in exports, high productivity and rapid GDP growth, perhaps helped trigger investors' expectations about the future flow of higher profits of Japanese corporations. Further, Japan's world leadership in manufacturing, steady economic growth and growing trade surplus with the United States led to a "self confidence" in Japan (Okina et. al 2000 p 12). This self confidence may have played a role similar to the notion of the "new economic era" which we have seen above is typically a necessary condition for a bubble to develop. The economic boom and sense of a new era were perhaps the initial catalyst that got Japanese stock prices rising. The rising stock prices induced a further optimism and euphoria with rises in prices inducing further increases in prices.

From February 1987 to April 1989 the BOJ keep the Official Discount Rate at 2.5% while the uncollateralized call rate ranged from 3.30% to 4.43%. By May of 1989, the BOJ grew considered about accelerating consumer price inflation even through inflation was still at a relatively modest level (see figure 9). In May 1989 BOJ's monetary policy shifted to tightening. The ODR increased from 2.50% to 3.75%, followed by a fifty basis point increase in October and another fifty basis points in December 1989. The stock market crashed in January 1990 and monetary policy continued to tighten even after the bubble popped, with the ODR reaching 6% by August of 1990 where it remained until

July 1991. At this point the Nikkei 225 was at 24,000, two-thirds the peak of December 1989.

One question is whether the Bank of Japan could have prevented the eventual burst by deflating the bubble earlier. The timing of the tightening of monetary policy with the stock market crash in 1990, unlike the episode of the U.S. monetary policy and the stock market in the 1920s, lends credence to the idea that monetary policy can pop a stock market bubble. The resulting recession due at least in part to restrictive monetary policy also gives evidence of the costs of popping a bubble, and following continued restrictive monetary policy after the pop.

While there is a consensus *ex post* that there was a bubble in the Japanese stock market, during the time the bubble was growing, there was no agreement. As in the U.S. in the late 1990s, inflation was low in Japan during the bubble, which suggested the boom was sustainable. Furthermore as in the case of the Fed in the 1990s, the Bank of Japan could not estimate the size of the bubble nor could the Bank estimate the size of the increase in interest rates necessary to deflate the bubble. This is position of Bernanke and Gertler (1999), although Kuttner and Posen (2001) discuss the fact that Japanese official estimates of potential growth were understated and allowed monetary policy to remain easy longer than was appropriate.

After the stock market bubble burst in Japan in December 1989 some economists such as Koo (2003) have argued that this burst is the major cause of Japan's long recession during most of the 1990s. Others like Hayashi and Prescott (2000) minimize the role of the bursting of the stock market bubble and argue that the recession can be explained by a real business cycle framework.

The role of Japanese monetary policy after the collapse of the stock market is an interesting example of a central bank responding to a popping bubble. As mentioned above, the Bank of Japan increased the ODR from 2.50 in May 1989 to 6% in August 1990. The ODR remained at 6% for eleven months before monetary policy shifted back to ease in July 1991 with a fifty basis point cut. By February 1993 the ODR was back at 2.50%. Currently the ODR is set at ten basis points. The size of the drop in the ODR since July 1991, are large. What has been disputed is the timing and pace of these declines. First of all, monetary policy remained tight for eleven months after the collapse in stock prices. Kuttner and Posen (2003) argue that the Bank of Japan should have followed a more rapid strategy of interest rate cuts by paying more attention to output rather than inflation. Central bank officials explained their tight monetary policy in the face of collapsing asset prices and a dramatic slowdown in economic growth, with language similar of that used by Federal Reserve Officials in the 1920s (Okina et al 2000) Since the Japanese core CPI inflation continued to rise after the burst of the stock market bubble until mid-1992, it is difficult, ex post, to claim that the Bank of Japan was slow in its pace to cut interest rates. Real GDP was also strong in both 1990 and 1991, from both the inflation and GDP data, Japan's bursting of the stock market did not have significant real economic effects. Actually, the 1990-94 period in Japan is viewed as a normal growth recession and 1995-96 was a typical recovery. Several other factors after the 1995-96 recovery contributed to further declines and deflation.

Japanese monetary policy during this period confirms that the bursting of financial bubbles can be contained by easy monetary policy. Japan's case illustrates the typical asymmetry in the role of monetary policy towards bubbles: monetary tightening is not

appropriate to deflate the bubble but monetary ease is the correct response to a bubble crash.

8. Real Estate Booms and Busts

Roubini (2006) argues that central banks can deflate asset price booms without an adverse impact on economic activity. To support his argument Roubini cites the cases of the real estate markets of the United Kingdom (during 2003-2004), Australia (during 2003-2005) and New Zealand (during 2004-2005) as empirical evidence that "...prove[s] that monetary policy can if used wisely and moderately, be very effective in pricking asset and housing bubbles without leading to significant economic or financial damage." Roubini goes on to say that any counter-examples you can think of "...are all cases in which the asset bubble policy management was botched." It is difficult to argue against such a position.

In the case of the UK and Australia the central banks increased short-term interest rates by relatively modest amount starting from low initial levels. For example for the UK, up 125 basis points starting from 3.50%, an increase that arguably was from slightly below to up a neutral short-term interest rate. In the case of New Zealand the RBNZ increased the official cash rate, their primary instrument of monetary policy 172 basis points from January 2004 (5.03%) to summer 2005 (6.75%). According to Roubini this was done to "cool inflationary pressures and deflate the housing bubble." As a result economic growth decreased by over 50% from 4.8% to 2.3% which Roubini states "...is hardly an economic or financial meltdown." In all three of these cases economic growth slowed in response to the tightening of monetary policy. One interpretation of these case studies is that a central bank can increase interest rates without causing a recession if the

target short-term interest rate is below or close to neutral and if the economy is initially growing above trend. Under these conditions increasing interest rates to dampen a real estate price boom may not cause a recession, i.e. negative real GDP growth.

Another interesting example of a real estate boom and bust is of course the recent experience of in the United States. Figure 10 shows the Shiller-Case composite housing price index. From 2000 U.S. housing prices increased 120% peaking in the middle of 2006. Since then housing prices have slowly fallen.

Figures 11 and 12 show the path of the Federal funds rate and the actual 30 year fixed mortgage rate from 2000 to 2007 and 1987 to 2008 respectively. During the 2000-7 period, the Fed kept Federal funds rate from 2002 to the middle of 2004 at a historically low level due to fear of deflation. Taylor (2007) acknowledges that the Fed had "...good reasons stated at the time for the prolonged period of low interest rates, most importantly the risk of deflation following the experience of Japan in the mid-1990s." However Taylor (2007) argues that the Fed could have prevented the housing starts boom and bust, associated with the boom and bust in housing prices if instead the Fed had stuck to the Taylor Rule and increased the Federal funds rate at beginning of 2002. Taylor's argument seems to ride entirely on whether or not the risk causing a housing boom and bust was greater than the risk of deflation, a point we will return in a moment. When the Fed did start to increase the Federal funds rate in 2004, long term interest rates, such as the 30 fixed shown in figure 11 stayed put. Figure 11 shows a forecasted 30 fixed rate based a simple regression of historical relationship between the Federal funds rate and the 30 year fixed rate. The cause of this "bond market conundrum" i.e. lack of response of long interest rates to monetary tightening is still not agreed upon. At least two explanations

have been suggested: Ben Bernanke has suggested the cause was a global saving glut while Taylor and Smith (2007) argue it was due to US monetary deviating from the Taylor rule by not increasing the Federal funds rate sooner.

However the fact that inflation did not accelerate as a consequence of the Fed deviating from the Taylor rule from 2002-2004 provides prima facie evidence that the risk of deflation was real and was dealt with. If the Fed had increased the Federal funds rate as in Taylor's counterfactual deflation may have occurred along with stopping the boom in housing starts. This episode points out the difficulty central bankers face in balancing multiple risks to the economy while having only one monetary policy instrument. One way to deal with the risk of deflation and the housing boom would have been to use monetary policy as was done but in addition regulated sub-prime lending more closely.

9. Fed's Mandate and Lack of Political Support for Deflating Asset Price Bubbles

The Fed is an independent government agency created by an act of Congress. However the monetary policy makers know that if the policies they implement are sufficiently unpopular the Fed will face political pressure from Congress and the President and the potential of change in the institutional structure of the Fed. Hence without at least implicit political consensus and support from Congress and the President, the Fed will not undertake what might be considered radical changes in the monetary policy. While the idea that Congress would change the institutional structure of the Fed, for example making it part of the U.S. Treasury, might be considered a very low probability event, as Greenspan states, in a risk-uncertainty management framework, low probability events that would result in large losses have to be insured against. Further the Federal Reserve

Act of 1977 explicitly states the Fed's mandate as price stability and maximum sustainable economic growth. As Poole (2007) points out the "congressional mandate to the Fed does not include stable exchange rates, stable asset prices or housing investment..." Even after this mandate the Fed waited for political consensus before disinflating in the early 1980s. It is even more unlikely that the Fed would aggressively attempt to deflate a stock market or real estate price boom without political support from Congress and the President.

To see the role that politics has played in the setting of monetary policy, consider the "great inflation" in the United States. From 1965 to 1979 the trend rate of inflation accelerated. It took fifteen years of accelerating inflation for a political consensus to develop to disinflate the economy via a recession (see DeLong (1997)). After a false start in October 1979, the Fed tightened monetary policy from November 1980 to August of 1982 resulting in the deepest recession in the US since the Great Depression. The 1981-82 recession was successful in lowering the trend rate of inflation down to the 2 to 4% range. Mussa (1994) suggests that use of targeting monetary aggregates during this period was partly politically motivated in attempt to diffuse the responsibility for higher interest rates away from the Fed. In addition, Mussa argues that the timing of the second tightening of monetary policy in November 1980, right after the Presidential election and the abandoning of the use of monetary aggregate targets in August 1982, three months before the mid-term elections was also politically motivated. In the twenty years since the Fed has been successful in maintaining low inflation. Alan Greenspan (2004) attributes the low inflation since the mid 1980s in part to the political support for low inflation.

Clearly goods price inflation is politically unpopular. However no such political consensus existed for monetary policy to try to pop the stock market bubble of the 1990s or the real estate bubble of the 2000s. In fact, at the time the investing public seemed to enjoy the stock market and housing market price inflation. It seems conceivable that if the Fed had decided to increase the Federal funds rate solely for the reason of trying to stop the stock market or housing price boom that this act would have been very politically unpopular and much more difficult to defend than raising interest rates to stop goods price inflation. Hence increasing interest rates to pop asset price bubbles would likely increase the probability, however low it might be, of a loss of institutional independence of the Fed. A less independent central bank could also hurt to society at large. Research suggests that a loss of central bank independence may result in higher trend goods price inflation. Thus, political risks and uncertainty, offer an additional reason for the Fed taking no action to deflate a bubble.

10. The Recent Subprime Mortgage Financial Crisis

Having considered various past episodes of financial instability we now briefly address the current financial crisis that at this point in time remains unresolved. There are numerous surveys that address various aspects of this crisis such as Bernanke (2007) and Bailey, Elmendorf and Litan (2008). Our interest here is not to repeat what is widely known but to view this crisis as a link to the earlier internet bubble and attempt to draw certain lessons.

The typical scenario of the current subprime mortgage crisis is as follows: housing prices have been slowly increasing for a long time with essentially no correction. Such

increases were not uniform across the country. Certain areas such as California and Florida experienced in certain areas above average appreciations but the general fact was that there were no areas with systematic declines. Around 2003-4, these real estate appreciations accelerated fueling expectations of further appreciation. With low inflation, constructions costs remained stable, while low interest rates stimulated further demand. Financial institutions increased their involvement in the securitization of mortgages with an emphasis on subprime mortgages, particularly in 2005 and 2006. As monetary policy became tighter and Fed funds increased from about 1% to 5.25%, economic signs appeared that the housing appreciation was not sustainable at which point mortgage delinquencies and defaults were expected. These expectations did materialize and around summer 2007, the early signs of a subprime mortgage crisis became apparent.

Both the financial press and economists such as Filardo (2006) have argued that had the Fed moderated the decrease in Fed funds to cushion against the NASDAQ crash and furthermore had the Fed not kept Fed funds as low for as long as it did, the subprime mortgage crisis might have been prevented. Controlled experiments are not possible in economics and no one knows the answer to such hypothesis, but what is certainly new and challenging in terms of analysis of financial instability is the novelty of linking one bubble to the next. If such a link exists between bubbles, the static optimality of the asymmetric response is questioned and the new challenge to the risk management approach to monetary policy is to evaluate it in a dynamic context.

11. Conclusions

Asset prices booms and busts, “bubbles”, are a recurring phenomenon of capitalist economies. So is the debate about the appropriate response of monetary policy.

The consensus among those who set monetary policy is that the appropriate response is to cut interest rates after a bubble pops but not to increase interest rates a priori solely to deflate asset price booms. We believe the evidence shows that central bankers have good reasons for behaving in the way: ambiguous at best results from simulations of theoretical models, a historical record that suggests significant risks to economic activity of attempting to pop bubbles and finally a lack of political support for central bankers to attempt to deflate on going asset price booms. However, if a link exists between bubbles, the static optimality of the asymmetric response may be questioned and the new challenge to the risk management approach to monetary policy becomes the selection of an appropriate monetary response in a dynamic context with multiple bubbles.

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Figure 1: A simple model of monetary policy and asset price bubbles.

Real interest rate

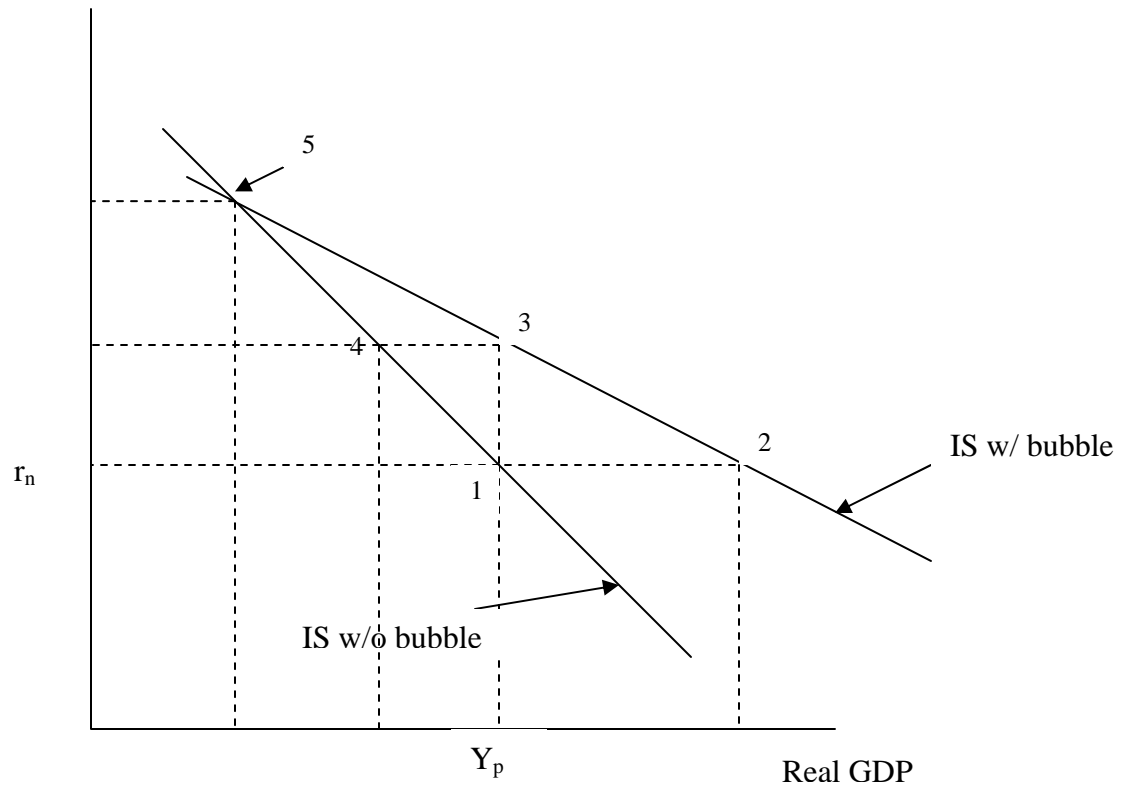


Figure 2: Measures of economic activity 1919-1930
 (Shaded areas are NBER dates for contractions)

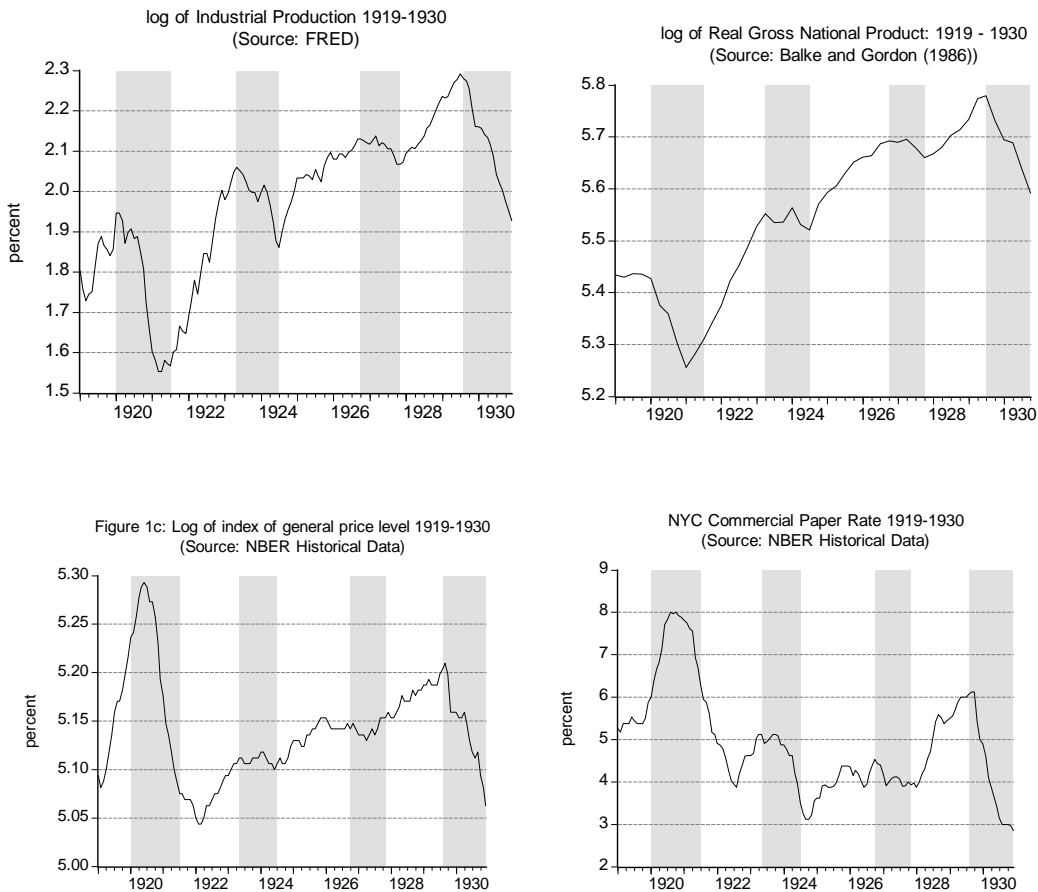


Figure 3
(Shaded areas are NBER dates for contractions)

Dow_Jones Industrial Stock Price Index (1919-1933)

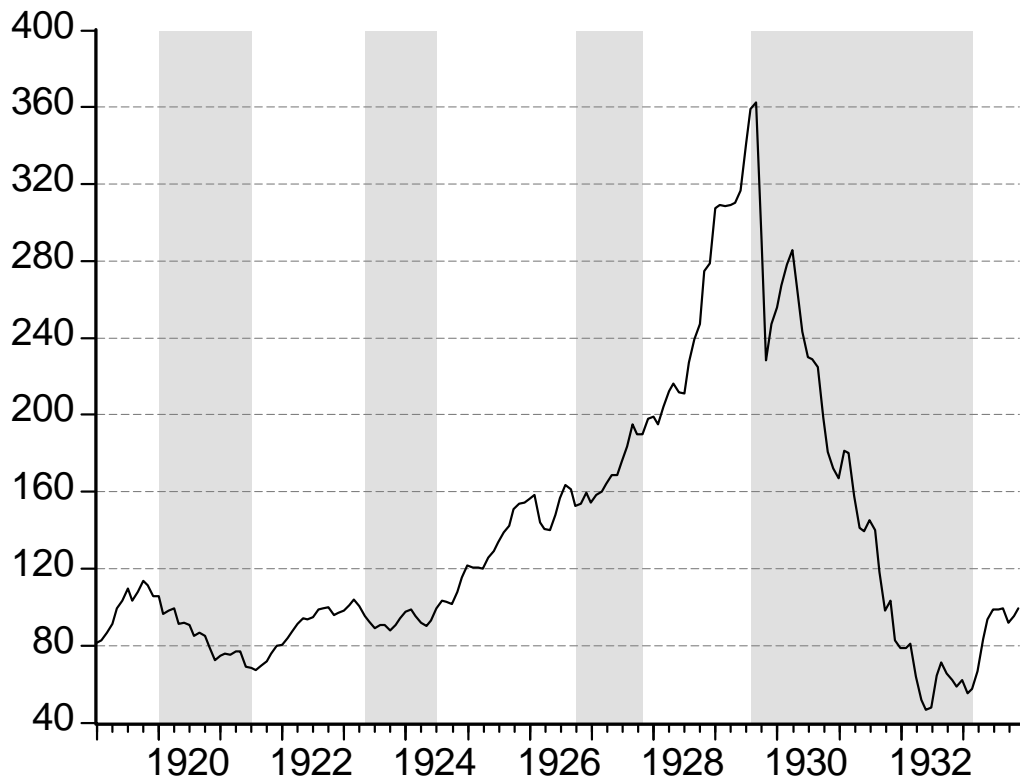


Figure 4: Measures of Monetary Policy, 1919-1930
 (Shaded areas are NBER dates for contractions)

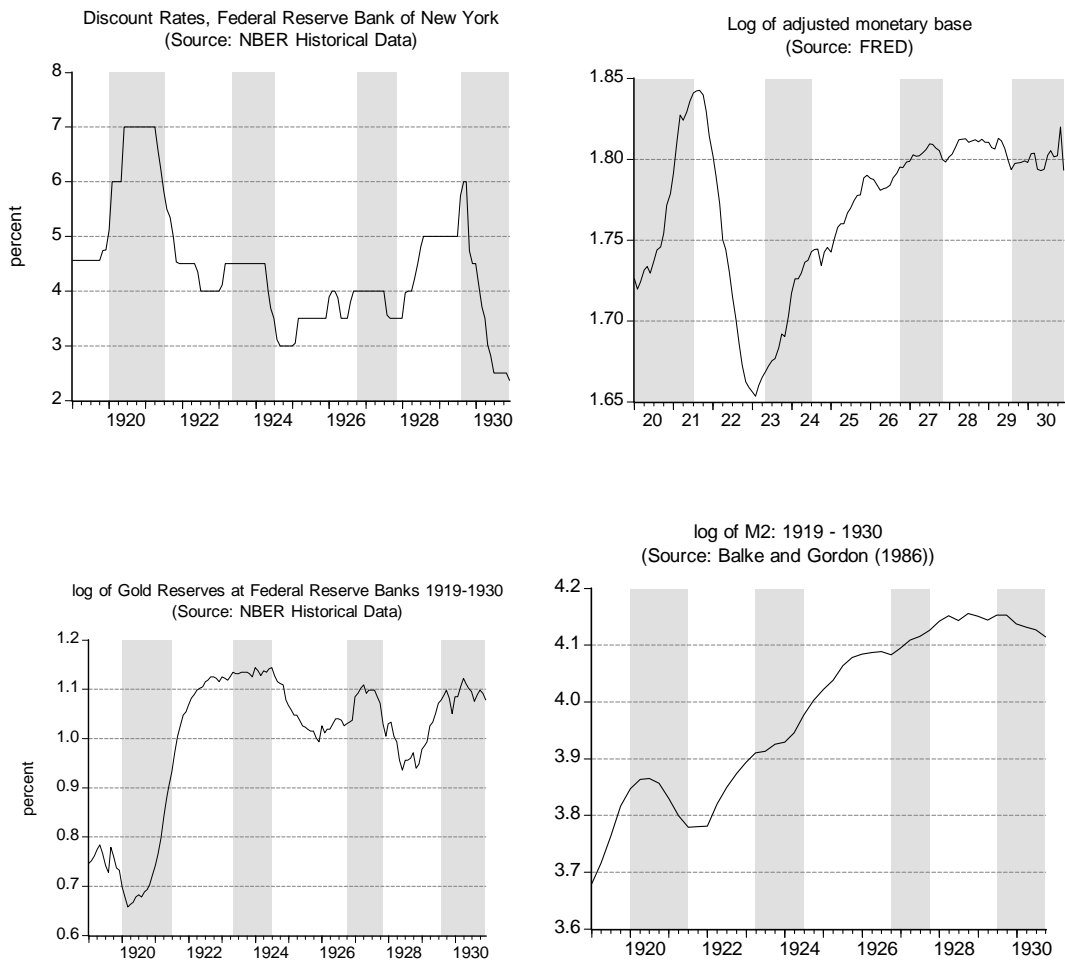


Figure 5

Nikkei Average

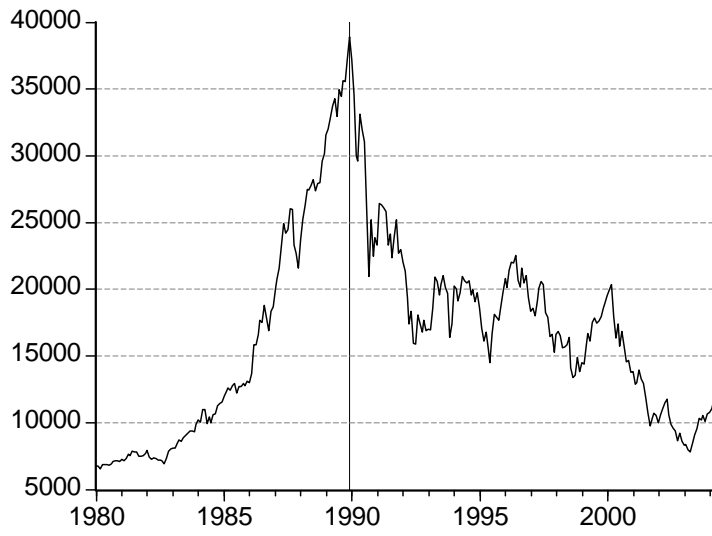


Figure 6

Exchange rate: Yen price of the dollar

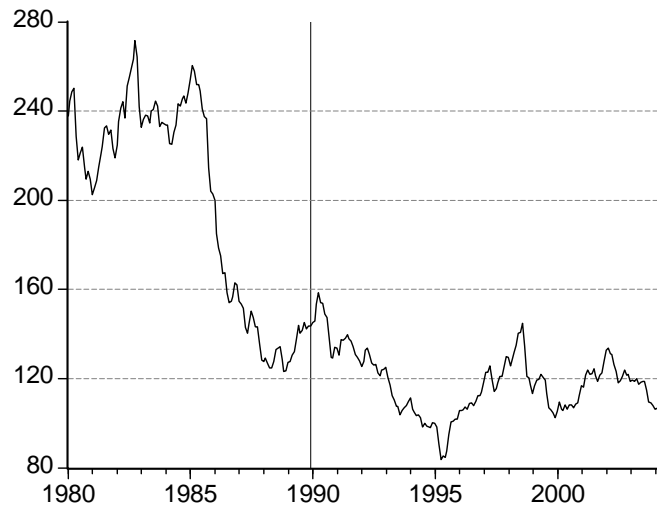


Figure 7

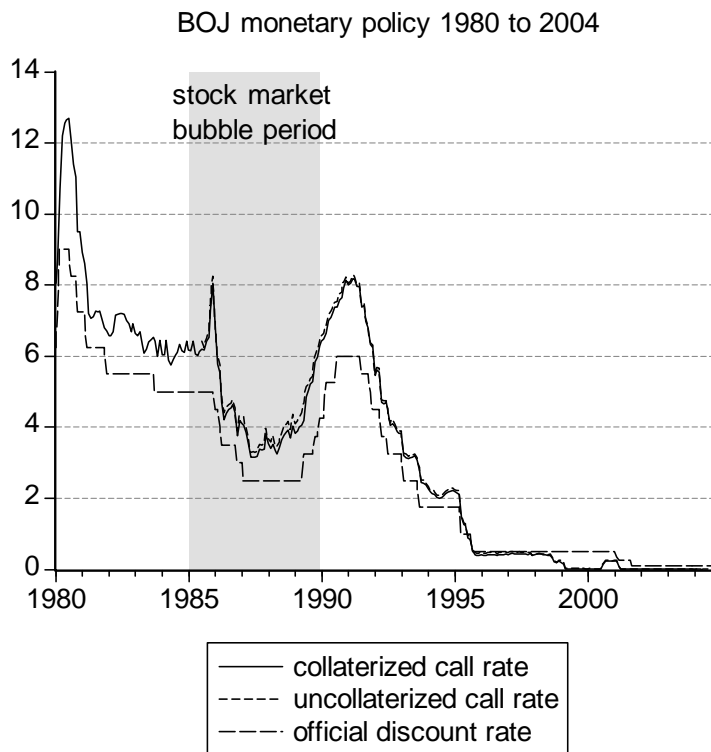


Figure 8

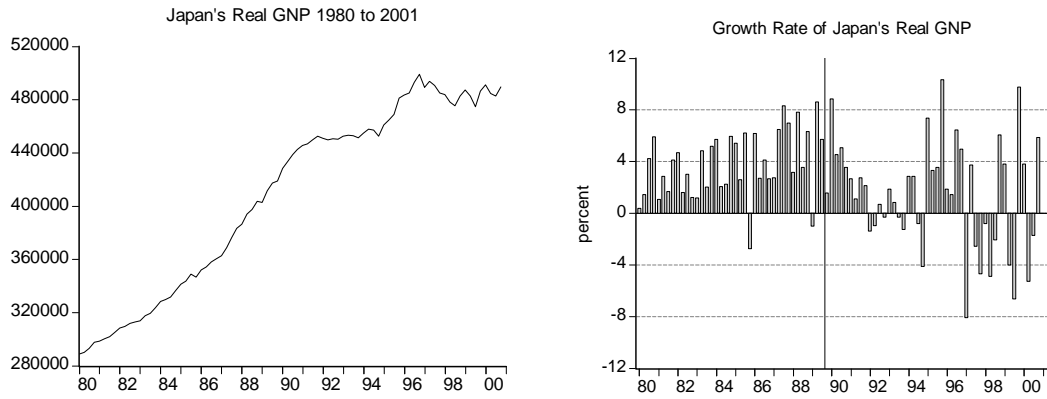


Figure 9

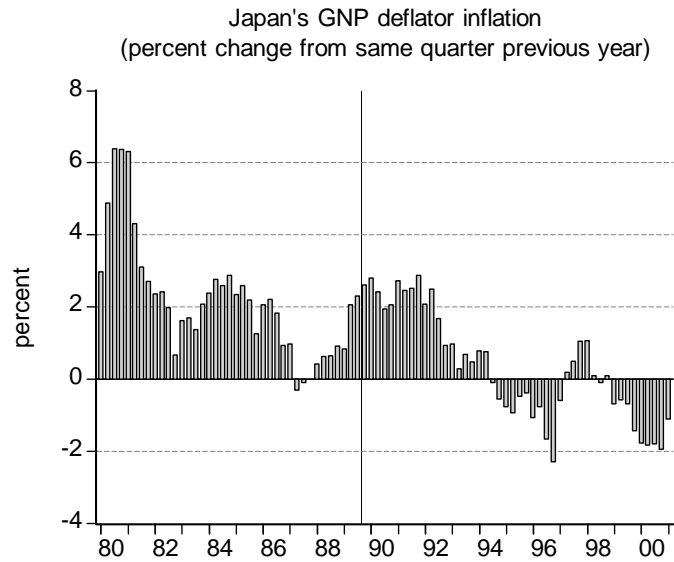


Figure 10

Shiller Case composite US housing price index

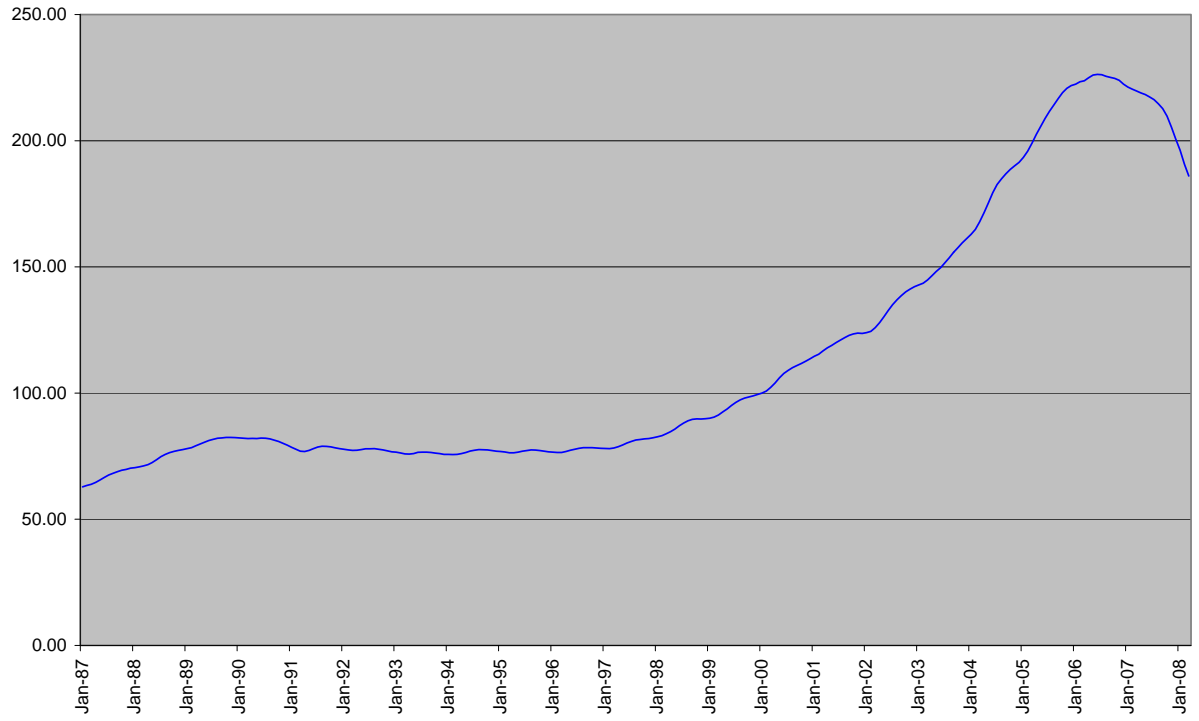


Figure 11

Fed funds rate, 30 year fixed mortgage rate (actual and forecasted)

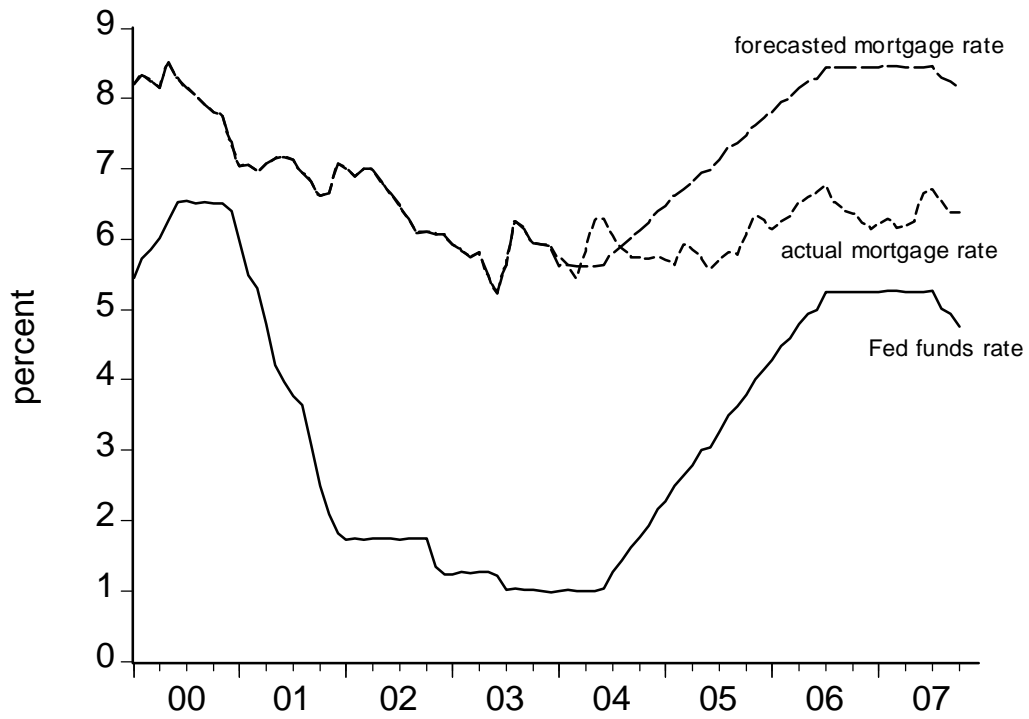


Figure 12

