

IMF Working Paper

Monetary Policy and Asset Prices: Does “Benign Neglect” Make Sense?

Michael D. Bordo and Olivier Jeanne

IMF Working Paper

Research Department

Monetary Policy and Asset Prices: Does “Benign Neglect” Make Sense?

Prepared by Michael D. Bordo and Olivier Jeanne¹

Authorized for distribution by Eduardo Borensztein

December 2002

Abstract

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

The link between monetary policy and asset price movements has been of perennial interest to policymakers. In this paper, we consider the potential case for preemptive monetary restrictions when asset price reversals can have serious effects on real output. First, we present some stylized facts on boom-bust dynamics in stock and property prices in developed economies. We then discuss the case for a preemptive monetary policy in the context of a stylized model. We find that the optimal policy depends on the economic conditions in a complex, nonlinear way and cannot be summarized by a simple policy rule of the type considered in the inflation-targeting literature.

JEL Classification Numbers: E52; N20

Keywords: Monetary policy; asset prices, credit crunch, Taylor rule, bubbles, new economy

Authors' E-Mail Addresses: bordo@econ.rutgers.edu; ojeanne@imf.org

¹ This paper was presented at the conference “Stabilizing the Economy: Why and How,” held at the Council on Foreign Relations (July 11, 2002). This paper benefited from comments by Ben Bernanke, Mark Gertler, Charles Goodhart, Allan Meltzer, and Anna Schwartz on our companion paper, Bordo and Jeanne (2002). For valuable research assistance, we thank Priya Joshi.

| | Page |
|--|------|
| I. Introduction..... | 3 |
| II. Identifying Booms and Busts in Asset Prices: The Postwar OECD..... | 7 |
| A. Methodology..... | 7 |
| B. Booms-Busts in the OECD, 1970–2001..... | 8 |
| C. Ancillary Variables..... | 13 |
| III. A Stylized Model..... | 15 |
| A. The Model..... | 16 |
| B. A Nonconventional, Nonlinear Taylor Rule..... | 20 |
| C. Discussion..... | 22 |
| Taylor rules..... | 22 |
| Irrational exuberance..... | 23 |
| Policy-induced booms..... | 23 |
| IV. Conclusions..... | 24 |
| Figures | |
| 1. Boom-Bust in Residential Property Prices, 1970–98..... | 9 |
| 2. Boom-Bust in Industrial Share Prices, 1970–2001..... | 10 |
| 3. U.S. Stock Prices: S&P 500, 1874–1999..... | 12 |
| 4. U.S. Stock Prices: Dow Jones Industrial Average, 1899–1999..... | 12 |
| 5. Ancillary Variables: Boom-Bust in Property Prices..... | 14 |
| 6. Ancillary Variables: Boom-Bust in Stock Prices..... | 14 |
| 7. Function $f(\cdot)$ | 18 |
| 8. The Optimal Monetary Policy..... | 21 |
| References..... | 26 |

I. INTRODUCTION

The link between monetary policy and asset price movements has been of perennial interest to policy makers. The 1920s stock market boom and 1929 crash and the 1980s Japanese asset bubble are two salient examples where asset price reversals were followed by protracted recessions and deflation.² The key questions that arise from these episodes is whether the monetary authorities could have been more successful in preventing the consequences of an asset market bust or whether it was appropriate for the authorities to react to these events only *ex post*. This question is of keen interest today in the United States, as more and more observers wonder about the extent of the decline in the stock market, and as the only bright spot in the economy seems to be a still ebullient housing market.

Should central banks respond only to inflation in the price of goods, or should they also respond to inflation in the price of assets? The main theme of this paper is that this question should be thought in terms of insurance. Restricting monetary policy in an asset market boom can be thought of as an insurance against the risk of real and financial disruption induced by a later bust. This insurance obviously does not come free: restricting monetary policy implies a sacrifice in terms of immediate macroeconomic objectives. However, letting the boom go unchecked entails the risk of even larger costs down the road. It is the task of the monetary authorities to assess the relative costs and benefits of a preemptive monetary restriction in an asset price boom.

Assessing the likelihood that an asset market boom will end up in a bust is a difficult task. Should this difficulty deter the monetary authorities from restricting monetary policy preemptively? The essence of the question becomes much clearer, we think, once it is cast in terms of insurance. In a boom the authorities' problem is to make the best possible assessment of the probability of a bust, and of the extent of the disruption it would produce. Obviously this assessment must be probabilistic—one cannot demand from the authorities that they exhibit a considerably higher degree of prescience than the market. But it is clear, from an insurance perspective, that uncertainty as to the sustainability of the boom is not *per se* a reason for inaction—no more than a homeowner needs to be certain that his house will burn to take some fire insurance.

Another theme that we develop in this paper is that the optimal monetary stance in an asset market boom depends on economic conditions in a complex, non-linear way. We do *not* argue that the monetary authorities should routinely target the price of assets in normal times. Rather, we argue that exceptional developments in asset markets may occasionally require deviations from the rules that should prevail in normal times. Moreover, we do not find that the optimal policy can be described in terms of a simple rule. The circumstances in which a preemptive monetary restriction is warranted cannot be reduced to the macroeconomic

² Other recent episodes of asset price booms and collapses include experiences in the 1980s and 1990s in the Nordic Countries, Spain, Latin America and East Asia, see e.g. Schinasi and Hargreaves (1993); Drees and Pazarbasioglu (1998); IMF (2000); and Collins and Senhadji (2002).

indicators that guide monetary policy in normal times. They involve imbalances in the balance sheets of the private sector, as well as market expectations.

This paper is related to a growing debate on the links between monetary policy, asset prices and financial stability. The dominant view among central bankers can be characterized as one of “benign neglect”. According to this view, the monetary authorities should deal with the financial instability that may result from a crash in asset prices if and when the latter occurs, but they should not adjust monetary policy preemptively in the boom phase.

“[...] the general view nowadays is that central banks should not try to use interest rate policy to control asset price trends by seeking to burst any bubbles that may form. The normal strategy is rather to seek, firmly and with the help of a great variety of instruments, to restore stability on the few occasions when asset markets collapse.”

(Ms Hessius, Deputy Governor of the Sveriges Risksbank, BIS Review 128/1999).³

This benign neglect is sometimes justified by the claim that although a liquidity injection may be required in the event of financial instability, it is short-lived and need not interfere with the macroeconomic objectives of monetary policy. The problems posed by lending-in-last-resort, in other words, are orthogonal to monetary policy.

On the face of it, the central bankers’ doctrine of benign neglect is difficult to understand. First, the idea that financial stability can be ensured, in the event of a crash, without sacrifice in terms of the objectives of monetary policy, is true only under a very special condition, namely that the crisis is a self-fulfilling panic. If the crisis is triggered by a permanent revision of expectations about future returns, lending-in-last-resort is not the solution. The bust in asset prices may provoke financial instability, a credit crunch, and an economic depression. Curing these problems may require maintaining for some time a higher rate of inflation than would otherwise be desirable. In this case, both the real dislocation induced by the financial crisis and the response of monetary policy involve some sacrifice in terms of the macroeconomic objectives of monetary policy.

If dealing with the crisis requires a sacrifice in terms of monetary objectives ex post, then it is difficult to understand why the monetary authorities should not take precautionary actions ex ante. There is an important difference between exogenous shocks and financial crises. Financial crises, unlike earthquakes, are endogenous in part to monetary policy. Their severity is determined by the imbalances that have built up in the boom phase, which, in turn,

³ See also Bullard and Schaling (2002), Reinhart (2002), Goodfriend (2002). Note that what we describe as the “central bankers’ view” is not shared by the official sector as a whole. Economists at the Bank for International Settlements (BIS), for example, have expressed concerns that are rather close to those developed in this paper (Borio and Crockett, 2000; Borio and Lowe, 2002).

depends on the more or less accommodating stance of monetary policy.⁴ It is quite unlikely that it is optimal for the monetary authorities to ignore the endogeneity of these risks to their own actions.

In this paper, we consider the potential cases for proactive versus reactive monetary policy based on the situation where asset price reversals can have serious effects on real output. Our analysis is based on a stylized model of the dilemma with which the monetary authorities are faced in asset price booms. On the one hand, letting the boom go unchecked entails the risk that it will be followed by a bust, accompanied by a collateral-induced credit crunch. Restricting monetary policy can be thought of as an insurance against the risk of a credit crunch. On the other hand, this insurance is costly: restricting monetary policy implies immediate costs in terms of lower output and inflation. The optimal monetary policy depends on the relative cost and benefits of the insurance.

Although the model is quite stylized, we find that the optimal monetary policy depends on the economic conditions—including the private sector's beliefs—in a rather complex way. Broadly speaking, a proactive monetary restriction is the optimal policy when the risk of a bust is significant *and* the monetary authorities can defuse it at a relatively low cost. One source of difficulty is that in general, there is a tension between these two conditions. As investors become more exuberant, the risks associated with a reversal in market sentiment increase. At the same time, leaning against the wind of investors' optimism requires more radical and costly monetary actions.⁵ To be optimal, a proactive monetary policy must come into play at a time when the risk is perceived as sufficiently large but the authorities' ability to act is not too diminished.

Another, more difficult question is whether (and when) the conditions for a proactive monetary policy are met in the real world. We view this question as very much open and deserving further empirical research. In the meantime, we present in this paper some stylized facts on asset booms and busts that have some bearing on the issue. We find that historically, there have been many booms and busts in asset prices, but that they have different features depending on the countries and whether one looks at stock or property prices. Boom-bust episodes seem to be more frequent in real property prices than in stock prices, and in small countries than in large countries. However, two dramatic episodes (the United States in the Great Depression and Japan in the 1990s) have involved large countries and the stock market. We also present evidence that busts are associated with disruption in financial and real activity (banking crises, slowdown in output and decreasing inflation).

⁴ The buildup in risks can also be mitigated by regulatory and other policies but there is no reason to believe that only these other policies, and not monetary policy, should bear all the burden of adjustment.

⁵ Alan Greenspan (2002) emphasized in a recent speech that the increase in the interest rate that may be required to prick a bubble may be quite sizeable and disruptive for the real economy.

This paper contributes to a growing academic literature on monetary policy and asset prices. The benign neglect view is vindicated, on the academic side, by the recent work of Bernanke and Gertler (2000, 2001) and Gilchrist and Leahy (2002). These authors argue that a central bank dedicated to price stability should pay no attention to asset prices *per se*, except insofar as they signal changes in future inflation. These results stem from the simulation of different variants of the Taylor rule in the context of a new Keynesian model with sticky wages and a financial accelerator. Bernanke and Gertler also argue that trying to stabilize asset prices *per se* is problematic because it is nearly impossible to know for sure whether a given change in asset values results from fundamental factors, non-fundamental factors, or both.

In another study, Cecchetti et al (2000) have argued in favor of a more proactive response of monetary policy to asset prices. They agree with Bernanke and Gertler that the monetary authorities would have to make an assessment of the bubble component in asset prices, but take a more optimistic view of the feasibility of this task.⁶ They also argue, on the basis of simulations of the Bernanke-Gertler model, that including an asset price variable (e.g. stock prices) in the Taylor rule would be desirable. Bernanke and Gertler (2001) attribute the latter findings to the use of a misleading metric in the comparison between policy rules.

Our approach differs from these in several respects. First, we view the emphasis on bubbles in this debate as excessive. In our model the monetary authority needs to ascertain the risk of an asset price reversal but it is not essential whether the reversal reflects a bursting bubble or a change in the fundamentals. Non-fundamental influences may exacerbate the volatility of asset prices and thus complicate the monetary authorities' task, but they are not of the essence of the question. Even if asset markets were completely efficient, abrupt price reversals could occur, and pose the same problem for monetary authorities as bursting bubbles.

Second, we find that the optimal policy rule is unlikely to be closely approximated by a Taylor rule, even if the latter is augmented by a linear term in asset prices. If there is scope for proactive monetary policy, it is highly contingent on a number of factors for which output, inflation and the current level of asset prices do not provide appropriate summary statistics. It depends on the risks in the balance sheets of private agents assessed by reference to the risks in asset markets. The balance of these risks cannot be summarized in two or three macroeconomic variables.

More generally, our analysis points to the risks of using simple monetary policy rules as the guide for monetary policy. These rules are blind to the fact that financial instability is endogenous—to some extent, and in a complex way—to monetary policy. The linkages between asset prices, financial instability and monetary policy are complex because they are inherently non-linear, and involve extreme (tail probability) events. The complexity of these linkages does not imply, however, that they can be safely ignored. Whether they like it or

⁶ Assessing the bubble component in asset prices should not be qualitatively more difficult, they argue, than measuring the output gap, an unobservable variable which many central banks use as an input into policymaking.

not, the monetary authorities need to take a stance that involves some judgment over the probability of extreme events. As our model illustrates, the optimal stance cannot be characterized by a simple rule. If anything, our analysis emphasizes the need for some discretionary judgment with respect to financial stability.

This article is based on an analysis that is presented in more detail in Bordo and Jeanne (2002). The latter paper describes and motivates the analysis by reference to two dramatic boom-bust episodes—the U.S. Great Depression and Japan in the 1990s. Our companion paper also shows how the stylized model used here can be grounded in rigorous micro-foundations.

The paper is structured as follows. As background to the analysis, Section II presents stylized facts on boom and bust cycles in asset prices in the post 1970 experience of 15 member countries of the Organization for Economic Cooperation and Development (OECD) countries. Section III presents the model and discusses policy implications. Section IV concludes.

II. IDENTIFYING BOOMS AND BUSTS IN ASSET PRICES: THE POSTWAR OECD

Many countries have experienced asset price booms and busts since 1973, often associated with serious recessions. In this section we present a simple criterion to delineate boom and bust cycles in asset prices. We apply this criterion to real annual stock and residential property price indexes for 15 countries: Australia, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, Spain, Sweden, the United Kingdom, and the United States over the period 1970–2001 for stocks and 1970–98 for property prices.⁷

A. Methodology

This section presents a criterion to ascertain whether movements in an asset price represents a boom or bust. A good criterion should be simple, objective and yield plausible results. In particular, it should select the notorious boom-bust episodes, such as the Great Depression in the U.S. or Japan 1986–1995, without producing (too many) spurious episodes. We found that the following criterion broadly satisfied these conditions—although it certainly is not the only one.

Our criterion compares a moving average of the growth rate in asset prices with the long-run historical average. Let $g_{i,t} = \frac{100}{3} \log(P_{i,t} / P_{i,t-3})$ be the growth rate in the *real* price of the asset (stock prices or property prices) in year t and in country i , expressed in annual

⁷ Some data points are missing for some countries. The source for the stock price data is IFS, for property prices is BIS.

percentage points. Let \bar{g} be the average growth rate over all countries. Let ν be the arithmetic average of the volatility (standard deviation) in the growth rate g over all countries.

Then if the average growth rate between year $t-3$ and year t is larger than a threshold:

$$g_{i,t} > \bar{g} + x\nu \quad (1)$$

we identify a *boom* in years $t-2$, $t-1$ and t .

Conversely we identify a *bust* in years $t-2$, $t-1$ and t if

$$g_{i,t} < \bar{g} - x\nu \quad (2)$$

Our method detects a boom or a bust when the three-year moving average of the growth rate in the asset price falls outside a confidence interval defined by reference to the historical first and second moments of the series. Variable x is a parameter that we calibrate so as to select the notorious boom-bust episodes without selecting (too many) spurious events. (We implement some sensitivity analysis with respect to this parameter.) We use the three-year moving average so as to eliminate the high frequency variations in the series. (This is particularly a problem with stock prices, which are more volatile than property prices.)

For real property prices the average growth rate across the 15 countries is 1.0 percent with an average volatility of 5.8 percent. For real stock prices the growth rate and the volatility are both higher, 3.8 percent and 13.4 percent respectively. For both prices we take $x=1.3$.⁸

B. Boom-Busts in the OECD, 1970–2001

Figures 1 and 2 show the log of the real prices of residential property and stocks,⁹ with the boom and bust periods marked with shaded and clear bars respectively. We define a boom-bust episode as a boom followed by a bust that starts no later than one-year after the end of the boom. For example, Sweden (1987–1994) exhibits a boom-bust in real property prices but Ireland (1977–1984) does not, because the boom and the bust are separated by a two-year interval (see Figure 2). We also show banking crises marked by an asterisk country by country.¹⁰ A few facts stand out.

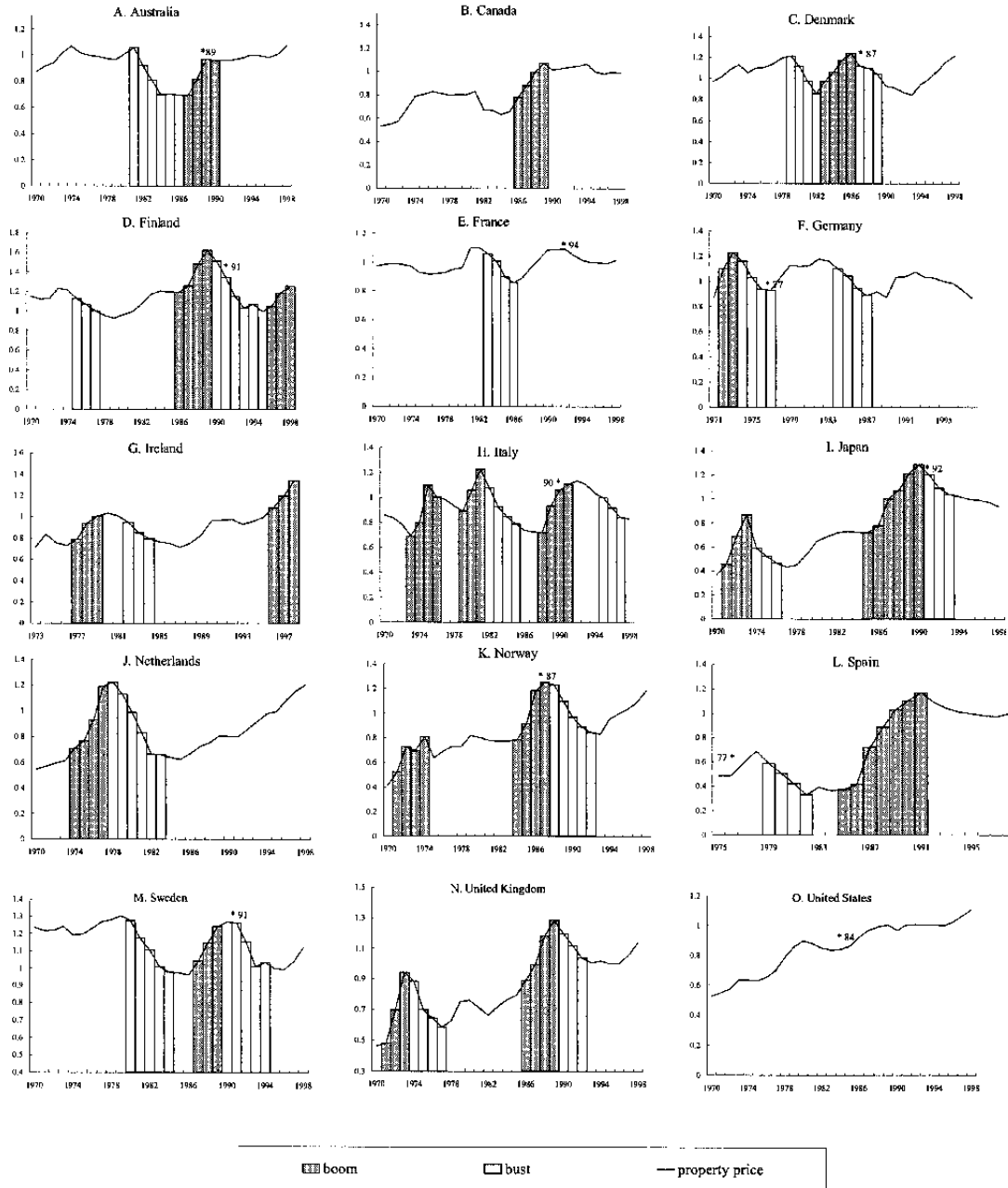
⁸ We experimented with different values of x in order to see how the number of boom-bust episodes declines as x increases. Thus for property prices at $x=1.0$, there are 14 boom-bust and for stock prices there are 8. We settled on $x=1.3$ because lowering the threshold below that level produces an excessively large number of booms and busts.

⁹ Nominal prices were deflated using the GDP deflator; a constant was added to the logs to show only positive values.

¹⁰ The data on banking crises come from Eichengreen and Bordo (2002).

First, boom-bust episodes are much more prevalent in property prices than in stock prices. Out of 24 boom episodes in stock prices only four are followed by busts: Finland (1989),

Figure 1. Boom-Bust in Residential Property Prices, 1970 - 1998 **



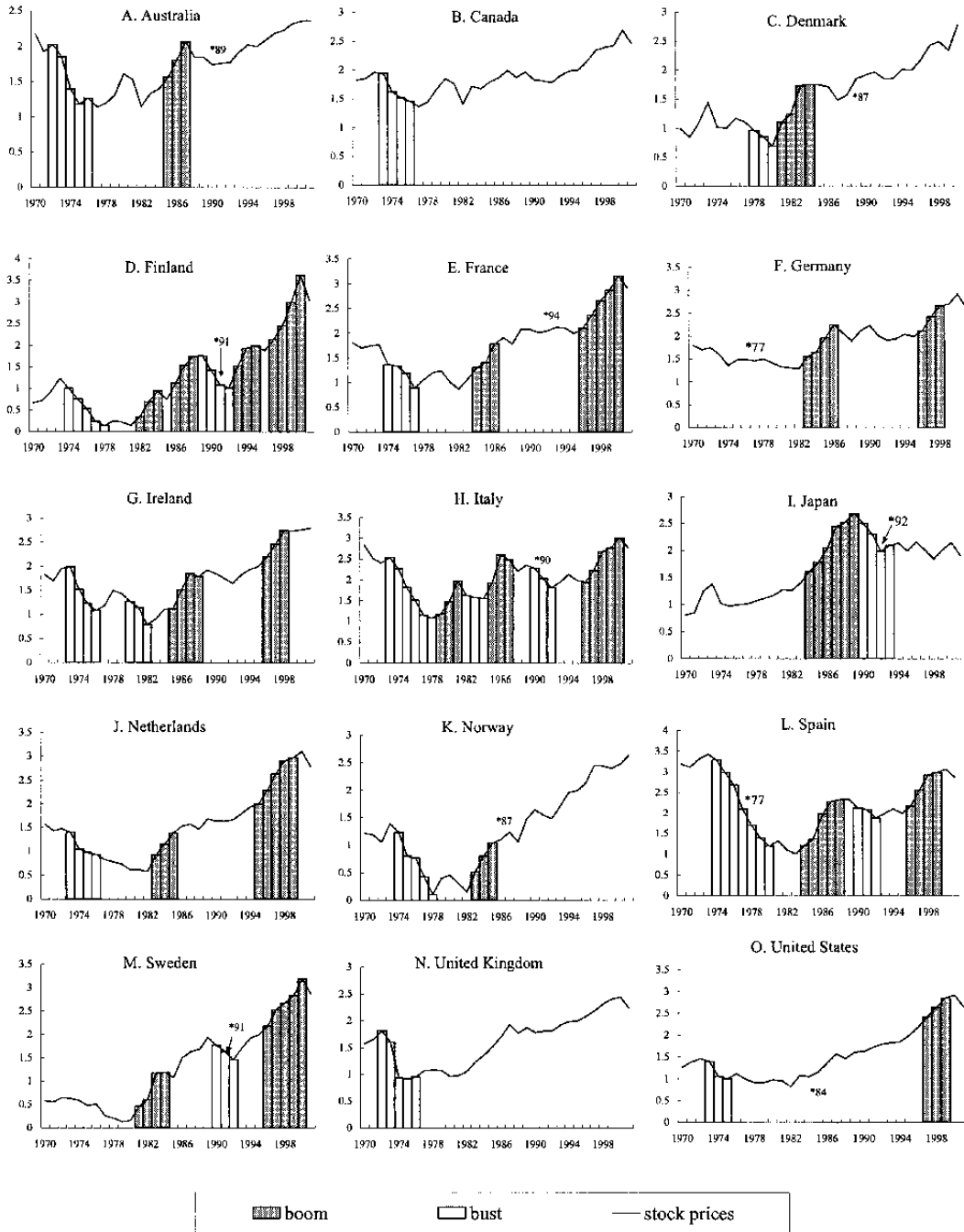
Sources: Bank of International Settlements; *International Financial Statistics and World Economic Outlook*, International Monetary Fund.

*Banking crisis. See Eichengreen and Bordo (2002) Appendix A.

** Booms and busts are calculated by a three year moving average. The data starts in 1971 for Germany and in 1975 for Spain due to limited availability.

The variable on the y-axis is 1 plus the log of the real property price index. The real property price index is derived by deflating the BIS nominal property price index by the GDP deflator. It is normalized to 1995 = 1.

Figure 2. Boom-Bust in Industrial Share Prices, 1970 - 2001 **



Sources: International Financial Statistics, World Economic Outlook and country desks, International Monetary Fund.

*Banking crisis. See Eichengreen and Bordo (2002) Appendix A.

** Booms and busts are calculated by a three year moving average. The data ends in 2000 for Denmark due to limited availability.

The variable on the y-axis is 2 plus the log of the real share price index. The real share price index is derived by deflating the IFS share price index by the GDP deflator. It is normalized to 1995 = 1.

Italy (1982), Japan (1990), Spain (1990).¹¹ (We give the first year of the bust in parentheses.) Hence the sample probability of a boom ending up in a bust is 16.7 percent. Of course Japan is a very significant boom-bust episode. Also there might be more boom-bust episodes in the making since it is too early to tell whether the recent slides in stock markets in all countries are busts according to our criterion.¹²

Out of 20 booms in property prices, 11 were followed by busts: Denmark (1987), Finland (1990), Germany (1974), Italy (1982), Japan (1974, 1991), the Netherlands (1978), Norway (1988), Sweden (1991), and the United Kingdom (1974, 1990).¹³ The probability of a boom in property prices ending up in a bust is 55 percent. That is, more than one in two property booms end up in a bust, against one in six for stock market booms. Only three countries had boom-busts in both stock prices and property prices, Finland, Italy and Japan. In all three cases the peaks virtually coincided.

One explanation for the larger number of boom-bust episodes in property prices than in stock prices may be that property price episodes are often local phenomenon occurring in the capital or major cities of a country. This would explain their high incidence in small countries like Finland or even in countries with relatively large populations like the United Kingdom, where the episode occurred in London and environs. The fact that no such episodes are found in the United States may reflect the fact that boom-busts in property prices that occurred in New York, California, and New England in the 1990s washed out in a national average index.¹⁴

Second, in a number of cases, banking crises occurred either at the peak of the boom or after the bust. This is most prominent in the cases of Japan and the Nordic countries.

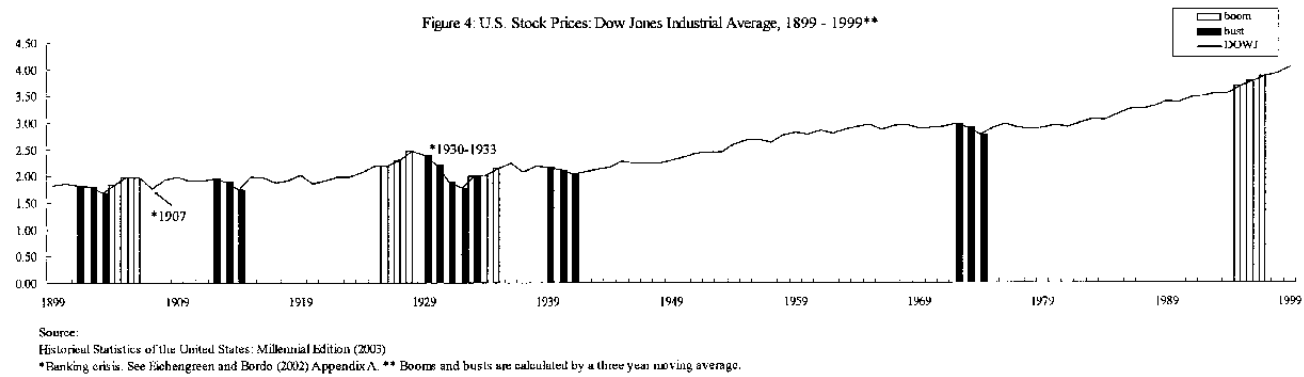
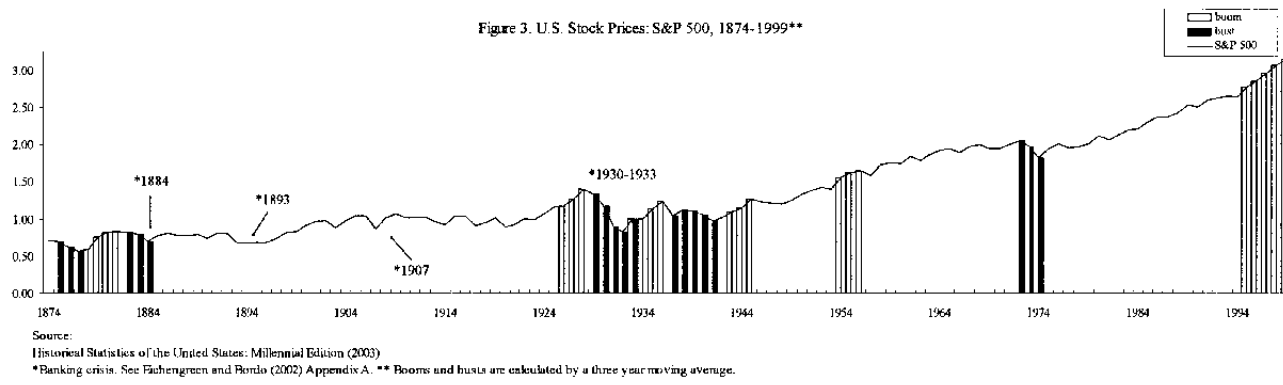
Finally, to provide historical perspective to our methodology, we do the same calculations for two U.S. stock price indexes for the last century: the S and P 500 from 1874 to 1999 and the Dow Jones Industrial Average for 1900–99. As can be seen in Figures 3 and 4, there are very few boom-bust episodes. The crash of 1929 stands out in both figures. In the S and P we

¹¹ If we were to take a lower threshold such as $x = 1.0$, then, two more countries would be listed as having boom-busts: Italy and Sweden.

¹² Note that the incidence of a boom-bust episode by our criterion is very different from what is usually referred to as a stock market crash. For the U.S. for example, Mishkin and White (2002) document 15 crashes 1900–2000 and 4 from 1970–2000. They define a crash as a 20 percent decline in stock prices in a 12-month window.

¹³ Again, a lower threshold of $x = 1.0$ would add in two countries: Ireland and Spain.

¹⁴ This fact has an interesting implication of for the theory of Optimum Currency Areas and the euro zone. One important source of asymmetric shocks could be boom-busts in real estate prices.



also identify a boom bust in 1884, the year of a famous Wall Street crash associated with speculation in railroad stocks and political corruption, and one in 1937, the start of the third most serious recession of the twentieth century.¹⁵ As is well known the bust of 1929 is followed by banking crises in each of the years from 1930–1933.

C. Ancillary Variables

Associated with the boom bust episodes for property and stock prices that we have isolated above, we display figures for three macro variables directly related to the asset price reversals: Consumer Price Index (CPI) inflation, the real output gap and domestic private credit.¹⁶ The figures are averages of each variable across all the boom-bust episodes demarcated above. The 7-year time window shown is centered on the first year of the bust.

In figure 5 for property price boom-busts we observe CPI inflation (panel A) rising until the first year of the bust and then falling with the bust, while the output gap plateaus the year before the bust starts and then declines with the bust (panel B). Domestic private credit (panel C) rises in the boom and then plateaus in the bust.¹⁷ This pattern is remarkably consistent with the scenario relating asset price reversals to the incidence of collateral, to the credit available to liquidity constrained firms and to economic activity that we develop in section III below.

Figure 6 shows the behavior of inflation, the output gap and domestic private credit averaged across the three boom-bust episodes in stock prices demarcated in Figure 2. Inflation rises to a peak in the year preceding the bust and then declines, although not as precipitously as with the property price episodes (panel A). The output gap plateaus the year the bust starts and then declines (panel B). Domestic credit plateaus the year after the bust starts (panel C). Although the pattern displayed for the 3 ancillary variables for stock price boom-busts is quite similar to that seen in Figure 5, we attach more weight to the property price pattern because it is based on a much larger number of episodes (11 versus 4).

With this descriptive evidence as background, in Section III below we develop a model to help us understand the relationship between boom-busts, the real economy and monetary policy.

¹⁵ Using a lower threshold of $x = 1.0$ does not change the outcome.

¹⁶ Private Credit, line 22d of the IMF's International Financial Statistics (IFS) is defined as "claims on the private sector of Deposit Money Banks (which comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits)."

¹⁷ The figure shows the nominal level of private domestic credit. Real private domestic credit declines in the bust.

Figure 5. Ancillary Variables:
Boom - Bust in Property Prices

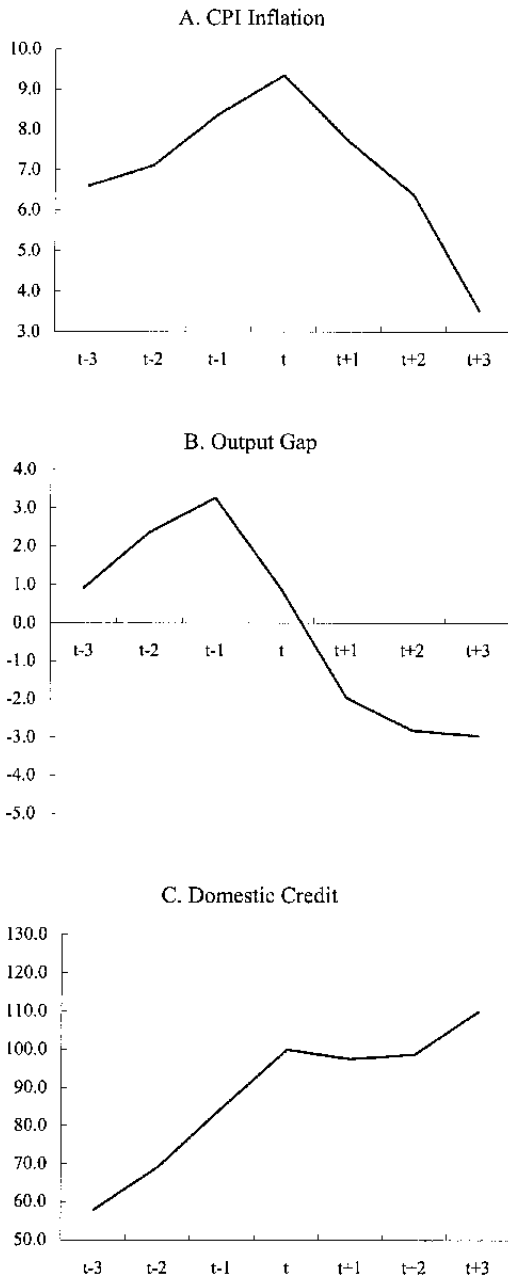
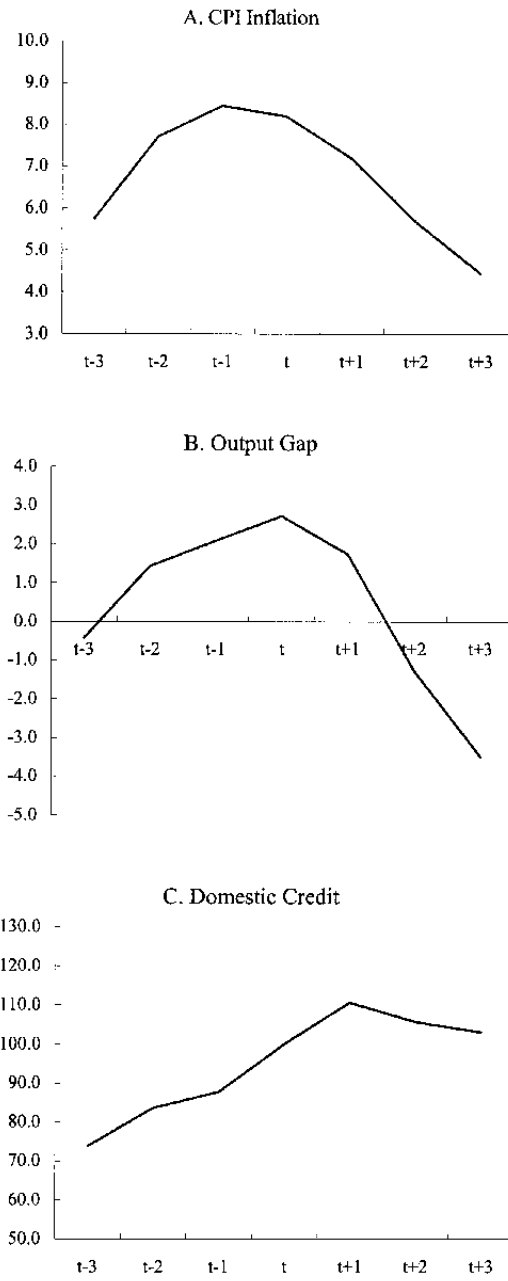


Figure 6. Ancillary Variables:
Boom - Bust in Stock Prices



Sources:

International Financial Statistics and *World Economic Outlook*, International Monetary Fund.

III. A STYLIZED MODEL

A regular feature of boom-bust episodes is that the fall in asset prices is associated with a slowdown in economic activity (sometimes negative growth), as well as financial and banking problems. There may be a number of explanations for this pattern, and they do not all give a causal role to asset prices. However, there is evidence that the bust in asset prices contributes to the fall in output by generating a credit crunch. The domestic private sector accumulates a high level of debt in the boom period; when asset prices fall, the collateral base shrinks, and so do firms' ability to finance their operations.¹⁸

This section addresses the following question. Assuming that asset market booms involve the risk of a reversal in which the economy falls prey to a collateral-induced credit crunch, what is the consequence of this risk for the design of monetary policy?

This section presents a stylized model in which the optimal policy can be derived analytically. Unlike a number of related papers (Bernanke and Gertler, 2000; Batini and Nelson, 2000; Cecchetti and others, 2000), the aim is not to compare the performance of different monetary policy rules in the context of a realistic, calibrated model of the economy. Rather, it is to highlight the difference between a proactive monetary policy and a reactive monetary policy in the context of a simple and transparent framework. It turns out that although the model is quite simple, the optimal monetary policy is not trivial, and depends on the exogenous economic conditions in a non-linear way. Although this non-linearity complicates the analysis, we think it is an essential feature of the question we study in this paper because financial crises are inherently non-linear events.

Our analysis is based on a reduced-form model that is very close to the standard undergraduate text-book macroeconomic model. In Bordo and Jeanne (2002), we provide micro-foundations in the spirit of the "Dynamic New Keynesian" literature. Private agents have utility functions and optimize intertemporally. The government prints and distributes money, which is used because of a cash-in-advance constraint. Nominal wages are predetermined, giving rise to a short-run Phillips Curve. Monetary policy has a credit channel, based on collateral. The collateral is productive capital; its price is driven by the expected level of productivity in the long run. However, the essence of our results can be conveyed with the reduced-form model that we present in this paper.

The reduced-form model has two periods $t = 1, 2$. Period 1 is the period in which the problem "builds up" (debt is accumulated). In period 2, the long-run level of productivity is revealed. An asset market crash may or not occur, depending on the nature of the news. If the long-run level of productivity is lower than expected, the price of the asset falls, reducing the

¹⁸ This meaning of a collateral-induced credit crunch differs from an earlier meaning which viewed a credit crunch as a restriction on bank lending induced by tightening monetary policy.

collateral basis for new borrowing. If the price of collateral is excessively low relative to firms' debt burden, the asset market crash provokes a credit crunch and a fall in real activity.

Note that these market dynamics are completely driven by the arrival of news on long-run productivity. The asset market boom is not caused by a monetary expansion or a bubble. Nor is the crash caused by a monetary restriction, or a self-fulfilling liquidity crisis. Irrational expectations or multiple equilibria can be introduced into the model, but keeping in line with our desire to stay close to the textbook framework, we prefer to abstract from these considerations in the benchmark model. At the end of this section we briefly discuss a variant of the model in which investors are "irrationally exuberant".

A. The Model

The equations of the reduced-form model are as follows.

$$\begin{cases} y_t = m_t - p_t \\ y_t = \alpha p_t + \varepsilon_t \\ y_1 = -\sigma(r - \bar{r}) \end{cases} \quad (3)$$

where y_t is the output gap at time $t = 1, 2$, m_t is money supply, p_t is the price level, r is the real interest rate between period 1 and period 2, and \bar{r} is the natural interest rate (the level consistent with a zero output gap in period 1). All variables, except the real interest rate, are in logs.

The first two equations characterizes aggregate demand and aggregate supply. Aggregate supply is increasing with the nominal price level because the nominal wage is sticky. The third equation says that the first-period output is decreasing with the real interest rate. It is based, in the micro-founded model, on the Euler equation for consumption.

The key difference between our model and the standard macro model is the "supply shock", ε . In the standard model the supply shock is an exogenous technological shock or more generally, any exogenous event which affects the productivity of firms (e.g., an earthquake). Here the supply shock is instead a "financial" shock and it is not entirely exogenous, since its distribution depends on firms' debt and the price of assets, two variables that monetary policy may influence. That monetary policy can influence debt accumulation ex ante (in period 1) plays a central role in our analysis of proactive monetary policy.

The supply shock ε results from credit constraints in the corporate sector. Firms issue debt in period 1 and inherit a real debt burden D in period 2 (debt is in real terms). They also own some collateral, whose real value in the second period is denoted by Q . Because of a credit constraint, the firms' access to new credit in period 2 is increasing with their net worth $Q - D$. In Bordo and Jeanne (2002), the credit constraint results from a debt renegotiation problem à la Hart and Moore (1994). Some firms must obtain new credit to finance working capital. The firms that need but do not obtain this intra-period credit simply do not produce, which reduces aggregate supply.

If $Q - D$ goes down, more and more firms are credit-constrained and must reduce their supply. As a result, the supply term ε_2 is an increasing function of $Q - D$:

$$\varepsilon_2 = f(Q - D), \quad f' > 0 \quad (4)$$

We present in Bordo and Jeanne (2002) a model where function $f(\cdot)$ is derived from more primitive assumptions about firms' behavior, but for the purpose of our present discussion, we can restrict our attention to the following properties of $f(\cdot)$. First, $f(\cdot)$ takes negative values: although the credit constraint can reduce supply below its potential level, it cannot increase it above potential.¹⁹ This implies an asymmetry and a nonlinearity in the response of supply to asset prices: while a fall in asset prices can depress output, an equivalent rise in asset prices should not be expected to raise it by the same amount. Second, it is plausible to assume that a threshold in the price of collateral occurs below which the credit constraint becomes widespread—i.e., there is a credit crunch. As a result, we would expect function $f(\cdot)$ to have a shape like the one shown in Figure 7.

There are several ways in which monetary policy can deal with a credit crunch. For the purpose of our discussion it is useful to distinguish the *ex post* and the *ex ante* channels of monetary policy.

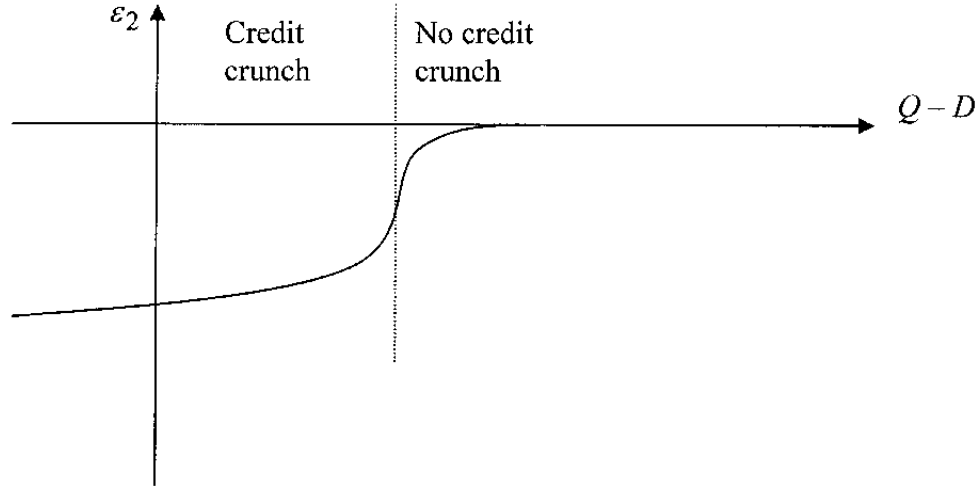
Ex post, monetary policy has three channels. The first channel is the standard one: inflation stimulates supply by reducing the real wage. Second, a monetary expansion increases the real price of collateral and thus reduces the number of collateral-constrained firms. Third, if firms' debt is set in nominal terms, inflation also relaxes the credit constraint by reducing the real burden of debt.

Ex ante (in period 1), a monetary restriction could reduce the *risk* of a credit crunch, by reducing the accumulation of debt.

In this paper we are more interested in the *ex ante* channel since we want to focus the analysis on *preemptive* monetary restrictions. For the sake of simplicity, we completely abstract from the *ex post* credit channel by assuming first, that debt is in real terms, and second, that Q , the real price of collateral in period 2, is stochastic and exogenous to monetary policy. Hence, monetary policy does not affect ε_2 . Period 2 monetary policy affects output solely through the standard channel based on nominal wage stickiness.

¹⁹ That $f(\cdot)$ is always negative implies of course that ε_2 is not centered on zero. The expected value of ε_2 is negative.

Figure 7. Function $f(\cdot)$



The relevant channel of monetary policy, hence, is the *ex ante* channel. The real interest rate r influences the stochastic distribution of ε_2 , and so the probability of a credit crunch. In general, an increase in the real interest rate r could increase or decrease the debt burden D , depending on whether the price effect does or does not dominate the demand effect. If the elasticity of firms' demand for loans is large enough, the burden of debt is decreasing with the real interest rate, i.e.:

$$D = D(r), \quad D' < 0 \tag{5}$$

It then follows that

$$\frac{\partial \varepsilon_2}{\partial r} \geq 0 \tag{6}$$

Other things equal, raising the interest rate in period 1 reduces the number of firms that are credit-constrained in period 2. Restricting monetary policy, in other words, reduces the risk of a credit crunch in the future.

As noted earlier, the difference between our model and the standard textbook model is that the distribution of supply shocks at period 2 is endogenous to monetary policy at period 1. The optimal monetary policy involves a trade-off between the macroeconomic objectives of monetary policy in the first period and the risk of a credit crunch in the second period. In order to investigate this trade-off one has to endow the monetary authorities with an

intertemporal objective function. We assume that the government minimizes the following quadratic loss function:

$$L = \sum_{t=1,2} (p_t^2 + \omega y_t^2) \quad (7)$$

In period 1 the authorities set the interest rate so as to minimize the expected intertemporal loss $E_1(L)$. In period 2 they set monetary policy so as to minimize their loss, given the realization of Q .²⁰

Setting the first period supply shock (ε_1) to zero for the sake of simplicity, we can express the macroeconomic variables as functions of monetary policy (r) and the second period supply shock (ε_2):

$$\begin{aligned} y_1 &= -\sigma r \\ p_1 &= -\sigma r / \alpha \\ y_2 &= \frac{1}{1 + \omega \alpha^2} \varepsilon_2 \\ p_2 &= -\frac{\omega \alpha}{1 + \omega \alpha^2} \varepsilon_2 \end{aligned} \quad (8)$$

Using these expressions as well as (4) to substitute out the macroeconomic objectives, the government's problem at time 1 can be written as a function of the policy instrument r

$$\min_r E_1(L) = \sigma^2 \frac{1 + \omega \alpha^2}{\alpha^2} (r - \bar{r})^2 + \frac{\omega}{1 + \omega \alpha^2} E_1(f(Q - D(r))^2) \quad (9)$$

where Q is stochastic and exogenous. If the credit constraint never binds when the interest rate is set at its natural level \bar{r} , then the credit crunch term in the equation above is equal to zero, and the solution to the government's problem is to set the real interest rate at \bar{r} . By contrast, if there is a strictly positive probability that some firms will be credit-constrained, it is optimal to marginally raise r above \bar{r} so as to reduce the risk of a credit crunch. That is, there is scope for a pro-active monetary restriction. In general, though, (9) is a nontrivial, non-linear problem, and the only way we can make derive properties of the solution is by specifying it further.

²⁰ There is no time consistency issue in this model since by assumption the nominal wage is taken as given in both periods.

B. A Nonconventional, Nonlinear Taylor Rule

We now illustrate the optimal monetary policy with a specification of the model that draws on the recent debates on the “New Economy” and the stock market. Assume that in the second period, the price of collateral can take two values, a high level, Q_H , corresponding to the “New Economy” scenario, and a low level, Q_L , corresponding to the “Old Economy” scenario. Viewed from period 1, the probability of the “New Economy” scenario is a measure of the optimism of economic agents. We denote it by π . We also assume that as firms become more optimistic, they borrow more, i.e. D is an increasing function of π :

$$D = D(\pi, r) \quad (10)$$

We adopt the following specification of function $f(\cdot)$. Either there is a systemic credit crunch ($\varepsilon_2 = -\nu$) or there is no credit crunch ($\varepsilon_2 = 0$). The systemic credit crunch occurs when the net worth of firms falls below a critical level, $Q - D < \gamma$. Thus, $f(x)$ is a step function equal to $-\nu$ for x smaller than γ and equal to zero for x larger than γ .

How does the optimal monetary policy depend on π , the optimism of the private sector? The answer is given in figure 8, which shows the optimal interest rate r as a function of π . For low levels of optimism, the monetary authorities optimally set the interest rate at the natural level \bar{r} . Then the authorities respond to rising level of optimism by raising the interest rate. For very high levels of optimism, the authorities revert to the first interest rate policy.

Let us give the intuition behind figure 8 step by step. First, if π is small, firms do not borrow a great deal, implying that a low realization of Q does not trigger a credit crunch.²¹ In this case the government’s loss function is minimized by setting $r = \bar{r}$. The government has no reason to distort its policy in period 1 since there is no risk of credit crunch in period 2.

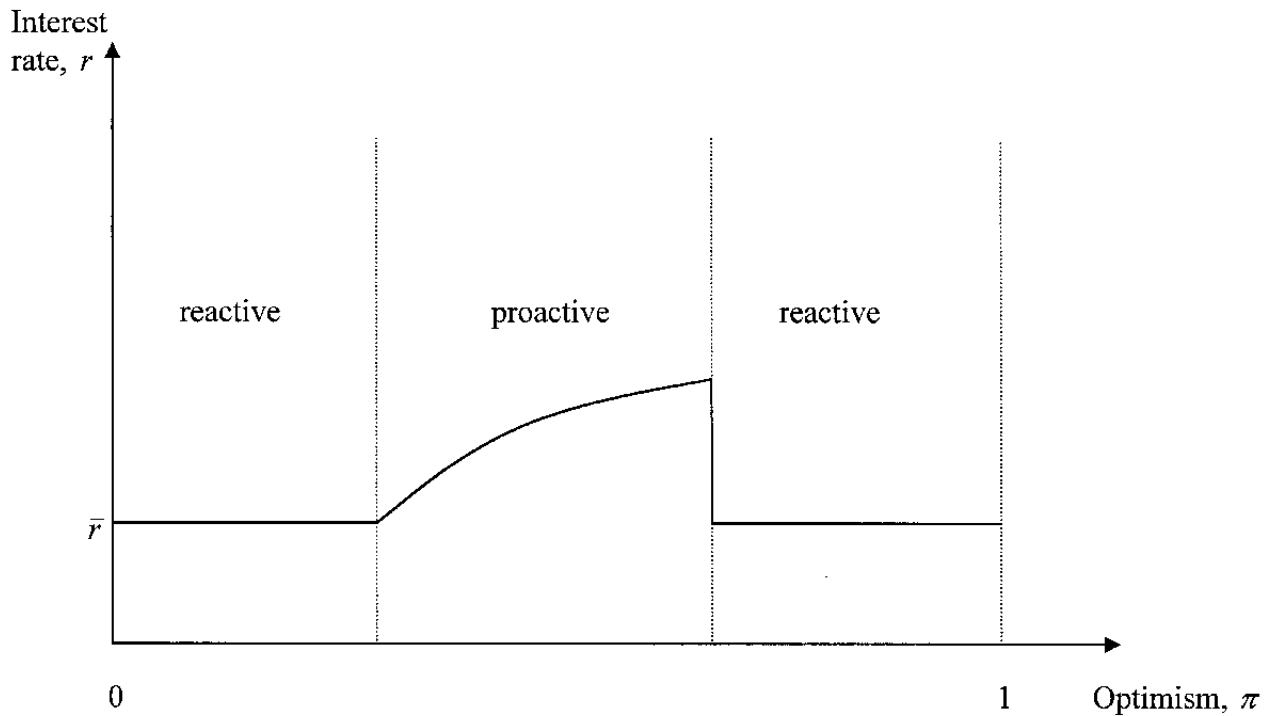
Things are different however for a higher level of optimism. In that case, assuming monetary policy to be unchanged, firms tend to borrow more, and a bad realization of Q is associated with a credit crunch. The monetary authorities are faced with a choice between the following alternatives

- A *proactive* monetary stance: increasing the interest rate r to ensure that a bad realization of Q will not trigger a credit crunch.
- A *reactive* monetary stance: keeping the real interest rate at $r = \bar{r}$, and responding ex post if the credit crunch happens.

²¹ Formally, this is true for values of π such that $D(\pi, \bar{r}) \leq Q_L - \gamma$.

A proactive monetary stance has a benefit and a cost. The benefit is to forestall the credit crunch. The cost is a sacrifice in terms of the short-run (period 1) macroeconomic objectives of monetary policy: raising the real interest rate lowers output and the price level below their target levels. How does this trade-off depend on market optimism π ?

Figure 8. The Optimal Monetary Policy



First, the cost of a proactive monetary stance is increasing with π . If the monetary authorities choose to be pro-active they set the interest rate at the minimum level to avoid a credit crunch conditional on a low realization of Q , that is

$$D(\pi, r) = Q_L - \gamma \quad (11)$$

This implicitly defines r as an increasing function of π . Intuitively, if the private sector becomes more optimistic, it takes a higher interest rate to induce firms not to increase their debt level.

At the same time, the benefit of a proactive stance diminishes with π . This benefit is proportional to the probability of a credit crunch under the alternative policy, $1 - \pi$. In the limit, if it is certain that the price of collateral will be high ($\pi = 1$), a proactive policy has no benefit in terms of insurance. Hence, increasing optimism tilts the balance toward a reactive policy in two ways: by increasing the cost and decreasing the benefit of the alternative policy.

Taken together, these considerations explain the shape of the optimal policy depicted in figure 8. A proactive policy dominates for *intermediate* levels of optimism, when a risk exists but it is not too costly to defuse. In this range, the monetary authorities respond to increasing optimism by restricting monetary policy. Beyond some level, however, leaning against the private sector's optimism becomes too costly, and the authorities are better off accepting the risk of a credit crunch.

The model highlights both the potential benefits and the limits of a proactive monetary policy. It may be optimal, in some circumstances, to sacrifice some output in order to reduce the risk of a collateral-induced credit crunch. However, there are also circumstances in which the domestic authorities are better off accepting the risk of a credit crunch (i.e., a reactive policy). Whether the authorities should in practice engage in a proactive policy at a particular time is contingent on many factors, and is a matter of judgment. In our model, the optimal monetary policy depends on the observable macroeconomic variables, and on the private sector's expectations, in a highly nonlinear way.

C. Discussion

Taylor Rules

Note the difference in our analysis with standard rules, such as the Taylor rule. Standard rules make the monetary authorities respond to the current or expected levels of macroeconomic variables such as the output gap or the inflation rate. The rule above suggests that the monetary policymaker should also respond to prospective developments in asset markets, for which macroeconomic aggregates do not provide appropriate summary statistics.

Admittedly, the standard Taylor rule could happen to be always close to the optimal policy by accident. However, there are reasons not to take this Panglossian view for warranted. It is not very difficult to imagine circumstances in which a standard Taylor rule induces the monetary authorities to take the wrong policy stance in an asset price boom.

For example, let us consider a situation in which the perceived risk of a bust increases from a low level to an intermediate level where it is optimal to restrict monetary policy proactively. Let us further assume that consistent with the evidence presented in Section II, an asset price

bust is deflationary.²² Then, other things equal, the increase in the probability of a bust reduces the expected level of inflation. According to a forward-looking specification of the Taylor rule, the decrease in the inflation forecast would call for a monetary relaxation, which is the exact opposite of the required policy adjustment. The monetary relaxation will only fuel the boom and exacerbate the macroeconomic dislocation in the bust, if it occurs.

This is only one example. One could also construct examples where the Taylor rule happens to coincide with the optimal policy. Our more general point, however, is that there is no reason to expect a Taylor rule to characterize the optimal policy in general, since this rule does not take as arguments the variables that are the most relevant in an asset price boom.

Irrational Exuberance

As noted in the introduction, a common objection against proactive monetary policies is that it requires the authorities to perform better than market participants in assessing the fundamental values of asset prices (Bernanke and Gertler, 2000). In this regard, it is important to note that our analysis of proactive monetary policy is not premised on the assumption that asset prices deviate from their fundamental values. The essential variable, from the point of view of policymaking is the risk of a credit crunch induced by an asset market reversal. This assessment can be made based on the historical record (as illustrated in Section II), as well as information specific to each episode. In particular, the suspicion that an asset market boom is a bubble which will have to burst at some point is an important input in this assessment. However, bubbles are not of the essence of the question since, as our model shows, the question would arise even in a world without bubbles. Hence, the debate about proactive versus reactive monetary policies should not be reduced to a debate over the central bank's ability to assess deviations in asset prices from fundamental values.

Going back to our model, the notion of irrational expectations can be captured by assuming that private agents base their decisions, in period 1, on an excessively optimistic assessment of the probability of the "New Economy" scenario. In Bordo and Jeanne (2002) we consider the case where firms borrow in period 1 on the basis of a probability π' which is larger than the probability π assessed by the authorities. We find that this tilts the balance toward a proactive policies as the authorities do not share the private sector's optimism. Hence irrational exuberance broadens the scope for proactive monetary policy.²³

²² In our model, a credit crunch is inflationary because it reduces supply without changing demand. For a credit crunch to be deflationary, it would have to affect demand as well as supply—a possible extension of our model.

²³ See Dupor (2002) for a model in which asset price targeting is justified by irrational expectations in the private sector.

Policy-Induced Booms

To conclude this section, let us also emphasize that we have not analyzed the question of whether booms in asset prices are induced by an excessively expansionary monetary policy. In our model, monetary policy affects the growth in credit but the dynamics of asset prices are exogenous. This assumption was made mainly for the sake of simplicity. Disentangling monetary policy from other sources of asset price booms is an important issue—which we do not attempt to tackle in this paper. In the event monetary policy induces an asset price boom—which in turn may be a warning sign of impending inflation—the case for a monetary restriction seems straightforward.²⁴

IV. CONCLUSIONS

A senior official of the Federal Reserve System recently disputed the view that monetary policy should pay special attention to booms in asset prices in the following terms (Reinhart, 2002):²⁵

“...macro policy should be focused on macro outcomes. Tightening monetary policy beyond that required to achieve desired macroeconomic outcomes in response to high and rising equity prices or other asset values would seem to involve trading off among goals. The central bank would be tolerating some straying from the fundamental goal of the stability of the prices of goods and services, at least in the near term, in order to lessen the risks of future systemic problems or severe macroeconomic dislocation down the road. It is by no means obvious that the mandates of most central banks in industrial countries admit accepting such a tradeoff.”

We find this statement interesting (and somewhat atypical) in that it acknowledges the risk of an asset price boom resulting in “severe macroeconomic dislocation” (which presumably cannot be painlessly averted by lending-in-last-resort). Hence the trade-off between current and future macroeconomic objectives is not exactly the same in an asset price boom as in normal times: it is between the risk of severe economic dislocation, and the cost of reducing this risk. This is indeed the trade-off that our stylized model focuses on. However, we have difficulty understanding why the monetary authorities, having acknowledged this trade-off, should always choose not to insure against the risk of severe economic dislocation.

We have made this point in the context of a very stylized illustrative model. Our analysis in this paper should be interpreted as being mainly suggestive because we do not provide empirical estimates of the magnitude of the output losses under the alternative policy

²⁴ Also, we have not addressed the question of whether asset price movements act as predictors of future inflation. The evidence on this issue is mixed (see Filardo 2000).

²⁵ Vincent Reinhart is the director of the Division of Monetary Affairs at the Board of Governors of the Federal Reserve System.

strategies. To do this would require simulating the effects of alternative policy rules in calibrated or estimated structural models. We would argue that it would be important for these models to involve the kind of non-linearity and tail-probability events that we have emphasized in this paper, an aspect that is generally ignored in the literature.²⁶ Although introducing non-linearities is technically challenging, non-linearity seems difficult to abstract from in an analysis of the relationship between monetary policy and financial stability. We suspect that in such models it may be optimal for the monetary authorities to deviate from the policy rule of normal times in some circumstances, in particular when there is an exceptional boom in asset prices.

Let us conclude by taking a broader perspective on the issues discussed in this paper. The recent literature on monetary policy may give the impression of having reached an “end of history” based on a consensus on the desirability of simple rules, with the main remaining object of debate being the precise form of the golden policy rule. Like all “ends of history,” this one must have its Achilles’ heel, and we would surmise that it has to do with the relationship between monetary policy and financial stability. Systemic financial crises are tail-probability events with huge consequences, and the rule paradigm has not developed a well-articulated doctrine with regard to these risks—rather, it has generally eschewed the question by arguing that monetary policy and financial stability should be thought of as separate issues. Indeed we do not think that this omission occurred by accident. Financial stability presents a direct challenge to the rule paradigm because it may require occasional deviations from simple rules—i.e., policies that are sometimes based in a complex way on discretionary judgment. Furthermore, these deviations may rely on information that may be difficult to communicate to the public. There might be such a thing, after all, as an “art of central banking”.

²⁶ For example, Bernanke and Gertler (2000) or Cecchetti and others (2000) run policy simulations in a model that is linearized around steady state. The financial friction introduces a financial accelerator but there are no financial crises.

REFERENCES

- Batini, Nicoletta, and Edward Nelson, 2000, "When The Bubble Bursts: Monetary Policy Rules and Foreign Exchange Market Behavior," (Unpublished; London: Bank of England).
- Bernanke, Ben, and Mark Gertler, 2000, "Monetary Policy and Asset Price Volatility," NBER Working Paper No. 7559 (Cambridge, Massachusetts: National Bureau of Economic Research).
- _____, 2001, "Should Central Banks Respond To Movements in Asset Prices?" *American Economic Review, Papers and Proceedings*, pp. 253–57.
- Bordo, Michael, and Olivier Jeanne, 2002, "Boom-Busts in Asset Prices, Economic Instability, and Monetary Policy," NBER Working Paper No. 8966 (Cambridge, Massachusetts: National Bureau of Economic Research).
- Borio, Claudio, and Andrew D. Crockett, 2000, "In Search of Anchors for Financial and Monetary Stability," *Greek Economic Review*, Vol. 20, No. 2, pp. 1–14.
- Borio, Claudio, and Philip Lowe, 2002, "Asset Prices, Financial and Monetary Stability: Exploring the Nexus", BIS Working Paper No. 114, July.
- Bullard, James B., and Eric Schalling, 2002, "Why the Fed Should Ignore the Stock Market," *Federal Reserve Bank of St. Louis Review*, Vol. 84, No. 2, pp. 35–41.
- Cecchetti, Stephen B, Hans Genberg, John Lipsky, and Sushil Wadhvani, 2000, *Asset Prices and Central Bank Policy* (London: International Center for Monetary and Banking Studies).
- Collins, Charles, and Abdejhak Senhadji, 2002, "Lending Booms, Real Estate, Bubbles, and the Asian Crisis." IMF Working Paper 02/20 (Washington: International Monetary Fund).
- Drees, Buckhard, and Ceyla Pazarbasioglu, 1998, *The Nordic Banking Crises: Pitfalls in Financial Liberalization?* IMF Occasional Paper No. 161 (Washington: International Monetary Fund).
- Dupor, William, 2002, "The Natural Rate of Q", *American Economic Review Papers and Proceedings*, Vol. 92, No. 2, pp. 96–101.
- Eichengreen, Barry, and Michael D. Bordo, 2002, "Crises Now and Then: What Lessons from the Last Era of Financial Globalization?" NBER Working Paper No. 8716 (Cambridge, Massachusetts: National Bureau of Economic Research).

- Filardo, Andrew J., 2000, "Monetary Policy and Asset Prices," *Federal Reserve Bank of Kansas City Review*, Vol. 85, No. 3.
- Gilchrist, Simon, and John Leahy, 2002, "Monetary Policy and Asset Prices", *Journal of Monetary Economics*, Vol. 49, pp. 75–97.
- Goodfriend, Marvin, 2002, "Interest Rate Policy Should Not React Directly to Asset Prices," paper presented at the Federal Reserve Bank of Chicago and World Bank Group Conference, "Asset Price Bubbles: Implications for Monetary, Regulatory, and International Policies."
- Greenspan, Alan, 2002, "Economic Volatility", speech at a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming.
- Hart, Oliver, and John Moore, 1994, "A Theory of Debt Based on the Inalienability of Human Capital," *Quarterly Journal of Economics*, Vol. 109, No. 4, pp. 841–79.
- International Monetary Fund, 2000, *World Economic Outlook, May 2000*, Chapter III, "Asset Prices and the Business Cycle" (Washington).
- Mishkin, Frederick S., and Eugene White, 2002, "U.S. Stock Market Crashes and Their Aftermath: Implications for Monetary Policy," (unpublished; Rutgers University).
- Reinhart, Vincent R., 2002, "Planning to Protect Against Asset Bubbles," paper presented at the Federal Reserve Bank of Chicago and World Bank Group Conference "Asset Price Bubbles: Implications for Monetary, Regulatory, and International Policies."
- Schinasi, Garry, and Monica Hargreaves, 1993, "Boom and Bust in Asset Markets in the 1980s: Causes and Consequences," in *Staff Studies For the World Economic Outlook*, (Washington: International Monetary Fund).