Finance and Economics Discussion Series
Divisions of Research & Statistics and Monetary Affairs
Federal Reserve Board, Washington, D.C.

Monetary Policy and the Housing Bubble

Jane Dokko, Brian Doyle, Michael T. Kiley, Jinill Kim, Shane Sherlund, Jae Sim, and Skander Van den Heuvel

2009-49

Monetary Policy and the Housing Bubble

Jane Dokko, Brian Doyle, Michael Kiley, Jinill Kim, Shane Sherlund, Jae Sim, and Skander Van den Heuvel

December 22, 2009

Corresponding author: Michael Kiley. *Address*: Mail stop 61, Federal Reserve Board, Washington, DC 20551. *Email*: mkiley@frb.gov

Acknowledgments: We benefited greatly from discussions of related issues and comments on this analysis from many of our colleagues at the Federal Reserve Board. In addition, this research was aided by the assistance of Trevor Davis. The views expressed here are those of the authors and do not necessarily reflect those of the Board of Governors or the other members of its staff.

Table of Contents

Introduction

Residential investment in the United States averaged about 4½ percent of nominal gross domestic product (GDP) from 1974 to 2002. After 2002, activity in housing markets strengthened considerably, pushing the share of residential investment in GDP to 6¼ percent by late 2005—40 percent above the average level and the highest share in a half-century. The strength in housing demand created a substantial run-up—indeed, a large bubble—in house prices: Increases in our preferred measure of (nominal) house prices in the United States averaged 12½ percent (on a year-over-year basis) during the 2003–05 period. Since 2006, however, both residential investment and house prices have collapsed.

Monetary policy was accommodative following the 2001 recession.[1] The target federal funds rate fell from 6.50 percent in December 2000 to 1.75 percent in December 2001 and to 1.00 percent in June 2003. The level of the nominal federal funds rate during this period reached lows that had not been seen since the 1950s.

Were these two developments closely related? What role did the setting of monetary policy play in housing market developments in this period?

These questions obviously leap to mind with a casual glance at the data. And indeed, researchers are increasingly suggesting that loose monetary policy was a primary cause of the bubble in house prices and activity. John Taylor (2007) provides an early example of a study ascribing a large role to "too loose" monetary policy in spurring housing activity after the 2001 recession. Although not universally held, this view has gained acceptance from many observers.[2] For example, Robert Gordon (2009, p. 6) writes:

> It is widely acknowledged that the Fed maintained short-term interest rates too low for too long in 2003-04, in the sense that any set of parameters on a Taylor Rule-type function responding to inflation and the output gap predicts substantially higher short-term interest rates during this period than actually occurred… thus indirectly the Fed's interest rate policies contributed to the housing bubble.

[1] Discussion of the stance of monetary policy as "tight" or "loose" requires a reference for comparison— – for example, to prescriptions from a policy rule or to a neutral rate from some economic model. Our subsequent discussion will highlight some of the many factors that might influence such an assessment of "loose" or "tight."".

[2] Taylor has followed up on his argument in the original 2007 article in several articles (e.g., Taylor (2008) and, more tangentially, Taylor (2009)—which focuses primarily on later policy actions). Leamer (2007) was also quite critical of monetary policy and the degree to which it was focused on housing activity, albeit through a different lens. Other recent references include Calomiris (2009) and Allen and Carletti (2009). Indeed, the International Monetary Fund's fall 2009 *World Economic Outlook* discussed this issue at some length (IMF, 2009).

In contrast, we provide evidence that monetary policy was well aligned with the goals of policymakers and was not the primary contributing factor to the extraordinary strength in housing markets. The relationship between interest rates and housing activity simply is not strong enough to explain the rise in residential investment or house prices. Although we ascribe some of the strength in housing markets to the low interest rates and accommodative monetary policy that followed the 2001 recession, the impetus from monetary policy to housing markets was only a small factor according to our baseline structural macroeconometric model (FRB/US) and alternative reduced-form macroeconomic/time-series models.

We do find that the federal funds rate was below levels suggested by some simple policy rules during this period. But a number of considerations suggest that the simple finding, taken on its own terms, may be less stark than some observers seem to believe. In particular, once one takes account of such factors as the effect of real-time measurement and the choice of price index; the parameterization of the policy rule; and the question of whether estimated equations for the federal funds rate—such as those from a vector autoregression (VAR)—are used in the counterfactual, the deviation of the policy rate actually adopted by the Federal Open Market Committee (FOMC) and that indicated by simple policy rules is not very great.

To gain further insight into the setting of monetary policy in this period, we briefly review the overall macroeconomic environment during the period and discuss factors that contributed to the setting of the federal funds rate, from three perspectives: a retrospective summary of the data based on our own judgment; the contemporaneous evaluation of macroeconomic developments from the perspective of U.S. monetary policymakers, as summarized in their published analyses; and the contemporaneous perspective of professional forecasters and other U.S. government agencies. In each case, our review suggests that the course of policy during the first half of this decade accorded well with conventional prescriptions.

Even if policy was looser than some measures suggest, these deviations are unlikely to have generated the outsized responses of house prices and residential investment that we saw, at least according to traditional macroeconomic models. Our empirical analysis and that of other researchers suggest that housing market developments would have been only modestly different if U.S monetary policy had followed a simple policy rule, such as those proposed by Taylor (1993, 1999).

Many advanced foreign economies experienced some sort of boom and bust in house prices, with some countries, such as Spain and the United Kingdom, having even higher growth rates in property prices than in the United States. Moreover, many other central banks' interest rates were lower than the rates implied by simple policy rules, although these gaps were for the most part smaller than they were for the United States. At the same time, several countries, such as Germany, Switzerland, and Japan, experienced little to no increase in house prices, or even saw declines, notwithstanding persistently low interest rates in some cases. All told, the evidence appears mixed at best on whether the policy stance of advanced economy central banks is among the most significant factors contributing to the run-up in housing.

Given the limited role we find for monetary policy in the housing bubble using a traditional macroeconomic approach, we consider how developments in housing finance, and mortgage markets more broadly, may have contributed to the rapid growth in house prices. Investor appetite for securities backed by novel mortgages was apparently quite high, which, in turn, drove down the cost of funds to marginal borrowers and borrowers using such loans. The rise of cheap and readily available credit no doubt stimulated housing demand. Indeed, the period saw a rise in loans featuring interest-only periods, interest rate resets, negative amortization periods, payment options, and extended amortization, which allowed borrowers to borrow much more money for a given initial monthly payment.

The factors giving rise to increased investor demand for mortgage-backed securities (MBS) and to the related surge in financial innovation remain the subject of debate. The literature has a number of explanations for the housing bubble, and we discuss several of them. We do not believe that the accommodative monetary policies of the period played a large role, although it is possible that the shifts in housing finance we discuss may have interacted with monetary policy in ways that are not captured by the historical relationships embedded in our macro-based approach.

However, we do not consider the full range of influences that may have caused the housing bubble or the global financial crisis more broadly. For example, the emergence of large current account surpluses among many foreign economies, which contributed to an increase in the global supply of savings and pushed down interest rates around the world, may have been important, and many observers have argued that external imbalances have played a central role in

causing the crisis.[3] We touch on this issue in particular, but only to the extent that it involves the role that monetary policy may have played.

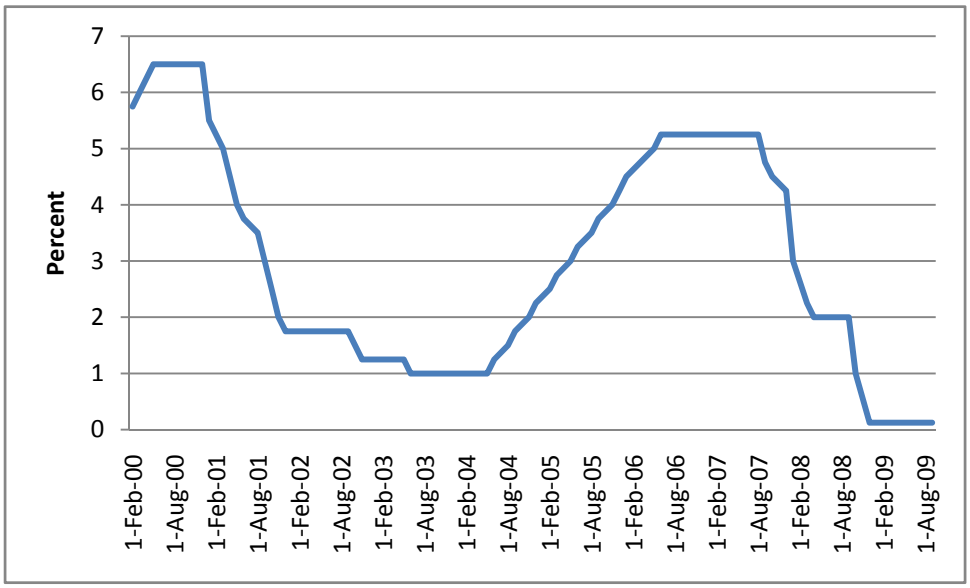
Even if the Fed's accommodative monetary policy during the 2003–06 period did not cause the housing bubble, it is reasonable to ask whether the Federal Reserve should have responded more forcefully to an emerging bubble in house prices once it materialized. Our review of the real-time experience suggests that such a response would have been challenging. Perhaps more significantly, adjustments to the federal funds rate sufficient to have a sizable impact on house prices would probably have had large and undesirable effects on unemployment and inflation. As a result, our judgment is that other types of policy responses may have been more appropriate. We discuss some such options in a brief review of the emerging literature on macroprudential regulation, highlighting how certain types of policies may have helped lean against a housing bubble while also emphasizing that much remains to be learned about the optimal design of macroprudential policies (such as countercyclical capital requirements or leverage restrictions). Accordingly, we close with some cautionary words regarding a reliance on monetary policy to meet possibly conflicting simultaneous objectives and the need for a coordinated approach to macroeconomic stabilization and financial policies.

A Review of Monetary Policy Rules from 2003 through 2006

We start by summarizing the recent history of the federal funds rate. As shown in figure 1, the target federal funds rate was lowered quickly as the recession began in early 2001—from 6.50 percent in late 2000 to 1.75 percent in December 2001 and to 1.00 percent in June 2003.

[3] On this point, a valuable discussion is in Obstfeld and Rogoff (2009). These authors draw a link between the large external imbalances and the current global financial crisis, including the boom and bust in housing markets. Although the U.S. current account may not have been a direct cause of the swings in housing markets, large global imbalances and the even larger gross international capital flows may have influenced it. Substantial savings, primarily from Asia, and low rates of investment led to low global long-term interest rates—the "global savings glut" (Bernanke (2005) and Gruber and Kamin (2007) examine this hypothesis). These low interest rates and ample credit may have encouraged some forms of financial innovation and a loosening of underwriting practices. Moreover, without large cross-country flows of capital, the ability of households and financial institutions to borrow may have been curtailed. Indeed, house prices and current accounts appear to have been strongly correlated during the run-up (Ahearne and others, 2005).

Figure 1: The Target Nominal Federal Funds Rate



Source: Federal Reserve Board

Policy Rules between 2003 and 2006

In order to gauge whether such settings of the federal funds rate were "loose" or "tight," a researcher requires some baseline for comparison. We follow the body of research analyzing the settings of monetary policy over some portion of the period between 2003 and 2006 by comparing actual policy to rule prescriptions. The relevance of such a comparison relies on a given rule being a "good" baseline, and we address this issue in our analysis of the real-time policy discussion in the next section.

We focus on versions of Taylor rules of the following form:

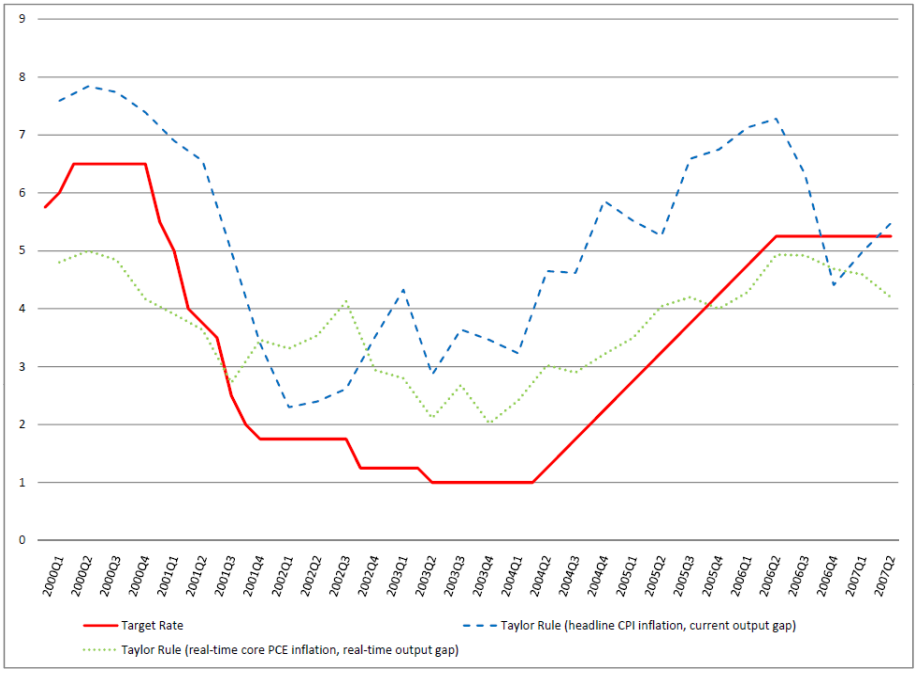
$$i_t = 2 + \pi_t + a(\pi_t - \pi^*) + b(y_t - y_t^*),$$

where the implied nominal federal funds rate is denoted i_t, inflation (π_t) is measured by the four-quarter growth rate of a price index, the inflation objective (π^*) is assumed to be 2 percent, and the output gap is measured by a percentage deviation of real GDP (y_t) from a measure of potential output (y_t^*). We focus especially on the Taylor (1993) rule, in which both "a" and "b" equal 0.5. However, we will consider other rule-based characterizations of policy elsewhere, as a long literature on policy rules has suggested a range of alternative coefficients; for example, some sources (see, e.g., Taylor (1999)) suggest setting the coefficient "b" at 1.

Figure 2 presents some results that illustrate a number of associated issues. The red, solid line is the target federal funds rate, as in figure 1, above. The blue, dashed line shows the

prescriptions from the Taylor (1993) rule when the inflation measure is based on the headline consumer price index (CPI) and the slack measure is the FRB/US model's *current* (as of the third quarter of 2009) estimate of the output gap over the relevant historical period. As is evident, the prescriptions of this rule follow the broad contour of the actual federal funds rate but lie above the actual rate for essentially the entire period. However, starting in the second half of 2002, the difference between the rule prescriptions and the target federal funds rate becomes larger: By this metric, monetary policy was markedly too easy from 2003 until some point in 2006—consistent with the claims of, for example, Taylor (2007). On average, the federal funds rate target is about 200 basis points below the rule prescriptions over this four-year period.

Figure 2: The Target Federal Funds Rate and Taylor (1993) Rule Prescriptions



Source: Federal Reserve Board, Congressional Budget Office, Bureau of Economic Analysis, Bureau of Labor Statistics, and authors' calculations

A comparison of the target federal funds rate with prescriptions from simple rules, as in figure 2, has considerable value and may provide a good summary guide to policy settings for three reasons: (1) A simple rule can provide a useful benchmark for policymakers, (2) simple rules may help financial market participants form a baseline for expectations regarding the future course of monetary policy, and (3) simple rules can be helpful in the central bank's communication with the general public. Indeed, these benefits are an important motivation for

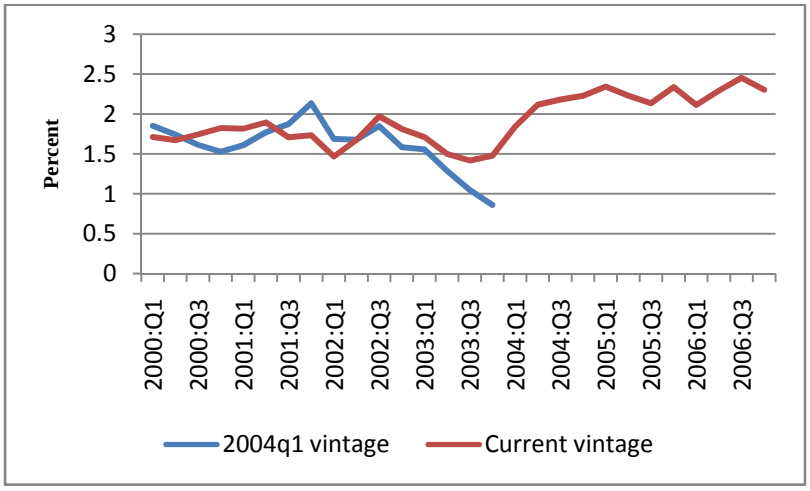
the presentation of prescriptions from a range of simple rules to the FOMC, as has been done routinely since 1995.[4]

But comparisons with simple rules also have limitations.[5] First, challenges associated with how to measure inflation and economic slack are central in actual policymaking despite their more limited role in research. For example, the path of the red line associated with the Taylor rule uses a particular measure of the output gap, even though several measures are available.

With regard to inflation measurement, the prescriptions shown in the red line use the headline CPI, and prescriptions based on other measures of inflation could differ. For example, Taylor (1993) used the GDP price index. The FOMC emphasizes the personal consumption expenditures (PCE) price index. So-called core inflation measures, which exclude volatile components that provide little signal about the underlying pace of inflation, are also of interest to policymakers, in part because they filter out the transient fluctuations.[6] Moreover, measures of inflation reported in real time can differ significantly from subsequent, revised estimates. This consideration may have been particularly important in the 2003–06 period. For example, the core PCE inflation rate (on a four-quarter basis) had fallen to 0.9 percent in the first release of the data on inflation in 2003 (in 2004:Q1), as shown in figure 3, and appeared to be on a steep downward trajectory. Given these real-time measured rates of inflation, the possibility of deflation was considered a significant risk.

[4] The prescriptions of many policy rules, including the Taylor (1993) and Taylor (1999) rules and estimated rules, are routinely presented to the FOMC in the briefing document known as the Bluebook.
[5] A similar discussion can be found elsewhere, e.g., Kohn (2007).
[6] For a summary of the literature on the signal content of overall and core inflation measures, see Kiley (2008).

Figure 3: Real-Time and Revised Core PCE Inflation



Source: Federal Reserve Bank of Philadelphia

Research that accounts for the importance of real-time measurement and different views regarding the appropriate price index to enter the policy rule has found that the implied trajectory of prescriptions is not too distant from the actual federal funds rate path.[7] For example, the green, dotted line in figure 2 presents the rule prescription using real-time data on core PCE inflation and real-time estimates of the output gap from the FRB/US model. The green line is closer to the actual federal funds rate, especially starting in late 2004; over 2003-06, the green line averages about 1½ percentage points lower than the blue line. Nonetheless, the actual federal funds rate lies notably below the prescribed rate from this rule and data for much of the period before 2006; our subsequent analysis will present the factors important in policy discussions during this period, and our empirical work will examine the consistency between the federal funds rate during this period and the predictions of other rules.

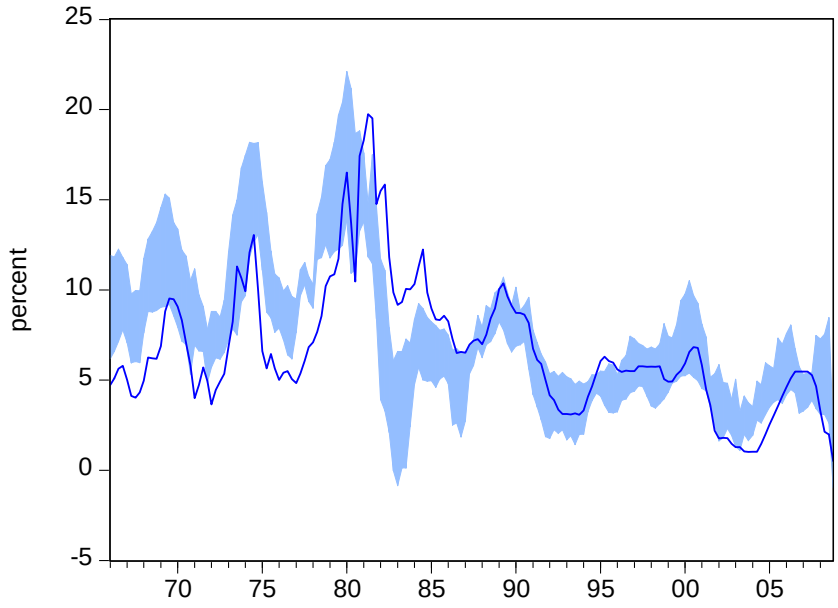
More generally, we think it is important to place the magnitude of deviations from simple rules into a historical perspective, taking into account different views about the appropriate price index, measure of the output gap, and the weights placed on such factors. Figure 4 presents the range spanned by16 permutations of policy rules, using two parameterizations of the rule (those of Taylor (1993) and Taylor (1999), where the output gap weights are 0.5 and 1.0, respectively); two price gauges (the PCE chain-type index and the CPI) and two specific indexes from each of these measures (the overall index and the core index); and two measures of the gap (the FRB/US

[7] For example, see Kohn (2007) and Orphanides and Wieland (2008).

model measure and the Congressional Budget Office (CBO) measure).[8] As can be seen, the magnitude of deviations from the range of prescriptions from such rules was significant prior to about 1987, reflecting the weak policy response to the rise in inflation in the 1970s and the aggressiveness of the disinflation under Federal Reserve Chairman Paul Volcker. In fact, the nominal federal funds rate was below the range from these policy rules for nearly the entire 15-year period prior to late 1979.

In contrast, the deviations in the period since then have been smaller. The period from 2003 to 2005 shows a federal funds rate path below the range for a short time and by a modest amount relative to the pre-1987 experience. We will return to the factors that may have contributed to this policy stance below.

Figure 4: The Federal Funds Rate and a Range of Rule Prescriptions



Source: Federal Reserve Board and authors' calculations

[8] This figure is based on a mix of real-time data and most-recent estimates. In particular, the rules based on the CBO gap all use the most-recent estimates for the output gap; similarly, the inflation rates based on the CPI used in the rules are based on the most recent data. For the rules based on the FRB/US gap, the output gap used is the most-recent estimate for all dates prior to 2001 and the real-time estimate for dates beginning in 2001; similarly, the inflation rates based on the PCE price index used in the rules are based on the most-recent data or the real-time data for the same group of dates. As a result, the contour this decade reflects the influence of real-time thinking, at least as seen through the FRB/US model.

Was Monetary Policy at Foreign Central Banks "Too Loose" Relative to a Taylor Rule?

Similar to the United States and as noted by Taylor (2008) and Ahrend and others (2008), monetary policy rates in a number of advanced foreign economies were also below the levels implied by the Taylor (1993) rule. Figure A1 in the appendix plots Taylor rule policy rates (in red) as computed by the International Monetary Fund (IMF) for the fall 2009 *World Economic Outlook* (WEO), along with the actual policy rates.[9] For countries within the euro area, the policy rate is that of the European Central Bank (ECB), but the policy rule is calculated using national data. Although many central banks were "too loose" relative to what the policy rule would imply, two additional points are worth making. First, most countries were closer to their simple rules shown in the figure than the United States was to its rule. Second, some foreign countries were either very close to, or even at times above, what the rule would imply, including countries where house prices also increased rapidly, such as the United Kingdom.

Other versions of simple monetary policy rules can produce smaller discrepancies from actual policy in many instances, but do not qualitatively change the result. The Taylor (1999) rule and an alternative version with a higher weight on inflation do in many cases lower the level of the policy rule relative to Taylor's 1993 version.[10] However, for many countries, these changes were small relative to the size of the discrepancies between the policy rules and the policy rates, and none of the alternative rules consistently resulted in lower levels of interest rates than the Taylor (1993) rule or other alternatives.

That many central banks had set policy rates below what a Taylor rule would imply has led Taylor (2008) to suggest that foreign central banks may have been "following the Fed." This possibility cannot be ruled out, and Taylor notes that the correlation between the policy rule deviations of the ECB and those of the Federal Reserve is sizable. However, central banks were all responding to the effects of the 2001 downturn. Also, the responses across major central banks were diverse. For example, the Bank of England's policy rates were not particularly low relative to a policy rule.

[9] The policy rule is $i = i^* + 0.5\,(\pi - \pi^*) + 0.5\,(y - y^*)$ where i^* is the IMF estimate of the equilibrium real rate, π^* is the inflation target (1.9 percent for euro- area countries and the United States, and 1 percent for Japan), and y-y* is the output gap estimated using a Hodrick-Prescott filter. Inflation rates are the Consumer Price Index for all countries, except the United States, where the Personal Consumption Expenditure index is used.

[10] In the rule with a higher weight on inflation, a is equal to 1 and b is equal to 0.5.

Macroeconomic Performance from 2003 through 2006 and the Real-Time Policy Discussion

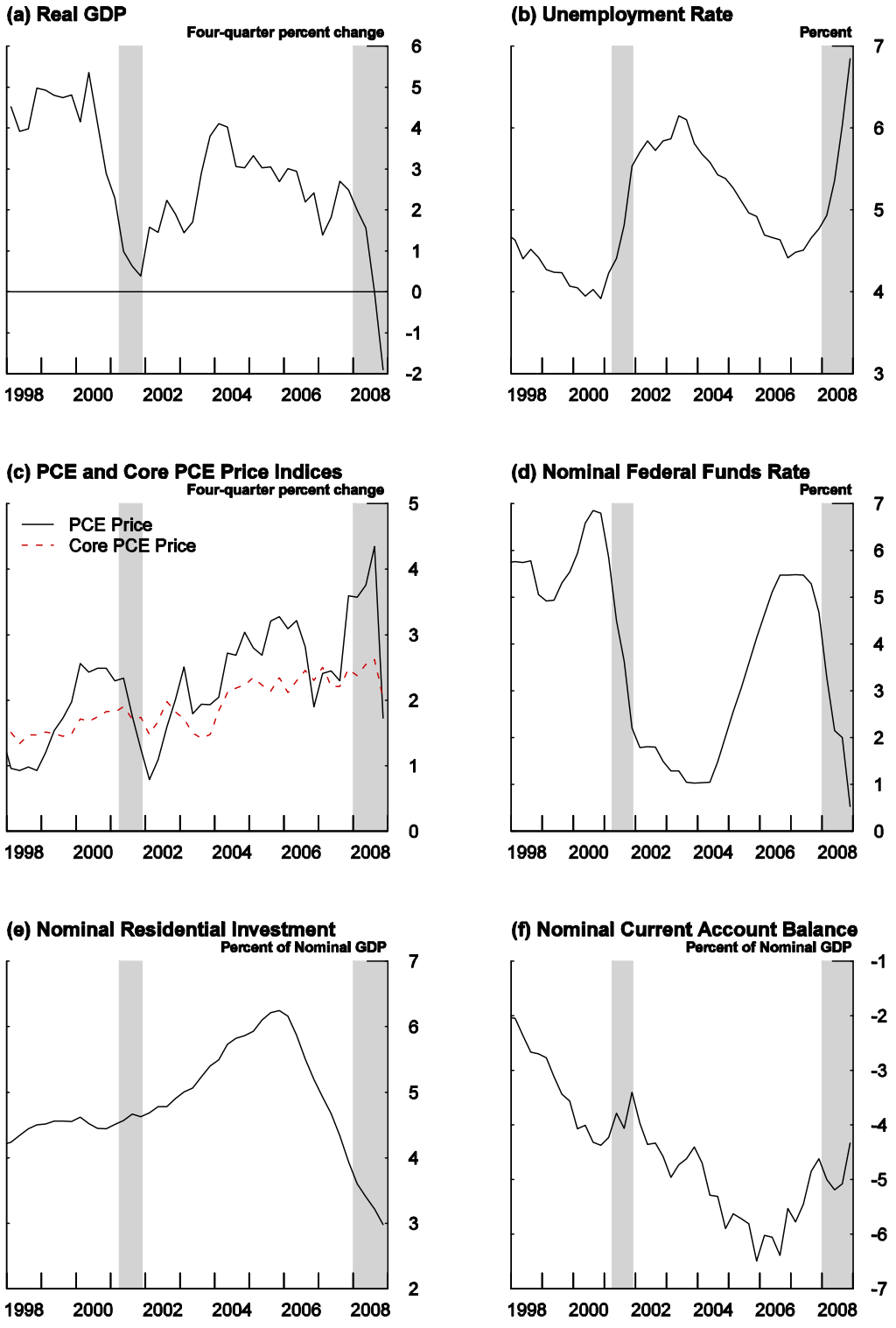
We now turn to a review of the macroeconomic environment from 2003 through 2006 in order to highlight the sorts of considerations that were prominent in policy discussions and in the views of the public at the time.

A review of economic activity following 2001 clearly indicates that economic performance was weak in the early stages of the recovery (figure 5). Real GDP (panel A) advanced at an average pace of just above 2 percent from 2002:Q1 to 2003:Q2, a rate insufficient to halt the rise in the unemployment rate (panel B), which peaked a bit above 6 percent in the first half of 2003. Moreover, inflation, on an overall or core PCE basis, averaged between 1½ and 2 percent during 2002 and 2003 (panel C) and was lower on a real-time basis (as discussed earlier). This confluence of factors, in conjunction with an assessment of key risks to the outlook (examined later in the paper), led the FOMC to lower the nominal federal funds rate to 1 percent by mid-2003 (panel D).

Residential investment advanced noticeably in 2002 and thereafter; this rise, on the heels of the lowering in the nominal federal funds rate, is one of the stylized facts that some analysts have used to suggest that monetary policy was a key factor behind housing market developments in the 2003–06 period. Our subsequent analysis will consider in detail whether the impetus from the federal funds rate to the housing market was as significant as this characterization suggests.

Finally, the current account deficit as a share of nominal GDP widened steadily from 2002 to 2006—from about 4 percent to more than 6 percent. The recovery in U.S. demand combined with the already high level of imports and the run-up in oil prices explains this contour. The decline in the exchange value of the dollar, which resulted, in part, from the weakness in the economy and the resulting low level of the federal funds rate, helped reverse the deterioration in the current account later in the period.

Figure 5: Key Macroeconomic Developments



Source: Federal Reserve Board, Bureau of Economic Analysis, and Bureau of Labor Statistics

The Real-Time Policy Assessment and Outcomes

In judging the stance of monetary policy, three considerations are central. First, policy must be forward looking so as to account for the effect of current actions on subsequent developments (Bernanke, 2004; Woodford, 2007). Second, policy should be evaluated by gauging how effectively it promotes the attainment of its objectives. And third, the benchmark against which effectiveness should be gauged is not what theoretically might have been attainable given perfect foresight of the future, but what could reasonably have been expected given what was known at the time the policy actions were taken.

In light of these considerations, the evaluation of policy settings is perhaps best done through a comparison of projected outcomes for the policy objectives given policy expectations; such a comparison involves examining whether the forecasts of policymakers, the private sector, or other forecasters were consistent with a balancing of the price stability objective and the full employment objective (for example, the unemployment rate in the neighborhood of its estimated natural rate). Indeed, this method for evaluating policy conforms most closely with actual practice, can be checked by looking at real-time data, and is directly connected to the economic theory of policy design as emphasized by, for example, Svensson (2009). Moreover, this approach highlights the weaknesses associated with too close a focus on simple policy rules. In particular, simple policy rules cannot account for the potential importance of the range of factors influencing the outlook beyond the variables that enter the rule or for the influence of risks that may be asymmetric.

During the 2003–06 time frame, the setting of monetary policy appeared to follow the broad contours that would be expected given conventional macroeconomic views: Inflation was expected to remain in the neighborhood of 2 percent, around the readings on core PCE inflation over the period, while the unemployment rate was near 6 percent early in the period and only inched toward 5 percent, a conventional view at that time of the natural rate of unemployment in this period (e.g., CBO (2004)). Given the near attainment of both the price stability and the maximum sustainable employment objectives of the Federal Reserve, there appears to be little to suggest that the federal funds rate should have been markedly higher.

This summary seems consistent with the real-time views of members of the FOMC. Table 1 presents the one-year-ahead forecasts for inflation, the unemployment rate, and real GDP growth presented in the *Monetary Policy Report to the Congress* at the start of each year from 2003 to 2006. (Note that the measure of inflation reported in these documents shifted from

overall PCE inflation to core PCE inflation from the years 2003–04 to the years 2005–06). The improvement in economic activity during 2003 and 2004 was in line with the expectations of FOMC members as of the beginning of each year. In 2003, inflation came in modestly higher than expected, but in 2004 the miss was more substantial, amounting to 2 percentage points for the change in overall PCE prices. The latter miss is partly explained by an unexpected jump in the price of oil that year.

The unemployment rate came in on the low side of FOMC members' expectations in 2005 and 2006, and inflation was again somewhat above expectations. But the federal funds rate had risen to 5¼ percent by the middle of 2006—at the high end of the prescriptions of the policy rules presented previously.

Of course, the discussion of FOMC members' projections focuses on what policymakers thought in real time; if these views were both erroneous and different from the views of most others, then the fact that policymakers expected their actions to yield desirable outcomes is not especially relevant for the question of whether policy was tuned appropriately. A review of the projections of outside forecasts (from the private sector and other government agencies) also suggests that the setting of policy was broadly in line with policy objectives. Table 2 presents one-year-ahead forecasts from the Blue Chip survey, the CBO, and the Administration. The inflation projections consistently show that forecasters expected inflation (on a CPI basis) in the neighborhood of 2 percent, and the unemployment rate was expected to exceed 5 percent from 2003 to 2005 and to essentially equal 5 percent by year-end 2006.[11] These projections indicate that outside forecasters, on balance, saw the policy stance adopted by the FOMC as consistent with the FOMC's objectives.

[11] The forecasts for inflation in this table refer to the CPI. In general, inflation as measured in the CPI averages a couple of tenths of a percentage point (at an annual rate) higher than inflation as measured by the PCE price index.

Table 1. FOMC Forecasts of Key Macroeconomic Variables[1]

	FOMC	Outcome
	Year 2003	
PCE prices (percent change, Q4/Q4)[2]	1¼ – 1½	1.9
Unemployment rate (percent, Q4)	5¾ – 6	5.8
GDP (percent change, Q4/Q4)	3¼ – 3½	3.8
	Year 2004	
PCE prices (percent change, Q4/Q4)	1 – 1¼	3.0
Unemployment rate (percent, Q4)	5¼ – 5½	5.4
GDP (percent change, Q4/Q4)	4½ – 5	3.1
	Year 2005	
Core PCE prices (percent change, Q4/Q4)	1½ – 1¾	2.3
Unemployment rate (percent, Q4)	5¼	4.9
GDP (percent change, Q4/Q4)	3¾ – 4	2.7
	Year 2006	
Core PCE prices (percent change, Q4/Q4)	2	2.3
Unemployment rate (percent, Q4)	4¾ – 5	4.4
GDP (percent change, Q4/Q4)	3½	2.4

1. The projections refer to those presented in the *Monetary Policy Report to the Congress* published at the start of the year indicated. The ranges shown are the central tendencies of the projections.
2. FOMC price forecasts and the outcomes were based on the PCE chain-type index in 2003 and 2004 and the core PCE index in 2005 and 2006.
3. Sources: Federal Reserve Board, Bureau of Labor Statistics and Bureau of Economic Analysis

Table 2. Forecasts and Outcomes of Key Macroeconomic Variables[1]

	Blue Chip	CBO	Administration	Outcome
		Year 2003		
CPI (percent change, Q4/Q4)	2.1	2.1	2.0	1.9
Unemployment rate (percent, Q4)	5.7	5.9[2]	5.6	5.8
GDP (percent change, Q4/Q4)	3.3	3.0	3.4	3.8
		Year 2004		
CPI (percent change, Q4/Q4)	1.9	2.0	1.4	3.0
Unemployment rate (percent, Q4)	5.6	5.8[2]	5.5	5.4
GDP (percent change, Q4/Q4)	4.1	2.6	4.0	3.1
		Year 2005		
CPI (percent change, Q4/Q4)	2.3	1.9	2.0	3.3
Unemployment rate (Q4)	5.2	5.2[2]	5.3	4.9
GDP (percent change, Q4/Q4)	3.5	3.7	3.5	2.7
		Year 2006		
CPI (percent change, Q4/Q4)	2.2	2.1	2.4	1.9
Unemployment rate (percent, Q4)	4.9	5.0[2]	5.0	4.4
GDP (percent change, Q4/Q4)	3.3	3.6	3.4	2.4

1. All forecasts were published in January or February.
2. Year-average unemployment rate.
3. Sources: Blue Chip Economic Survey, Aspen Publishers; Congressional Budget Office; Council of Economic Advisers; Bureau of Labor Statistics and Bureau of Economic Analysis

A final important aspect of policy during this period was the communications strategy. The FOMC noted that policy was likely to remain accommodative for a "considerable period" starting in August 2003, that the Committee believed it could be "patient" with regard to the

removal of accommodation starting in January 2004, and that the Committee believed that policy accommodation could be removed at a pace that was "measured" starting in May 2004. The FOMC began to raise the target federal funds rate in June 2004. This guidance was designed to influence asset prices, economic activity, and inflation in a manner consistent with the goals of price stability and full employment. As has been emphasized by many researchers, the guidance of expectations is the primary channel through which policy affects economic outcomes—the overnight interest rate in the interbank market is in itself inconsequential for economic activity, except to the extent that it affects expectations of the future path of this rate, which in turn influence a broad array of asset prices important to aggregate spending and price setting.[12]

The central role of communication regarding the future path of the policy rate is arguably even greater at low rates of inflation, when the risk associated with the zero lower bound on nominal interest rates is greatest. Indeed, the possibility of deflation and hitting the zero lower bound played an important role in shaping policymaker views regarding the appropriate setting of monetary policy. In particular, policymakers adopted what became known as a risk-management approach during the 2003–06 period. The motivation for a risk-management strategy arises in circumstances in which the risks to the outlook or the perceived costs of missing an objective are markedly asymmetric. Under such conditions, policymakers may choose to respond by adjusting policy in a way that would not be justified solely by the modal outlook for output and inflation gaps; instead, policy actions may be guided by the entire distribution of potential outcomes and associated costs. As a result, the policy stance in such circumstances is likely to differ appreciably from what would be chosen if policy was guided solely by the modal outlook. For example, the potential for an "unwelcome fall" in inflation, to rates that could have involved deflation and perhaps a period of poor macroeconomic performance, was real in this period.[13] Specifically, in June 2003, the Federal Reserve staff estimated a probability that the economy would experience price deflation over 2004 and 2005 of about 40 percent, and a probability of the federal funds rate falling to the zero lower bound of about 20 percent. The fact that these probabilities were as high as they were reflected, among other factors, the influence of the weak state of the labor market and the low level of inflation over the course of 2003 in the initial data releases, as discussed earlier.

[12] See Woodford (2005) for a discussion.
[13] See Bernanke (2003).

As a result, policy actions that aggressively moved against the risk of deflation were in line with prescriptions from related macroeconomic research and the lessons from the Japanese experience of the 1990s (e.g., Fuhrer and Madigan (1997), Reifschneider and Williams (2000), and Ahearne and others (2002)). In addition to the recommendations for aggressive policy action to prevent the economy from reaching a state at which the zero lower bound binds, research has emphasized the potential for forward guidance about the path of policy rates to mitigate the adverse effects of the zero lower bound (e.g., Eggertson and Woodford (2003)). In the event, the evolution of the macroeconomy suggest that communication regarding the stance of policy was effective and contributed positively to economic performance—a view shared by Federal Reserve policymakers such as Kohn (2005) and academics such as Woodford (2005).

Other Critiques of Policy

Given the broad consistency between projected outcomes (from the FOMC, private-sector forecasters, and other government agencies) and desired outcomes, a critique of policy settings after 2002 would need to focus on other developments not addressed by the evidence just presented. In light of the contour of macroeconomic developments in this period, shown in figure 5, three possible critiques seem plausible. First, the high levels of overall PCE inflation (relative to core) at some points during the 2003–06 period could be viewed as calling for a different policy stance; second, the strength of the housing market per se could have been viewed as a policy concern; and third, the erosion of the current account position could have been viewed as calling for a somewhat different stance of monetary policy.

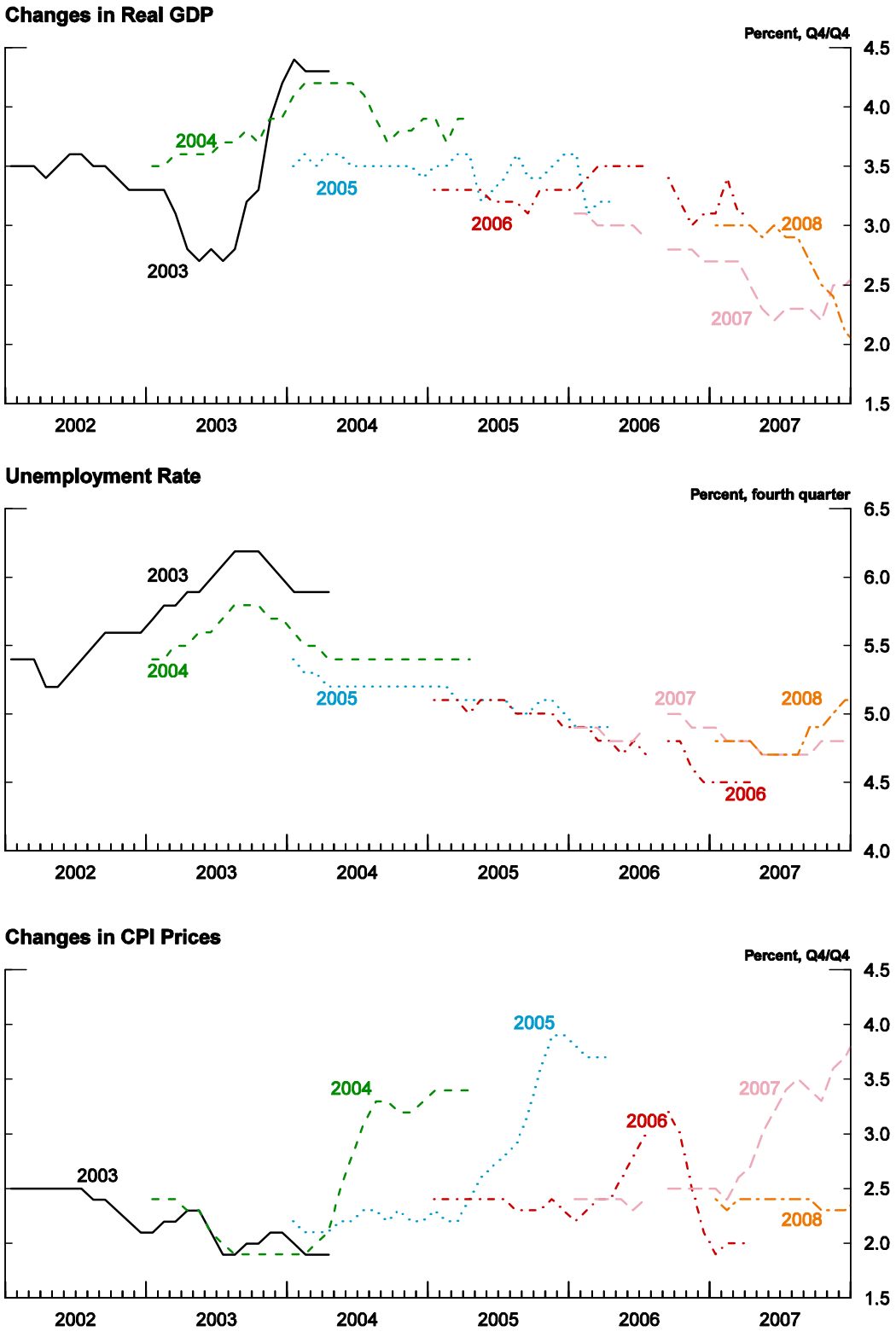
It is not obvious, in our view, that the string of surprises on the price of oil, which led to unexpectedly high overall PCE inflation, suggests that monetary policy should have been tighter during this period. In particular, these increases in the price of oil were not expected by most economists. For example, figure 6 presents the evolution of the forecasts for inflation, the unemployment rate, and GDP from the Blue Chip survey. As is quite clear in the evolution of the CPI projections, forecasters were surprised by the jump in the price of oil in 2004 and subsequently, and did not expect inflation to be high going forward at any point in this period.[14] This stability of inflation expectations, and the importance of being forward looking in policymaking, indicates again that monetary policy did not appear excessively loose.

[14] The fact that market participants were surprised by the continual rise in the price of oil over this period is apparent in quotes from futures markets (not shown).

Standard macroeconomic reasoning also does not support a view that current account developments during this period indicate that monetary policy should have been set differently, though changes in other policies, such as fiscal policy, may have been appropriate.[15] A number of observers have pointed to large external imbalances as helping to bring about the global financial crisis, in part through channels that may have raised house prices, such as low long-term interest rates. However, over the course of the mid-2000s, the scenario that most concerned many observers was not an influx of foreign capital fueling a credit boom, but rather a disorderly adjustment of the U.S. current account.[16] This possibility involved a sharp depreciation of the U.S. dollar, which in turn might have destabilized financial markets, prompted balance sheet concerns regarding some institutions, and potentially led to a recession. In a number of speeches during the period from 2002 to 2004, FOMC participants (members of the Board of Governors and all Reserve Bank presidents) also expressed varying degrees of concern about the growing size of the U.S. external balances and the possibility of a disorderly correction.[17] However, it was clear that in their view monetary policy was not and should not be directed toward addressing external balances per se. As then Governor Kohn stated, "Simply put, monetary policy is not the appropriate tool for improving the current account." [18]

[15] Obstfeld and Rogoff (2009) discuss the policy environment (both monetary and fiscal aspects) during this period and the role of such factors in the subsequent financial and macroeconomic crisis.
[16] See Obstfeld and Rogoff (2005).
[17] See Ferguson (2004), Greenspan (2003), and Kohn (2002, 2004).
[18] Kohn (2002).

Figure 6: Evolution of Forecasts from the Blue Chip Survey



Source: Blue Chip Economic Survey, Aspen Publishers

The reasoning behind such a view is that the effect of even a sizable tightening of monetary policy on the U.S. current account would likely be fairly limited. Tighter monetary policy would result in weaker activity in the United States, which would lower the growth of imports and improve the trade deficit. However, this effect would be offset (perhaps even entirely) by a real appreciation of the dollar, which makes U.S. exports more expensive for foreigners. Simulations with the Federal Reserve's large open-economy macroeconomic models yield improvements in the current account on the order of only 0.05 to 0.1 percent of GDP at a two-year horizon in response to an increase in the federal funds rate of 100 basis points. Likewise, accommodative monetary policy likely played a limited role in the substantial widening of the current account deficit during the 2003–06 period.

This discussion leaves us with one outstanding issue: the specific role of monetary policy in the housing market this decade and the possibility that, despite overall macroeconomic conditions, policy should have been set quite differently during this period because of developments in this particular sector. We now turn to a detailed focus on housing.

Macroeconomic Evidence on the Contribution of Monetary Policy to the Housing Boom

The previous section suggests that the federal funds rate was a bit lower than suggested by the Taylor (1993) rule. This section turns to the task of attempting to quantify the extent to which the stance of monetary policy could have contributed to the high level of housing activity. One may suppose that such influence might have been considerable, as housing is one of the sectors most sensitive to monetary policy (e.g., the review in Boivin, Kiley, and Mishkin (2009)). Indeed, Kohn (2003) noted that policy actions were likely to contribute to housing activity disproportionately, and raised several questions regarding the degree to which such impetus may create future dislocations. In this regard it is important to remember that housing demand is determined by the level of interest rates and other factors – not by deviations from policy rules; as a result, the low level of the nominal funds rate may have contributed substantially to the boom in housing markets even if there was no policy "deviation".

We assess the contribution of monetary policy to the housing boom from several perspectives: the timing of the boom, simulations designed to gauge the links between monetary policy and the housing boom using both the Federal Reserve's FRB/US model and a vector

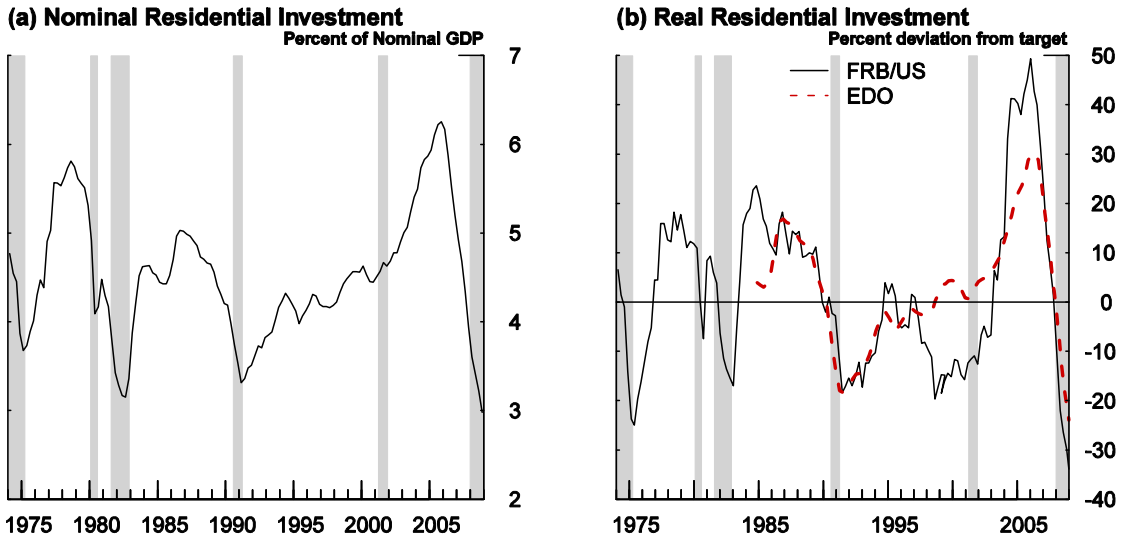
autoregression, a summary of related research on U.S. developments, and a comparison to international developments in housing markets and global economic developments.

The Timing of the Housing Boom

Figure 7 presents the time series for the share of (nominal) residential investment in GDP (left panel); as noted earlier, residential investment moved above its average share (for the 1974–2001 period) in 2002 and rose substantially through the end of 2005, reaching 6¼ percent of GDP late that year—the highest share in a half-century.

The right panel of figure 7 presents the level of real residential investment relative to two estimates of "target" long-run investment—the target level from the Federal Reserve's FRB/US model and the target level from EDO, the Federal Reserve's U.S. dynamic stochastic general equilibrium (DSGE) model (see Edge, Kiley, and Laforte (2009) or Kiley (2009)); both of these target measures are *long-run* concepts, and hence significant deviations over the business cycle should be expected. With that caveat in mind, it is clear from the right panel that residential investment rose to very high levels relative to these models' estimates of long-run targets after 2002.[19] Given the timing of these deviations, one may be inclined to follow Taylor (2007) and draw a link between monetary policy and the strength of residential investment in this period.

Figure 7: Residential investment as a share of GDP and relative to long-run targets

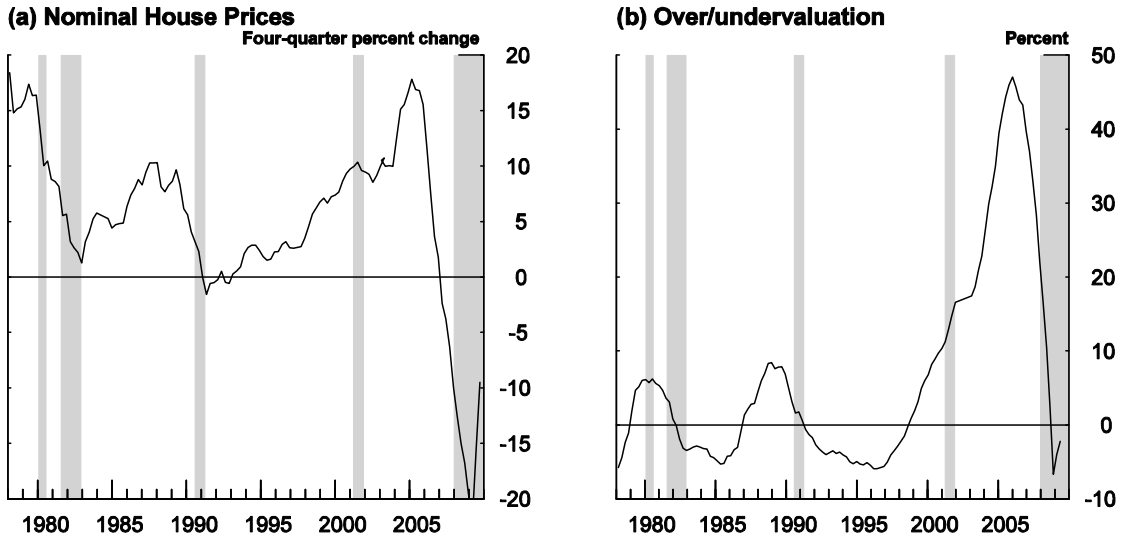


Source: Bureau of Economic Analysis and authors' calculations

[19] Kohn (2003) presents similar ratios of housing investment to targets (from FRB/US only) in his discussion of monetary policy and housing.

Figure 8 presents the growth rate of the LoanPerformance house price index (left panel) and one measure of the overvaluation or undervaluation of house prices relative to rents (based on a model similar to Gallin (2008)).

Figure 8: Nominal House Price Growth and Over/Undervaluation



Source: For nominal house prices, LoanPerformance, a division of First American CoreLogic; for over/undervaluation, authors' estimates.

Nominal house price growth began to pick up in the late 1990s. Consequently, Shiller (2007) and Iacoviello and Neri (forthcoming) suggest that the boom began in 1998; this timing clearly predates the accommodative monetary policy following the 2001 recession. However, the pace of house price appreciation increased notably after 2002, and much of the overvaluation in house prices appears to have occurred after 2002 as well. As with the data on residential investment, the timing of these events suggests that it may be possible to draw a causal link between the setting of monetary policy and the strength of housing.

One additional issue on the timing of the bubble in house prices concerns real-time views on house price developments. As we will emphasize in our later discussion of the lessons from our analysis, there was considerable uncertainty in real time about the sustainability of the increase in home values. One important (and perhaps underappreciated) issue related to this uncertainty concerns data availability and quality. Measurement of house prices improved

significantly over the past decade. Initially, analysts used average sales prices, "constant quality" indexes, and other measures, in addition to the weighted repeat-sales indexes (such as the LoanPerformance index we used earlier) that have emerged as the best high-frequency indicators of house price changes. Only two such indexes (published by the Office of Federal Housing Enterprise Oversight and Freddie Mac) were publicly available over the first half of this decade; both were based on data taken from mortgages purchased by Fannie Mae and Freddie Mac. These indexes were substantially and frequently revised in light of distortions introduced by, for example, refinancing waves. Because they were based on homes purchased using conforming mortgages, these indexes missed price movements in homes financed with jumbo, alt-A, and subprime mortgages. Indexes based on repeat sales of all properties became publicly available only in 2006.

Model-Based Evidence on the Contribution of Monetary Policy

We examined two empirical models in order to gauge the role that monetary policy may have played in housing market developments—the Federal Reserve Board's FRB/US model and a reduced-form vector-autoregressive model.

The FRB/US model

One of the main models used for macroeconomic policy analysis of the U.S. economy at the Federal Reserve Board is the FRB/US model. In this model, monetary policy affects the user cost of housing and households' wealth through conventional asset price channels; these channels determine the impetus to residential investment from monetary policy. In particular, the demand for housing is especially sensitive to persistent shifts in the federal funds rate, as such shifts have large effects on the user cost of housing because houses are long-lived assets (see Boivin, Kiley and Mishkin (2009)).

We considered two alternative paths for monetary policy: the Taylor (1993) rule, with coefficients of ½ on inflation and the output gap, and the Taylor (1999) rule, with an inflation coefficient of ½ and an output gap coefficient of 1.[20] We simulated the course of the economy

[20] The policy rules use inflation as measured in the core PCE price index and the FRB/US model's estimate of the output gap.

assuming policy strictly follows each rule.[21] Figure 9 presents the baseline and alternative paths for key macroeconomic aggregates under each policy.

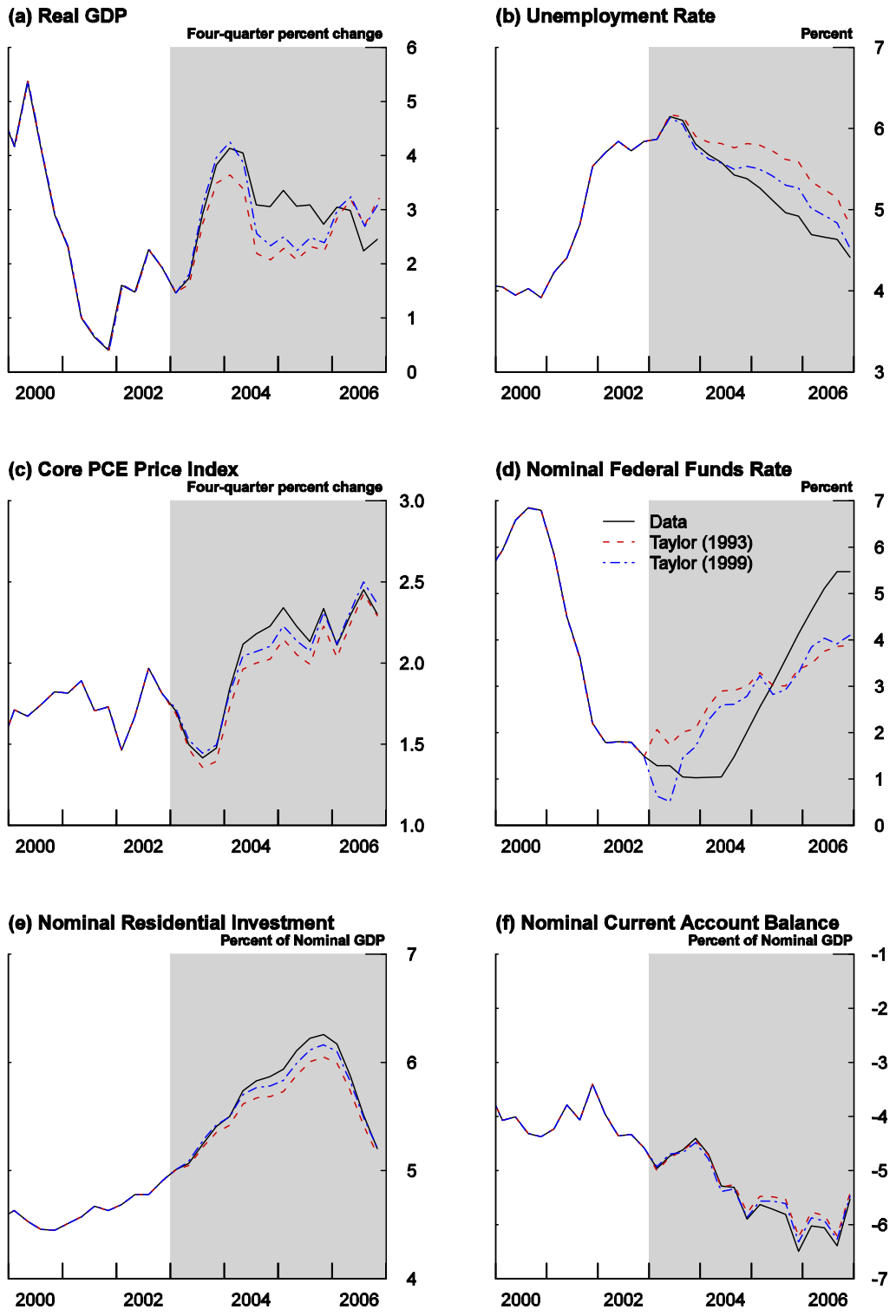
As shown in the middle right panel, the paths of the policy interest rate from each simple rule are modestly higher than the actual federal funds rate path by late 2004 and through the beginning of 2005; after early 2005, the actual federal funds rate is higher than the alternate path. As a result, the alternate paths for the (30-year, fixed) mortgage rate are higher for most of 2004 and 2005. Consequently, the residential investment share of GDP (the lower left panel) is a touch lower— – about ¼ percentage point. This change from baseline is very small relative to the rise in residential investment over this period.

Other macro aggregates also would have differed under alternative policy paths: For example, the unemployment rate (top right panel) would have been 50 basis points higher, on average, during the entire simulation period (2003–06) under the strict implementation of Taylor's 1993 rule. In contrast, as noted earlier, the current account deficit as a share of GDP (bottom right panel) would only be slightly lower.

Indeed, it is quite clear from these simulation results that a stance of monetary policy sufficiently "tight" so as to exert a considerable drag on the housing market during its most exuberant phase would have resulted—at least according to the FRB/US model—in an unemployment rate far higher than the rate realized over this period.

[21] In these simulations, we produce a baseline in which the FRB/US model tracks the data over the simulation period, and examine the consequences of alternative monetary policy paths holding constant other factors over the period.

Figure 9: Macroeconomic Implications of Alternative Policy Settings



Source: Federal Reserve Board, Bureau of Economic Analysis, and Bureau of Labor Statistics

A vector-autoregressive model

We now present some results using a vector autoregression. This framework allows us to consider our two questions—Was monetary policy loose? and Was monetary policy a major contributor to the strength in housing markets?—without imposing the FRB/US model's particular economic structure.

In broad terms, we followed the spirit of similar analyses carried out by researchers outside the Federal Reserve. We considered a VAR with seven macroeconomic variables: real GDP and real personal consumption expenditures (in log levels), the (nominal) share of residential investment in GDP, real house prices (as measured by the ratio of the (seasonally adjusted) LoanPerformance index to the core PCE price index in log levels), core PCE inflation, the unemployment rate, and the nominal federal funds rate. These variables are a core set of macro (income, consumption, inflation, unemployment, and the policy interest rate) and housing-related (residential investment and house prices) variables, and other VAR-based analyses have considered similar sets of data (e.g., Del Negro and Otrok (2007), Jarocinski and Smets (2008)). The sample period for estimation is 1977:Q1 to 2002:Q4; we exclude the period after 2002 from estimation in order to examine whether developments over the later period deviated substantially from the predictions of the VAR.[22] The VAR includes two lags of each variable.

Given the unrestricted specification associated with the VAR, we could evaluate the 2003–08 period in several ways. One possibility is to identify monetary policy shocks (using, for example, a recursive identification strategy). Another possibility is to ask whether the paths of the federal funds rate or housing variables deviated from those consistent with the VAR conditional on other variables that enter the VAR (as in Doan, Litterman, and Sims (1984); Clarida and Coyle (1984); and Waggoner and Zha (1999)); this *conditional forecast* approach does not require identification of structure. We present the conditional forecast approach; the most similar study regarding whether policy paths deviated from previous relationships, that of Clarida and Friedman (1984) on the post-1979 policy environment, also followed the conditional forecast approach.

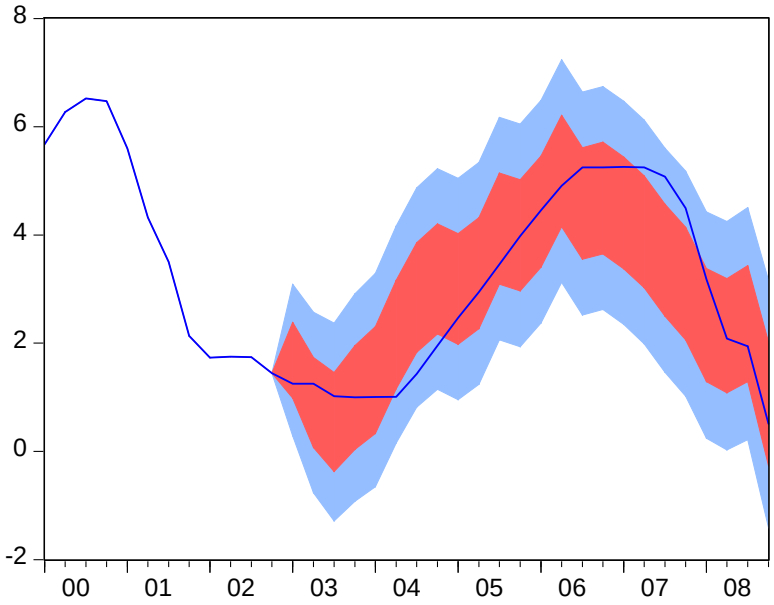
Given this approach, realized paths that differ significantly from the conditional forecast path would suggest that the path of the variable under consideration was not typical of historical links with the set of variables that enter the VAR.

[22] Our sample period is notably longer than that of Del Negro and Otrok (2007) or Jarocinski and Smets (2008).

To answer the first question (was monetary policy loose?), we presented the conditional forecast for the federal funds rate for the period after 2002:Q4 using the parameters estimated for 1977:Q1 through 2002:Q4 and all of the observable data through 2008. Figure 10 presents the realized path and the simulated standard deviation bands.

Figure 10: Conditional Forecast for Federal Funds Rate (percent)

(all other data observed, +/- 1- and 2-standard error bands)



Source: Authors' calculations

As can be seen, the realized path of the federal funds rate is within the 2–standard deviation conditional forecast band, suggesting that policy was not unusually loose in this period. From this perspective, it is very clear that the path of the federal funds rate over the past decade has been very consistent with the policy strategy over the preceding twenty five years. This result echoes the spirit of our earlier discussion, in which the setting of policy during this period seemed broadly in line with the macroeconomic environment.

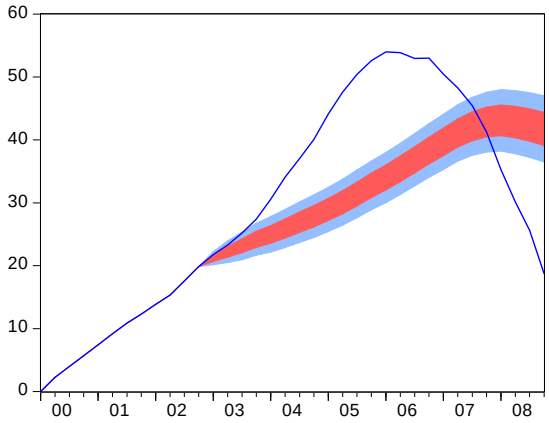
Figure 11 presents an analogous simulation for the residential investment share and house price growth. In these simulations, all the macro variables are observed. As a result, the correspondence between the simulated bands for housing variables and the realized paths for

these variables indicates whether the course of such housing variables was consistent with historical relationships to macro variables, including monetary policy.

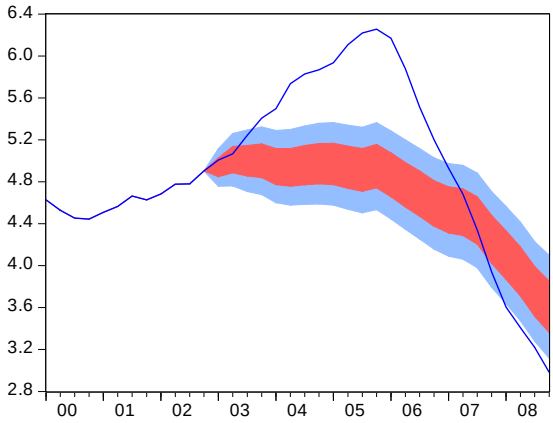
Figure 11: Conditional Forecasts for Residential Investment Share and House Prices

(macroeconomic variables observed, +/- 1- and 2-standard error bands)

House Prices (Index=0 in 2000Q1) (Log units)



Nominal Residential Investment (Percent of nominal GDP)



Source: Authors' calculations.

As is clear from the figure, the housing market developments over 2003 through 2008 were far outside the 2–standard deviation confidence bands based on observed macro variables, *including the federal funds rate* and the VAR's estimated parameters. With that said, it is important to note that the confidence interval for the share of residential investment in GDP includes 5 percent for much of the period up to 2006 – which would have been the highest realized share in over 20 years; in this respect, accommodative monetary policy was certainly supportive of macroeconomic activity and a source of strength in the housing market. Nonetheless, the simulation suggests that macroeconomic conditions did not drive the housing market developments in this period—at least not in a historically typical manner, as captured by the VAR.

Related Macroeconomic Research on U.S. Developments

In our analysis using a large-scale macroeconometric model or an unrestricted VAR, we have emphasized the role that monetary policy may have played in spurring the housing boom. Our results echo those in most related literature.

For example, both Del Negro and Otrok (2007) and Jarocinski and Smets (2008) use VARs to assess the role of monetary policy in shaping the course of house prices and, in the latter case, residential investment. Both of these studies ascribe only a small role to monetary policy and attribute the bulk of the run-up in house prices or residential investment to "housing-specific" shocks—a conclusion that partly motivates our turn to housing-specific developments in the next full section.

Alternative structural model exercises also attribute only a modest portion of the strength of housing markets to monetary policy, similar to our FRB/US-based conclusions. For example, a U.S. DSGE model used at the Federal Reserve Board, EDO, ascribes only a small portion of the strength of residential investment over 2003 through 2006 to monetary policy (Edge, Kiley, and Laforte, 2009). Similar analyses reach much the same conclusion. Most notably, Iacoviello (2006) and Iacoviello and Neri (forthcoming), using a DSGE model with collateral-based financial accelerator effects from housing, also attribute only a small portion of the run-up in house prices and residential investment to monetary policy. We are not aware of studies using a structural or semistructural approach that attribute a significant portion of the strength in housing markets to monetary policy.

A separate literature addresses issues regarding a bubble, defined as a rise in asset prices above the asset's fundamental value. However, as pointed out by Brunnermeier (2008), most of these models do not address the question of whether monetary policy easing can start a bubble.[23] In fact, Brunnermeier's survey concludes that "we do not have many convincing models that explain when and why bubbles start" (Brunnermeier, 2008). In addition, this branch of research is generally not integrated into a broader model of the economy, so it is difficult to assess the effects that monetary policy might have.

Finally, Shiller (2007) presents a series of case studies and a historical description of U.S. housing market developments. His discussion emphasizes psychological factors, including the perception that house prices were likely to rise rapidly and unlikely to fall and the positive feedback loop to which this mindset contributed. As we will see in our discussion that focuses in even more detail on housing-specific factors, Shiller's view on house prices and expectations is one of many plausible explanations for the housing bubble. On the narrower question of the role of monetary policy in the housing boom, his views accord with ours: "[Monetary] policy does

[23] An exception is Allen and Gale (2000), who present a model in which uncertainty about credit expansion by the central bank can give rise to asset price bubbles.

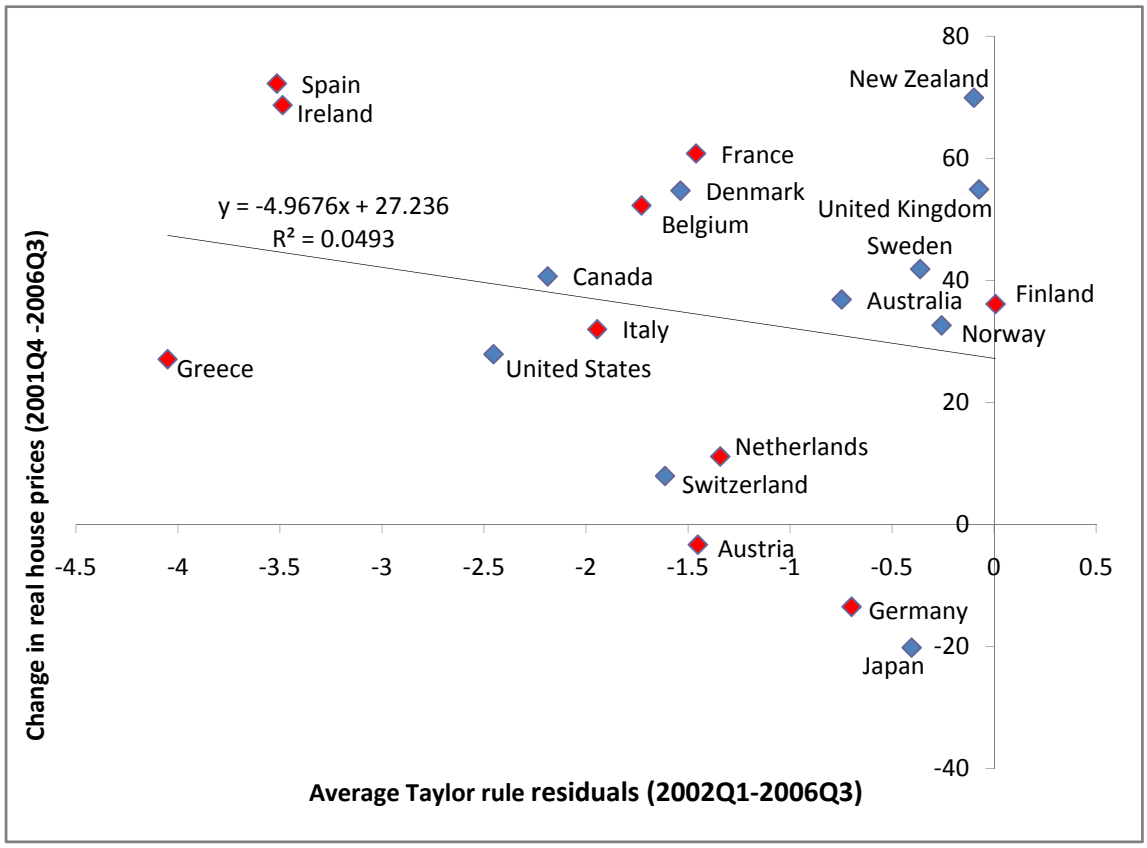
not come out as central in the case studies examined here" (Shiller, 2007, p. 117). His reasoning follows much the same lines as our analysis: Historical relationships do not suggest the strong link necessary to ascribe a large role to monetary policy in the recent episode; rather, although the recent period did feature both accommodative monetary policy and a housing boom, those two developments were only tenuously related.

How Were Monetary Policy and Housing Markets Related during the Mid-2000s in Foreign Economies?

The coincidence of accommodative monetary policy and the housing bubble in the U.S. in the mid-2000s is, in a sense, just one observation. Seeking to overcome this limitation, some researchers have looked at foreign economies to see if, across countries, looser monetary policy was associated with more house price appreciation during this time period. We have already seen that, besides the U.S., several other countries had loose monetary policy relative to a Taylor rule, albeit to varying degrees. At the same time, some (but not all) foreign economies experienced housing booms, again to varying degrees. Did those countries with the most accommodative monetary policy have the biggest housing booms? The evidence on this is mixed.

On the one hand, deviations from a simple monetary policy rule do not seem to be correlated with changes in house prices. Figure 12—reproduced from the Fall 2009 World Economic Outlook (WEO)—plots average residuals from the Taylor rules shown in the appendix between 2002:Q1 and 2006:Q3 (i.e., the actual minus Taylor-rule policy rate) against the rise in real house prices from 2001:Q4 to 2006:Q3. The relationship is of the expected negative sign but statistically insignificant (and relatively weak in economic terms as well): Although some countries such as Ireland and Spain had policy rates that were low relative to the policy rule along with large increases in house prices, many other countries with big rises in house prices, including the United Kingdom and Australia, had small deviations from the policy rules. The relationship between average real policy rates and the change in real house prices (not shown) is also insignificant.

Figure 12: Monetary Policy and House Prices in the Advanced Economies



Source: IMF (2009)

The correlation between Taylor rule residuals and house prices is stronger if the sample is restricted to only countries in the euro area (marked in red), with the simple correlation rising from -0.22 to (a still statistically insignificant) -0.48. However the direction of causation is complex. For example, within the euro area the policy interest rate is common to all countries, thus variation in Taylor rule residuals is driven purely by differences in local inflation and output. Countries with higher output growth and inflation than the euro area as a whole will likely have negative Taylor rule residuals (or positive residuals in the opposite case), as policy is set for the entire economy. Countries with stronger growth will also likely have more demand for housing and if the supply of houses is at least somewhat inelastic in the short run, more house price appreciation. Thus the observed negative correlation could result in this case, even if monetary policy was not loose relative to a Taylor rule in the aggregate or if monetary policy has little or no effect on house prices.[24]

[24] The observation that the correlation between Taylor rule residuals and house prices is more pronounced in a case in which there is no variation in the policy interest rate and that the correlation may be spuriously driven by other

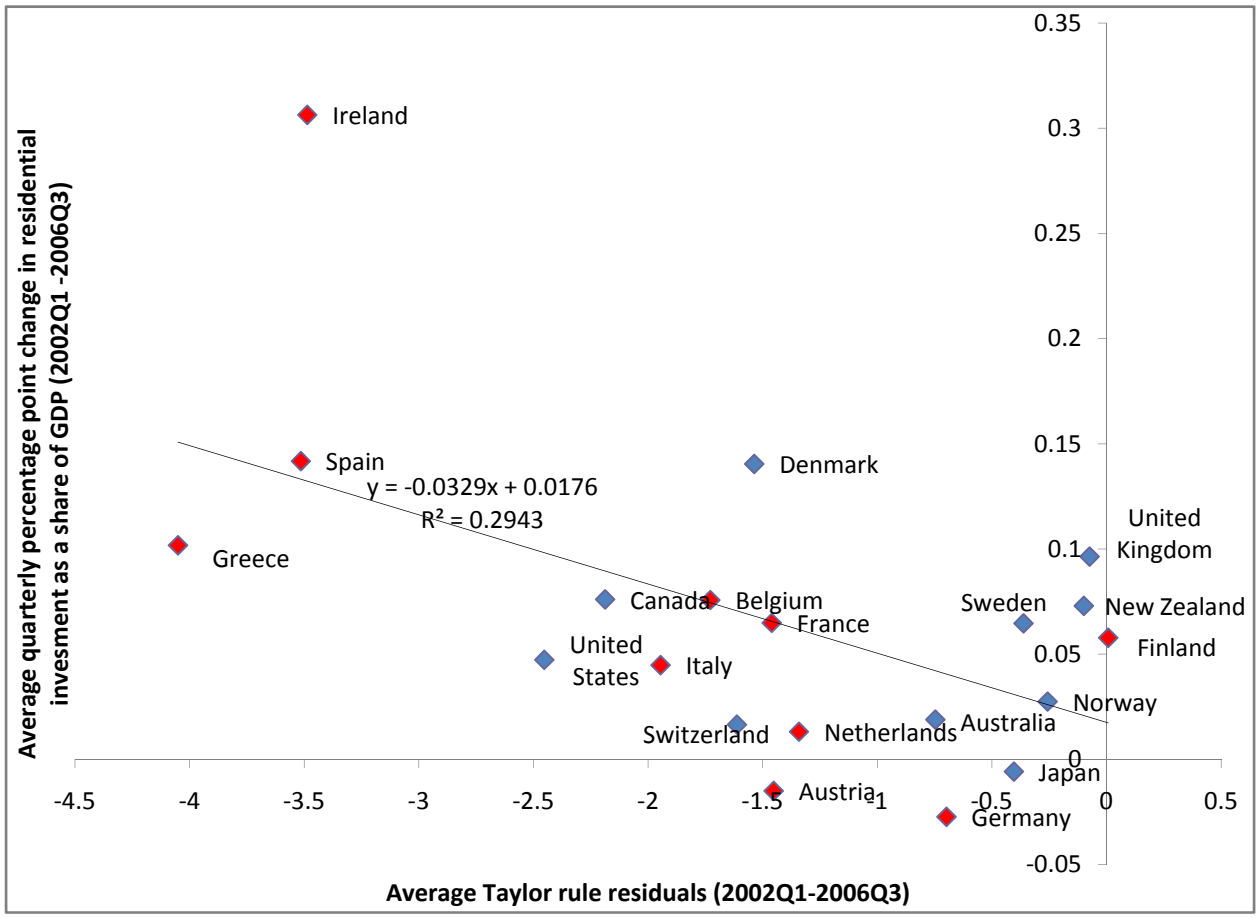
Although the relationship between monetary policy and house price appreciation is relatively weak, Ahrend and others (2008) have found a statistically significant relationship between deviations from a Taylor rule and the change in residential investment as a share of GDP. Figure 13 illustrates this relationship using data from the Fall 2009 WEO. Part of the strength of this relationship depends on the observation for Ireland, which appears to be an outlier relative to the other observations. Removing Ireland from the sample reduces the strength (from a R-squared of 0.29 to 0.16) and significance of the relationship, but does not eliminate it. Furthermore, the euro area observations (in red) again account for most of the strength of the relationship with a correlation of -0.68, compared with the correlation the other countries at only -0.11.[25]

---

factors is confirmed by examining U.S. cities. Using data on 27 U.S. Metropolitan Statistical Areas, we find that local CPI inflation is positively correlated with local real house price appreciation, and local unemployment is negatively correlated, with coefficients equal to 0.63 and -0.61, respectively. As a result, "city-level" Taylor rule deviations are strongly negatively correlated with real house price appreciation, with a simple correlation of -0.65. However, as we have argued, this fact does not imply that "loose" monetary policy caused house price appreciation. It seems likely that reverse causality played at least some role. (Source: House prices from LoanPerformance, CPI from BEA, and unemployment from BLS. Metropolitan areas matched based on largest city. Real house price appreciation is from December 2001-June 2006 and is constructed using local CPI. Taylor rule residuals are calculated using 2002-06 averages of metropolitan headline CPI inflation and the deviation of the city unemployment rate from its natural rate. City natural rate is the 1990-2008 average local unemployment rate.)

[25] Taylor (2008) cites a figure from Ahrend and others (2008) that includes only 10 euro area countries and has an R-squared of 0.83.

Figure 13: Monetary Policy and Residential Investment in the Advanced Economies



Source: IMF (2009)

Developments in Housing Finance

As we have emphasized previously, both house prices and residential investment increased very rapidly after 2002, and we find only weak linkages, at best, to monetary policy based on macroeconomic models, time-series evidence, or international comparisons. We therefore attribute much of the strength in house prices and residential investment to factors other than monetary policy that affected the housing market over this period. In this section, we discuss housing market developments and consider how such factors may have contributed to unusual strength in housing demand or, indeed, how they may have stoked the house price bubble. Housing finance, in particular, saw rapid and unusual changes during the boom and was the initial locus of distress during the subsequent bust. However, given that this episode has had relatively few precedents in history, our discussion is necessarily somewhat speculative and focuses on identifying those factors that may have been particularly significant, that may have

interacted with monetary policy in a manner not well captured by the models underlying the time-series or cross-country evidence in the previous section, and that may have interacted with the regulatory or institutional framework in new ways during the past decade.

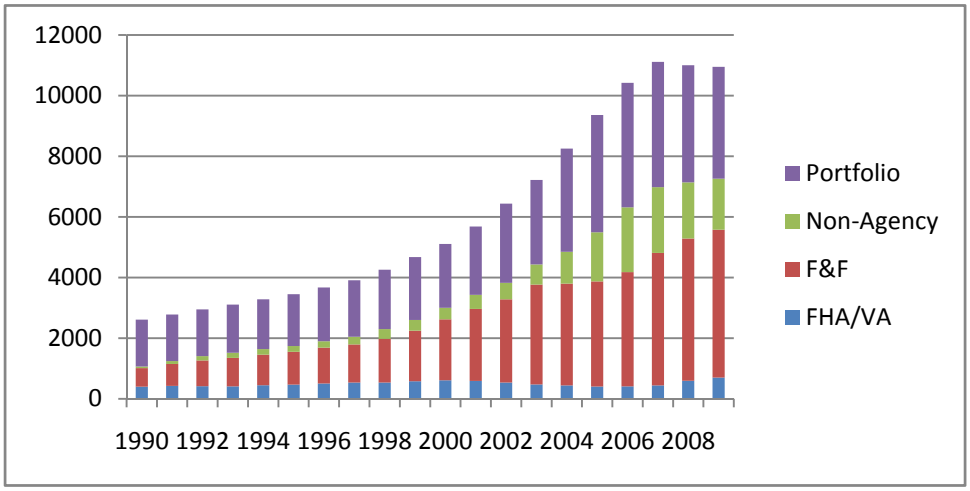
Our thinking is similar to the well-known description of boom-bust cycles, based on the discussion of Kindleberger (2000) and Minsky (1975):

> Events leading up to a crisis start with a "displacement"… Whatever the source of the displacement, if it is sufficiently large and pervasive, it will alter the economic outlook by changing profit opportunities in at least one important sector of the economy… A boom is underway… Increased demand presses against the capacity to produce goods or the supply of existing financial assets. Prices increase… Positive feedback develops… When the number of firms and households indulging in these practices grows large, (…) speculation for profit leads away from normal, rational behavior to what has been described as "manias" or "bubbles."… At some stage, a few insiders decide to take their profits and sell out… Prices begin to level off. There may then ensue an uneasy period of "financial distress"… It is time to withdraw. The race out of real or long-term financial assets and into money may turn into a stampede. (Kindleberger, 2000, pp. 14-17)

Originations of nontraditional mortgages began to expand in earnest by 2002 (Mayer and Pence, 2009). These mortgage originations were profitable for lenders, borrowers, and investors: Robust house price appreciation in the first half of the 2000s ensured that default rates on these originations were incredibly low, in part because homeowners were able to refinance, or roll over, their mortgages or sell their homes. As the origination and subsequent securitization of these mortgages continued to prove successful and profitable, borrowers, lenders, and investors became more comfortable, perhaps even complacent, with extending more mortgage credit to an even wider range of borrowers. It now appears likely that the extension of mortgage credit raised the demand for owner-occupied and investor-owned real estate and, given the upward-sloping short-run supply of housing, probably contributed to further increases in home prices. Such a feedback loop (from higher house prices to the extension of mortgage credit and increased demand for housing and back to higher house prices) stimulated house price growth to a significant degree, especially given the use of various nontraditional mortgage instruments during the housing boom. We will now discuss in more detail the growth in mortgage securitization, the use of nontraditional mortgages, and how these developments may have contributed to the boom in the U.S. housing market and, as mortgage lending was eventually sharply curtailed, may have ultimately amplified the bust.

Mortgage securitization increased significantly during 1996 through 2005 (figure 14). Mortgage-backed securities outstanding increased from about $1.1 trillion in 1990 to $3.0 trillion in 2000 and to $6.9 trillion by 2007. The rise was fueled disproportionately by non-agency securitizations—non-agency MBS outstanding increased from $194 billion in 1995 to more than $2.1 trillion at the height of the housing boom. This increase is consistent with the large volume of subprime and alt-A mortgages originated over this period. By comparison, agency MBS outstanding increased from about $1.5 trillion in 1995 to about $4.2 trillion in 2006, while nonsecuritized mortgages held in portfolio increased from $1.7 trillion to $4.1 trillion.

Figure 14: MBS and Portfolio Outstanding (dollars in billions)



Source: Inside Mortgage Finance.

As we now know, when the rise in house prices stalled and reversed, this wave of originations and securitizations was followed by unusually large defaults and foreclosures, especially in the subprime market. Several arguments have been offered for why so many loans were made that, in the end, wound up in default. First, with the increase in securitization, investors may have, for some reason, relaxed their vigilance when purchasing securities backed by mortgages and boosted the demand for these securities above the level commensurate with their risk. Further, investors may have relied heavily on the ratings provided by the rating agencies, and the rating agencies, in turn, may have underestimated the probability of future decreases in house prices and thus given investors a false sense of security. Similarly, investors themselves assigned very small probabilities to events in which house prices declined even

slightly in nominal terms (Gerardi and others, 2008). This is consistent with the view that there was a classic bubble in the markets for housing-related assets (Gorton, 2008).

Second, securitization and the originate-to-distribute model may have led to lax screening standards, which were later manifested in high defaults. Originators may have favored securitization because the process allowed them to take advantage of the fact that they generally had more information about the underlying mortgages than investors. Originators may have exploited this informational advantage by securitizing mortgages that were riskier (in ways unobservable to the investor) than the mortgages held in portfolio or simply by securitizing most of their originations. In support of this theory, Keys and others (2009) conclude that the securitization process increases lax screening among subprime loans and results in an increase in defaults of 10 to 25 percent. A limitation of this explanation for the subsequent house price boom and bust is that it is not clear why investors should not have been able to discern the incentives faced by originators. If mortgage securities suffered from a classic "lemons" problem, in which the seller had more information than the buyer, the willingness of investors to purchase such securities at high prices is even more puzzling. Of course, one possibility is that investors simply did not fully understand the moral hazard yet, as private-label securitization, while not a new phenomenon, only really took off in the 2000s and the lax screening standards were initially masked by the ability to refinance in the context of higher house prices.

Third, an extensive body of research links the increase in securitization to greater access to mortgage credit for subprime borrowers (Nadauld and Sherlund, 2009; Gabriel and Rosenthal, 2007; Mian and Sufi, 2009; Goetzmann and others, 2009). In this view, a pool of risky borrowers represents a certain amount of "latent" demand for mortgage credit that goes unmet because traditional lenders are unwilling to accept the risks associated with these loans. Securitization allows the risk to be allocated to willing investors, in turn allowing the riskier borrowers to get loans. Alternatively, investors may have been overly sanguine about the risks posed by securities backed by riskier loans. In either case, a group of borrowers that had previously been rationed out of the credit market found credit readily available.

Next, a change in the attractiveness of adjustable-rate mortgages (ARMs) and a proliferation of nontraditional mortgage products also boosted households' borrowing power. Discussion of the popularity of ARMs in recent years, and hybrid ARMs in particular, often focuses on the cost of the de facto insurance against future interest rate increases embedded in

rates on fixed-rate mortgages (FRMs) (LeRoy, 1996; Passmore, 1993; Stanton and Wallace, 1995, 1999; Lehnert, Passmore, and Sherlund, 2006).[26]

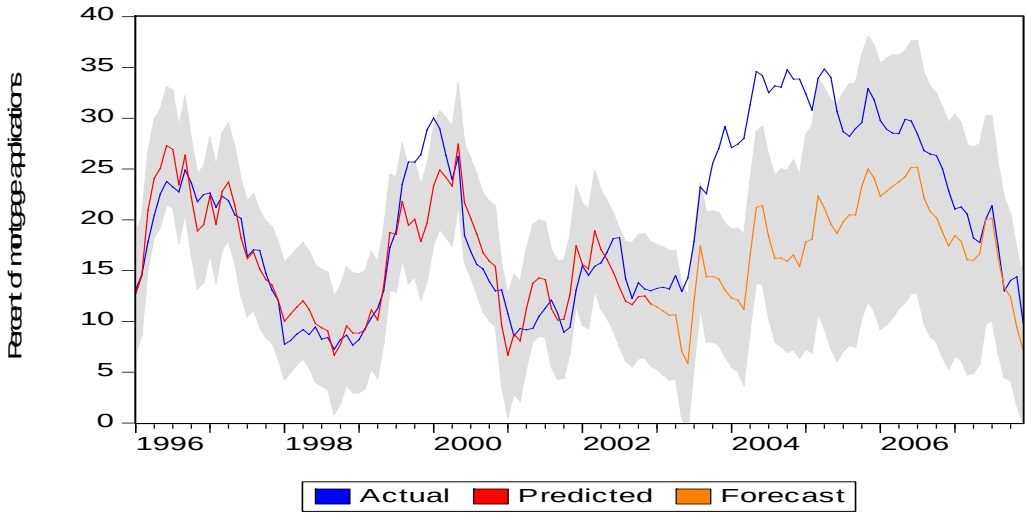
As shown in figure 15, the ARM share of mortgage applications increased more than can be explained by simple models that include the stance of monetary policy, particularly during 2003 through 2005.[27] Indeed, this pattern is reminiscent of the earlier macroeconomic story in this period, in which overall residential investment and home prices rose in a historically atypical manner during 2003 through 2006. Admittedly, the federal funds rate entered previously rarely-navigated waters in 2003 and early 2004 and was at the low end of the historical range of the previous five decades. As a consequence, monetary policy during this period may have contributed to the rise in ARM usage to a degree that is not well captured by the statistical model we consider (or the degree implicit in our earlier macroeconomic analysis).

[26] Homeowners may have private information that is unobservable to the mortgage lender, such as the expected duration of their own mortgage. Thus, households might examine the costs of purchasing interest rate protection, given their private information about housing tenure and (perhaps) credit risks, and their idiosyncratic beliefs about future interest rates. Clearly, such considerations are important not only in choosing between ARMs and FRMs, but also in the decision of which ARM to choose (Brueckner,1992; Posey and Yavas, 2001).

[27] The model used here is similar to that of Lehnert, Passmore, and Sherlund (2006) but also includes a measure of monetary policy. The ARM share is modeled as a function of the fixed-rate to adjustable-rate mortgage spread, the yield curve slope, the level of mortgage rates, a measure of housing affordability relative to personal disposable income, and the federal funds rate. The model is estimated on data from 1996 to 2002, then used to forecast the ARM share during 2003 through 2007.

It is interesting to note that the shift in the types of mortgage products available or used in foreign economies was quite different from the shift in the United States. In particular, the new mortgage products in foreign economies tended to involve increased use of mortgages with fixed rates for some period. In this sense, the common theme across countries seems to have been innovations in mortgage finance, not the specific type of innovation.

Figure 15: Applications for Adjustable-Rate Mortgages as a Share of All Mortgage Applications



Source: For actual, Mortgage Bankers Association; for predicted and actual, authors' estimates.

The rise in the share of ARMs may have occurred for affordability reasons—borrowers may have selected mortgage products so that they could afford the initial monthly payments in light of locally high house prices. The high use of ARMs, of course, may have accommodated house price gains beyond levels that could have been sustained had ARMs not been available. As shown in Table 3, nontraditional mortgage features can lower initial monthly payments, allow increased borrowing for the same initial monthly payment, or have both of these effects. For example, a borrower purchasing a $225,000 house (with a 20 percent down payment) using a typical 30-year FRM would have monthly payments of about $1,079.[28] A typical borrower using an ARM, however, would have initial monthly payments closer to $900—a savings of nearly $180, or 16 percent, over the fixed-rate borrower.[29] If the ARM borrower were to purchase more housing such that he or she faced the same initial monthly payment as the fixed-rate borrower, he or she could purchase a home 19 percent more expensive.

[28] The average 30-year fixed-rate mortgage rate during 2003 through 2006 was 6.00 percent according to Freddie Mac's Primary Mortgage Market Survey.
[29] The average one-year adjustable-rate mortgage rate during 2003 through 2006 was 4.42 percent.

Table 3: Initial Monthly Payments and Fixed-Rate Mortgage Equivalents[1]

Mortgage Product	Initial Monthly Payment	Loan Amount (FRM Equivalent)	House Price (FRM Equivalent)
Fixed-rate mortgage	$1,079.19	$180,000	$225,000
ARM	903.50	215,000	268,750
Interest-only ARM	663.00	292,990	366,238
40-year amortization	799.98	242,820	303,525
NegAm ARM[2]	150.00	1,295,030	1,618,785
Pay-option ARM	<150.00	1,295,030+	1,618,785+

[1] We use the average Freddie Mac PMMS rates from 2003 through 2006 (6.00 percent for FRMs, 4.42 percent for ARMs). A 20 percent down payment is assumed.
[2] We use an initial interest rate of 1 percent.

Source: Authors' calculations.

We next explore how nontraditional amortization features may have enhanced affordability even further: interest-only periods, negative amortization periods, payment options, and extended amortization schedules. Interest-only mortgages lower initial monthly payments by allowing borrowers to pay only the interest due each month—the principal balance on the loan remains constant during the interest-only period. Negative amortization and pay-option ARMs allow borrowers to pay *less* than the interest due each month—the principal balance on these loans can *increase* over time. Finally, mortgages with extended amortization often allow borrowers to make payments as if they were fully amortizing over 40 or even 50 years, even though the mortgage matures after 30 years.[30] As a result, borrowers taking on these nontraditional mortgage features can afford to purchase more-expensive homes than their fixed-rate counterparts. As shown in table 3, interest-only terms lower monthly payments by about 39 percent, negative amortization by 86 percent, and extended amortization by 26 percent—all relative to an FRM. This additional flexibility in affordability—in the initial monthly payment sense—could have led to additional upward pressure on house prices: Interest-only terms allowed borrowers to purchase homes that were 63 percent more expensive. Extended amortization enabled borrowers to purchase houses that were 35 percent more expensive, while negative amortization and pay-option ARMs allowed borrowers to finance homes that were as

[30] This feature obviously requires a balloon payment at the end of the 30-year legal maturity of most loans.

much as 620 percent more expensive than their fixed-rate counterparts, holding the initial monthly payment fixed at $1,079.[31]

Although not new to the mortgage market during 2003 through 2006, these nontraditional features gained popularity as house prices increased rapidly (table 4). In particular, the use of interest-only payment periods became more popular among nonprime borrowers, while negative amortization and payment-option terms increased among borrowers with alt-A mortgages. The use of extended amortization schedules also increased remarkably among subprime borrowers relatively late in the boom.

Table 4: Nontraditional Mortgage Feature Shares

(Percent of ARM originations)

	Interest Only		Negative Amortization	Pay-Option ARMs	Extended Amortization	
	Subprime	Alt-A	Alt-A	Alt-A	Subprime	Alt-A
2000	0	3	--	--	0	0
2001	0	8	--	--	0	0
2002	2	37	--	--	0	0
2003	5	48	19	11	0	0
2004	18	51	40	25	0	0
2005	21	48	46	38	13	0
2006	16	51	55	38	33	2

Source: Calculations from data provided by LoanPerformance, a division of First American CoreLogic.

The increased use of these products, possibly by riskier borrowers, allowed house prices to continue to increase well into 2005 and 2006: Higher prices may have fed demand by contributing to a mindset that considered housing a particularly desirable asset, and innovations that stretched affordability allowed further price appreciation, feeding back again to the investment mindset. Indeed, the use of these innovations was particularly high in bubble areas, with well over half of interest-only, negative amortization, and payment-option features being extended in California, Florida, Arizona, and Nevada.

However, the rise in the popularity of nontraditional mortgage features may have merely been a symptom of an underlying bubble mentality. While such mortgages allow borrowers to

[31] These calculations assume that lenders were willing to allow borrowers to leverage to this extreme.

buy more-expensive houses, they do not necessarily make borrowers more willing to pay inflated prices. Rather, these products may have instead provided some support to house prices as they became unsustainable. Borrowers, especially those with shorter planning horizons, appear to have been comfortable taking out these mortgage products as they speculated on continued increases in house prices. As long as house prices continued rising, borrowers could accumulate equity in their homes and refinance into new mortgage loans when rates on their existing mortgages reset to higher levels or when other nontraditional features of their mortgages took effect (Mayer, Pence, and Sherlund, 2009). This strategy was successful until house prices stopped rising and borrowers could no longer refinance. Based on the evidence, lenders, borrowers, rating agencies, and investors alike seemed to share this view.

Thus, in our view, the most logical conclusion is that expectations of future house price growth among borrowers, lenders, and investors played a key role in the house price bubble—consistent with the views of Shiller (2007) and Kindleberger (2000). As long as borrowers continued to accumulate housing equity and lenders and investors were profitable, mortgage credit was readily available and this in turned allowed the rise in house prices to continue. The evidence points to expectations of higher prices on the part of lenders, investors, and borrowers. Indeed, as late as March 2007, approximately 40 percent of households anticipated that their home values would rise over the next year (Reuters/University of Michigan Surveys of Consumers). We do not necessarily identify what event sparked the cycle leading to the housing bubble. Monetary policy probably influenced house prices to a modest degree through traditional channels, and these effects may have been amplified to some extent by changes in mortgage financing. However, we think a more powerful force resided in the rapid increase in nontraditional mortgage financing funded through private securitization. This enabled the feedback between the availability of credit and the rise in house prices to continue for several years, and with enough force to create the largest boom and bust cycle in the U.S. since the Great Depression.

International evidence on financial innovations and the housing sector

It is possible that changes in mortgage financing may have made the housing sector more responsive to the easing of monetary policy that took place during the mid-2000s. Duca and others (2009) documents evidence of substantial changes in mortgage market financing in a number of other advanced economies during the past decade. And recent theoretical work has

looked at how down-payment size, fixed versus flexible rate mortgages, or other aspects of mortgage finance may increase (Calza and others, 2009; Iacoviello and Minetti, 2007) or decrease (Aoki and others, 2004) the response of the housing sector to changes in policy rates.

Unfortunately, we have fairly limited systematic empirical evidence on the size of such effects. Iacoviello and Neri (forthcoming) try to quantify the role of U.S. monetary policy during the recent boom (which they date as 1998-2005) including some of the above effects, and come up with a relatively modest number.[32] Looking across countries over 1970 to 2007, the Spring 2008 WEO looked at the responses of both house prices and residential investment to monetary policy shocks using closed-country VARs.[33] Estimating the responses for two broad sub-periods—1970-1982 and 1983-2007—the response of house prices appears to have increased whereas that of residential investment has not. The greater response of house prices may be a result of liberalized financial markets during the second period, but the evidence is only suggestive. Within the 1983-2007 period, the differences across countries in the responses of both house prices and residential investment are correlated with an index of mortgage market "sophistication" (at 0.3 and 0.6, respectively) that the IMF constructed.[34]

Lessons

Our findings are both clear and limited in scope.

We find little evidence that the setting of U.S. monetary policy could have directly accounted for a substantial share of the strength in U.S. housing markets between 2003 and 2006. In particular, the rise in house prices or housing activity during this period was much faster than the pace consistent with the overall macroeconomic environment at that time.

But we also find that housing-specific developments were unusual in this period—and not only with respect to prices and activity. The form of mortgage finance—the prevalence and nature of mortgages with adjustable rates versus fixed rates, the role of other "new" or exotic

[32] As Iacoviello and Neri note, "Technology shocks are one important factor in the 1998-2005 increase, accounting for about 40 percent of the run-up in prices, whereas monetary conditions explain around 15 percent."

[33] The VAR included six variables: output, the GDP deflator, real house prices, residential investment, a short-term, nominal interest rate, and a long-term spread over the short-term interest rate. The VAR was identified recursively with the interest rate and spread ordered first, the housing sector variables second, and output and inflation last. See http://www.imf.org/external/pubs/ft/weo/2008/01/c3/Fig3_10.pdf for the figure.

[34] See http://www.imf.org/external/pubs/ft/weo/2008/01/c3/Fig3_11.pdf for the figure. The mortgage market index constructed by the WEO includes weights on whether households can withdraw mortgage equity or can prepay their mortgage without fees, the typical loan-to-value ratio, the typical term of mortgages, and covered bond and mortgage-backed security issuance. The index does not include any measure of the proportion of fixed versus variable interest rate mortgages.

mortgage features, and the role of different types of lenders and securitization paths—all shifted during this period. These shifts undoubtedly fed on each other, with strong demand for housing and rising house prices spurring unsustainable evolution in the nature and perceived risks associated with mortgage innovations and vice versa. This finding is quite limited in that it describes developments but does not explain why such developments occurred.

Nonetheless, our clear finding that traditional channels of monetary policy accounted for little of the rise in housing markets and that housing-specific factors involved the interaction of shifts in demand and mortgage finance suggest two important lessons for policy and certainly for subsequent research. In particular, our discussion connects to the questions of whether monetary policy should "lean against the wind" in the face of asset price bubbles and of how complimentary financial policies (for example, macroprudential regulation) may interact with monetary policy.

Should Monetary Policy Have Leaned against the Wind More Forcefully?

According to our analysis, monetary policy was not a primary factor in the housing bubble. We also suspect that tighter monetary policy would not have been the best response to the bubble.

The literature considering how monetary policy should address the development of an asset price bubble is quite large, and we will touch on only a few factors here. A number of authors have argued that a central bank could increase their official interest rates somewhat in response to asset market misalignments even if the near-term inflation and output outlook did not warrant such actions. This "leaning against the wind" strategy, proponents argue, would limit the size of the bubble, and could be seen as buying insurance against a possible bad outcome.[35]

As has been noted previously (e.g., Kohn (2008)), monetary policy actions in response to asset price bubbles, above and beyond the effect that such bubbles may have on price stability and full employment, should be guided by several principles: First, can the bubble be detected in real time? Second, will policy actions, and specifically monetary policy actions, to reduce the bubble compromise other desirable macroeconomic outcomes? Third, will such monetary policy actions be effective in addressing the bubble? Finally, would other policy responses be more effective?

In retrospect, it is now apparent that house prices in the United States (and other countries) experienced a bubble over the past decade. But what was the potential role and

[35] Cecchetti and others (2000, 2002) and Borio and Lowe (2002).

effectiveness of monetary policy in addressing the house price bubble, and could policy have acted at the appropriate time?

In our view, there is no a priori reason, based on "efficient markets" or other such notions, to rule out the potential for asset price bubbles or their real-time detection. Rather, we view detection as, at least in part, a practical empirical question. And on this basis, experience suggests that real-time detection, especially of bubbles that are likely to prove pernicious for the macroeconomy, is very difficult. For example, relatively early in the episode, Case and Shiller (2003) argued that house prices were substantially overvalued, but that a national decline with severe adverse macroeconomic consequences was not the most likely outcome. Other research also suggested some overvaluation in real time: For example, Gallin (2008) presented an empirical analysis that suggested house prices in 2005 were higher than could be explained by fundamentals, but recognized that such evidence was consistent with substantial uncertainty regarding the outlook for house prices. These studies indicating that house prices were on an unsustainable path were matched by a set suggesting that overvaluation was not a significant concern.[36]

When these sets of studies are considered together, it seems difficult to suggest that the course of house prices was ex ante the most significant risk calling for policy actions in 2003 through 2006—even though subsequent house price developments and their effects on financial markets would contribute to the need for extraordinary global policy action in subsequent years.

Moreover, our analysis does provide some clues that suggest it may not have been prudent to lean especially hard against the rise in house prices. In particular, our analysis and the related studies we have discussed suggest that monetary policy actions affect house prices only a bit more forcefully than they affect GDP or unemployment, for example. These moderate effects explain why monetary policy is assigned only a modest role in the run-up in home prices in our summary of the empirical evidence. But the moderate size of the effects of monetary policy actions on house prices also implies that monetary policy actions sufficient to appreciably affect house prices would have large effects on GDP and unemployment. In general, the cost to output and unemployment seems very high relative to the potential gain in terms of controlling house prices, suggesting that other policy actions more focused on housing markets could perhaps have

[36] Examples include Himmelberg, Mayer, and Sinai (2005); Smith and Smith (2006); McCarthy and Peach (2004); Duca (2004, 2005); Stewart and Brannon (2006); and Van Order and Lai (2006).

achieved a more desirable policy response. Goodhart and Hofmann (2007, 2008) and Assenmacher-Wesche and Gerlach (2009) make this point as well.

In sum, the view of Shiller (2007, p. 118) regarding the use of monetary policy to affect the decisions of households and firms with regard to housing per se is persuasive: "Using monetary policy to manage such decisions is a bit like adding a grain of sand a day to a scale that is weighing a car.". (p. 118)

We remain open, however, to the possibility that monetary policy can play some role. Recent economic literature has explored how informational barriers or institutional structures—such as asymmetric information, limits to arbitrage, or delegated portfolio management—may allow rational bubbles to persist. In some cases, these market features may prevent sophisticated market participants from trading against a bubble. (As Keynes noted, "The markets can stay irrational longer than you can stay solvent.") In other cases, sophisticated market participants may be induced to buy into a bubble. Monetary policy may have some role to play in these different instances. In some cases, it may be able to influence the trajectory of the bubble by credibly providing information. In others, raising interest rates or imposing restrictions on credit may make it more difficult to invest in bubbles by influencing the costs of trading.[37]

Moreover, Borio and White (2004) emphasize that policymakers should be on the lookout for banking stress and general financial imbalances, which they argue can be tracked using indicator models with measures such as private credit and asset prices. They suggest that such models can predict 70 to 80 percent of the periods of banking distress identified by the authors and give false positives only 1 percent of the time.[38] Two weaknesses of these arguments are the assumptions that the nature of financial bubbles do not change over time and that these indicator models can be easily implemented in real time. Each crisis tends to differ in important respects from those in the past, and, as a result, the most useful early-warning indicators will inevitably change over time. In addition, measures that signal the presence of a bubble only when the bubble is large may be of limited use in policy implementation. At that

[37] The zero lower bound on nominal interest rates may also affect the policy response to credit growth and asset price increases, although our experience with policy at the zero lower bound is limited. Much of the previous policy debate assumed that monetary policy was unconstrained in its ability to lower policy rates in order to cushion the impact of a bursting asset price bubble on inflation and output. However, many countries have effectively reached the lower bound constraint. If it is more difficult or costly to stimulate the economy in those circumstances (perhaps because of uncertainty about the transmission of unconventional policy measures), it might be more desirable than indicated in the previous analysis for central banks to use interest rate policy to "lean against" asset price bubbles. But this possibility remains an open research question.

[38] Borio and White (2004). Also see Borio and Lowe (2002) and Borio, English, and Filardo (2003).

point, policies aimed at containing the bubble may have a high probability of popping it in a damaging fashion.

Macroprudential Regulation

Despite the weaknesses associated with the specifics of any given indicator model, the point that the most pernicious bubbles are those with especially close connections to the banking sector or credit provision more generally seems on the mark. Research has noted the tendency for financial crises to be preceded by bubbles spurred by financial liberalization or innovations, and how the most damaging crises have been associated with disruptions to credit provision that resulted from excessive leverage.[39] And the relatively modest macroeconomic fallout from the bursting of the technology bubble early this decade seems illustrative of a case of a substantial fall in asset price with more-limited macroeconomic effects; in that case, the role of credit was minimal.

Our discussion has highlighted how the shift in demand toward housing-related assets and the perception that house prices were unlikely to fall contributed to a feedback loop that led to unsustainable levels of leverage among some households and many large financial institutions. As we have discussed, there is by now substantial evidence that both the process of securitization and ex-post grossly unrealistic expectations of continuing house price appreciation led to a relaxation of lending standards and the availability of mortgage credit on terms that fed the housing bubble.[40] Prudential regulation may be useful in preventing or limiting this buildup of credit that can lead to higher asset prices through a feedback loop; as a result, macroprudential policies may be able to play a more significant role in financial and macroeconomic stability going forward.

Discussions of such policies highlight a range of issues that may make the financial system, and thus the broader economy, more resilient to fluctuations in asset prices and credit, including (but not limited to) identification of systemically important intermediaries; better alignment of capital requirements with the risk associated with a given institution, including its contribution to systemic risk; raising capital requirements and making them less procyclical or

[39] For example, Bordo (2008) discusses the history of financial crises and their relationship to the evolution of the financial system and leverage. Minsky (1975) and Kindleberger (2000) provide lengthier treatments. See also Allen and Gale (2000).

[40] E.g., Keys and others (2009), Mian and Sufi (2009), Naduald and Sherlund (2009), Mayer, Pence and Sherlund (2008), and Gorton (2009)..

even countercyclical; and addressing the institutional features in the financial markets that may amplify cycles, such as accounting and margining practices.[41]

Our review illustrates how housing market developments over the period we consider provide a straightforward example of the potential role for higher and countercyclical capital requirements. As has been noted previously, rising asset prices and falling default rates in an economic expansion will boost capital, allowing institutions either to trim efforts to maintain capital adequacy or to boost lending; falling asset prices and rising default rates deplete capital during a downturn, forcing institutions to raise capital, trim and/or reduce lending, or both. Countercyclical capital requirements would lean against this bias and could limit the feedback loop between bubbles and credit. For example, the evidence in Nadauld and Sherlund (2009) suggests that raising capital requirements on assets that are long on the bubble might limit the growth of that bubble; in another example, Keys and others (2009) find that in states with laws that require mortgage brokers, which require such brokers to "have "skin in the game,"", lending standards were loosened to a lesser degree as a result of securitization than in other states.

As these examples suggest, macroprudential supervision and regulation of systemically important intermediaries—oversight that incorporates spillover and feedback effects of these firms on the broader financial system—could help mitigate the development of bubbles that could be destabilizing. In this framework, supervisory guidance and regulations could be targeted to particular assets or types of credit that are thought to be fueling a bubble. Such a targeted approach is of course impossible with monetary policy, which has a broad impact on all credit as well as all investment and consumption.

At the same time, it is true that some of the problems associated with using monetary policy to control bubbles remain for macroprudential policy as well. It may be difficult to be sure about the presence of a bubble in real time, and given our limited understanding of bubbles, uncertainty also surrounds the size of the effect of macroprudential regulation on a bubble. However, to the extent that such regulation can be more targeted and less distortionary, these drawbacks are smaller than for monetary policy. Moreover, in the case of capital regulation, even if raising capital requirements should have little effect on a bubble, at least financial institutions would have a larger cushion of capital to deal with the bubbles' aftermath.

[41] Our discussion is brief: For a more comprehensive discussions and references, see Acharya and others (2009), Brunnermeier and others (2009), and Goodhart (2009).

Taking all these factors into account, research on macroprudential regulation and its potential macroeconomic impact remains at a very early stage, and it would be premature to conclude that such policies will prove as effective or as well targeted as desired in limiting the business cycle implications of asset price bubbles.[42]

Policy with Multiple Objectives

More generally, uncertainty is associated with the form of the first-best tools to deal with emerging financial stability problems; moreover, such tools may not always be in place, may not always be used effectively, and may not be able to be used in a timely way. Accordingly, we should not rule out the use of monetary policy as a second-best solution if a constructive monetary policy action can be devised. The current crisis demonstrates how high the costs of financial instability can be for an economy, and recognition of these costs may justify devoting greater weight to financial stability in monetary policy decisions.

This observation is even more general. Our discussion of the stance of monetary policy early this decade focused on how the setting of the federal funds rate was consistent with the goals of price stability and full employment. Economic policy aims to achieve a much broader set of goals: In addition to full employment and price stability, the government as a whole may wish to aim for financial stability, external balance, fiscal sustainability, intergenerational equity, and many other goals. Monetary policy can affect some of these goals for at least some period. But the optimal approach to achieving these multiple objectives, and indeed the only feasible approach in the long run—in which the effects of monetary policy on macroeconomic outcomes other than inflation are much more limited—requires the effective use of a much broader set of tools.

[42] For examples of research considering the macroeconomic implications of alternative policy strategies, see Blum and Hellwig (1995), Cecchetti and Li (2008), Angeloni and Faia (2009), and the IMF's fall 2009 *World Economic Outlook*.

References

Acharya, Viral V., Lasse H. Pedersen, Thomas Philippon, and Matthew Richardson (2009). "Regulating Systemic Risk," in Acharya and Richardson, eds., *Restoring Financial Stability: How to Repair a Failed System.* New Jersey: John Wiley & Sons, chapter 13.

Ahearne, Alan, Joseph Gagnon, Jane Haltmaier, Steven Kamin, and others (2002). "Preventing Deflation: Lessons from Japan's Experience in the 1990s," International Finance Discussion Paper 72. Washington: Board of Governors of the Federal Reserve System, June.

Ahearne, Alan, John Ammer, Brian Doyle, Linda Kole, and Robert Martin (2005). "House Prices and Monetary Policy: A Cross-Country Study," International Finance Discussion Paper 841. Washington: Board of Governors of the Federal Reserve System, September.

Ahrend, Rudiger, Boris Cournède, and Robert Price (2008). "Monetary Policy, Market Excesses and Financial Turmoil," Organisation for Economic Co-operation and Development Working Paper 597, March.

Allen, Franklin, and Elena Carletti (2009). "The Global Financial Crisis," paper presented at the 13th Annual Conference of the Central Bank of Chile, "Monetary Policy under Financial Turbulence," November 20.

Allen, Franklin, and Douglas Gale (2000). "Bubbles and Crises," *Economic Journal*, vol. 110 (January), pp. 236-55.

Angeloni, Ignazio, and Ester Faia (2009). "A Tale of Two Policies: Prudential Regulation and Monetary Policy with Fragile Banks," Kiel Institute for the World Economy Working Paper 1569, October 22.

Aoki, Kosuke, James Proudman, and Gertjan Vlieghe (2004). "House Prices, Consumption, and Monetary Policy: A Financial Accelerator Approach," *Journal of Financial Intermediation*, vol. 13, issue 4 (October), pp. 414-35.

Assenmacher-Wesche, Katrin, and Stefan Gerlach (2009). "Financial Structure and the Impact of Monetary Policy on Property Prices," Swiss National Bank, Working Paper, October.

Bernanke, Ben S. (2003). "An Unwelcome Fall in Inflation?" speech delivered before the Economics Roundtable, University of California, San Diego, La Jolla, California, July 23, www.federalreserve.gov/boarddocs/speeches/2003/20030723/default.htm.

Bernanke, Ben S. (2004). "The Logic of Monetary Policy," speech delivered before the National Economists Club, Washington, December 2, www.federalreserve.gov/boarddocs/speeches/2004/20041202/default.htm.

Bernanke, Ben S. (2005). "The Global Savings Glut and the U.S. Current Account Deficit," speech delivered at the Sandridge Lecture, Virginia Association of Economics, Richmond, Virginia, March 10,

www.federalreserve.gov/boarddocs/speeches/2005/200503102..
(http://www.federalreserve.gov/boarddocs/speeches/2005/200503102/)

Blum, Jürg, and Martin Hellwig (1995). "The Macroeconomic Implications of Capital Requirements Adequacy for Banks," *European Economic Review*, vol. 39, pp. 739-40.

Boivin, Jean, Michael T. Kiley, and Frederic S. Mishkin (2009). "The Evolution of the Monetary Transmission Mechanism?" paper prepared for the *Handbook of Monetary Economics.*

Bordo, Michael D. (2008). "An Historical Perspective on the Crisis of 2007-2008," NBER Working Paper Series 14569. Cambridge, Mass.: National Bureau of Economic Research, December.

Borio, Claudio, William English, and Andrew Filardo (2003). "A Tale of Two Perspectives: Old or New Challenges for Monetary Policy?" Bank for International Settlements Working Paper 127, February.

Borio, Claudio, and Philip Lowe (2002). "Asset Prices, Financial and Monetary Stability: Exploring the Nexus," Bank for International Settlements Working Paper 114, July.

Borio, Claudio, and William White (2004). "Whither Monetary and Financial Stability? The Implications of Evolving Policy Regimes," Bank for International Settlements Working Paper 147, February.

Brueckner, Jan K. (1992). "Borrower Mobility, Self-Selection, and the Relative Prices of Fixed- and Adjustable-Rate Mortgages," *Journal of Financial Intermediation*, vol. 2, pp. 401-21.

Brunnermeier, Markus K. (2008). "Bubbles," in Steven N. Durlauf and Lawrence E. Blume, eds., *The New Palgrave Dictionary of Economics*, 2nd edition. New York: Palgrave Macmillan. Also available in *The New Palgrave Dictionary of Economics Online*, Palgrave Macmillan, www.dictionaryofeconomics.com/article?id=pde2008_S000278.

Brunnermeier, Markus, Andrew Crockett, Charles Goodhart, Avinash D. Persaud, and Hyun Shin (2009). "The Fundamental Principles of Financial Regulation," preliminary conference draft, *Geneva Reports on the World Economy.* Geneva, Switzerland: International Center for Monetary and Banking Studies, January.

Calomiris, Charles W. (2009). "Reassessing the Role of the Fed: Grappling with the Dual Mandate and More?" paper presented at the Shadow Open Market Committee meeting, September 30.

Calza, Alessandro, Tommaso Monacelli, and Livio Stracca (2009). "Housing Finance and Monetary Policy," European Central Bank Working Paper 1069, July.

Cecchetti, Stephen, Hans Genberg, John Lipsky, and Sushil Wadhwani (2000). "Asset Prices and Central Bank Policy," *Geneva Reports on the World Economy*, 2, International Center for Monetary and Banking Studies and Centre for Economic Policy Research, July.

Cecchetti, Stephen, Hans Genberg, and Sushil Wadhwani (2002). "Asset Prices in a Flexible Inflation Targeting Framework," in William C. Hunter, George G. Kaufman, and Michael Pomerleano, eds., *Asset Price Bubbles: Implications for Monetary, Regulatory, and International Policies*. Cambridge, Mass.: MIT Press, pp. 427-44.

Cecchetti, Stephen, and Lianfa Li (2008). "Do Capital Adequacy Requirements Matter for Monetary Policy?" *Economic Inquiry*, vol. 46, issue 4 (October), pp. 643-59.

Clarida, Richard H., and Diane Coyle (1984). "Conditional Projection by Means of Kalman Filtering," NBER Technical Working Papers 0036. Cambridge, Mass.: National Bureau of Economic Research, May.

Clarida, Richard H., and Benjamin M. Friedman (1984). "The Behavior of the U.S. Short-Term Interest Rates Since October 1979," *Journal of Finance*, vol. 39, no. 3 (July), pp. 671-82.

Congressional Budget Office (2004). The Budget and Economic Outlook: Fiscal Years 2005 to 2014. Washington, DC.

Del Negro, Marco, and Christopher Otrok (2007). "99 Luftballons: Monetary Policy and the House Price Boom across U.S. States," *Journal of Monetary Economics*, vol. 54, pp. 1962-85.

Doan, Thomas, Robert Litterman, and Christopher Sims (1984). "Forecasting and Conditional Projection Using Realistic Prior Distributions," *Econometric Reviews*, vol. 3, issue 1, pp. 1-100.

Duca, John V. (2004). "How vulnerable are housing prices?," The Southwest Economy, Federal Reserve Bank of Dallas, March, pp. 11-16.

Duca, John V. (2005). "Making sense of elevated housing prices," The Southwest Economy, Federal Reserve Bank of Dallas, September, pp. 7-13.

Duca, John V., John Muellbauer, and Anthony Murphy (2009). "Housing Markets and the Financial Crisis of 2007-2009: Lessons for the Future." Mimeo, July.

Edge, Rochelle M., Michael T. Kiley, and Jean-Philippe Laforte (2008). 2009), "The Sources of Fluctuations in Residential Investment: Housing Markets: A View from a Policy-Oriented DSGE Model of the U.S. Economy," Washington: Board of Governors of the Federal Reserve System, April 2Board, October.

Eggertson, Gauti and Michael Woodford (2003) "The Zero Interest-Rate Bound and Optimal Monetary Policy." *Brookings Papers on Economic Activity* vol. 1, pp. 139-211

Ferguson, Roger W. (2004). "Global Imbalances," speech delivered at the European Institute Roundtable on Financial and Monetary Affairs, Washington, April 23, www.federalreserve.gov/boarddocs/speeches/2004/20040423/default.htm.. (http://www.federalreserve.gov/boarddocs/speeches/2004/20040423/default.htm)

Ferraro, Andrea, Mark Gertler, and Lars Svensson (2008). "Current Account Dynamics and Monetary Policy," NBER Working Paper 13906. Cambridge, Mass.: National Bureau of Economic Research, April, www.nber.org/papers/w13906.

Fuhrer, Jeffrey C. and Brian F. Madigan, 1997. "Monetary Policy When Interest Rates Are Bounded At Zero," *The Review of Economics and Statistics*, vol. 79, issue 4 (November), pp 573-585.

Gabriel, Stuart A., and Stuart S. Rosenthal (2007). "Secondary Markets, Risk, and Access to Credit: Evidence from the Mortgage Market," working paper, April.

Gallin, Joshua (2008). "The Long-Run Relationship between House Prices and Rents," *Real Estate Economics*, vol. 36, issue 4 (Winter), pp. 635-58.

Gerardi, Kristopher, Andreas Lehnert, Shane M. Sherlund, and Paul S. Willen (2008). "Making Sense of the Subprime Crisis." *Brookings Papers on Economic Activity*, pp. 69-145.

Gete, Pedro (2009). "Housing Markets and Current Account Dynamics," October, www9.georgetown.edu/faculty/pg252/H&CAbyGete.pdf.

Goetzmann, William N., Liang Peng, and Jacqueline Yen (2009). "The Subprime Crisis and House Price Appreciation," NBER Working Paper 15334. Cambridge, Mass.: National Bureau of Economic Research, September.

Goodhart, Charles (2009). "Is a Less Pro-Cyclical Financial System an Achievable Goal?" Mimeo, Financial Markets Group, London School of Economics, August 31.

Goodhart, Charles, and Boris Hofman (2007). *House Prices and the Macroeconomy: Implications for Banking and Price Stability*. New York: Oxford University Press.

Goodhart, Charles A.E. and Boris Hofmann (2008), "House Prices, Money, Credit, and the Macroeconomy," *Oxford Review of Economic Policy*, vol. 24, pp. 180-205.

Gordon, Robert J. (2009). "Is Modern Macro or 1978-Era Macro More Relevant to the Understanding of the Current Economic Crisis?" Northwestern University, September 12, revision of a paper first presented to the International Colloquium on the History of Economic Thought, Sao Paulo, Brazil, August 3, 2009.

Gorton, Gary, (2008). The Panic of 2007. In: *Maintaining Stability in a Changing Financial System*, Proceedings of the 2008 Jackson Hole Conference, Federal Reserve Bank of Kansas City.

Greenspan, Alan (2003). Remarks delivered at the 21st Annual Monetary Conference, Cosponsored by the Cato Institute and *The Economist*, Washington, November 20, www.federalreserve.gov/boarddocs/speeches/2003/20031120/default.htm.

Gruber, Joseph W., and Steven B. Kamin (2007). "Explaining the Global Pattern of Current Account Imbalances," International Financial Discussion Paper 2005-846, November, www.federalreserve.gov/pubs/ifdp/2005/846/default.htm.. (http://www.federalreserve.gov/pubs/ifdp/2005/846/default.htm)

Greenspan, Alan (2003), remarks at the 21st Annual Monetary Conference, Cosponsored by the Cato Institute and *The Economist*, Washington, D.C., November 20. (http://www.federalreserve.gov/boarddocs/speeches/2003/20031120/default.htm)

Himmelberg, Charles, Christopher Mayer, and Todd Sinai (2005). "Assessing High House Prices: Bubbles, Fundamentals and Misperceptions," *Journal of Economic Perspectives*, vol. 19, issue 4, pp. 67-92.

Iacoviello, Matteo (2006). "The Fed and the Housing Boom," Boston College, notes for an invited talk at the Eurobank EFG Group International Conference on "International Real Estate Prices and Investment Opportunities," Athens, Greece, January 20.

Iacoviello, Matteo, and Raoul Minetti (2003). "Financial Liberalization and the Sensitivity of House Prices to Monetary Policy: Theory and Evidence," *The Manchester School*, vol. 71, issue 1 (January), pp. 20-34.

Iacoviello, Matteo, and Stefano Neri (forthcoming). "Housing Market Spillovers: Evidence from an Estimated DSGE Model," *American Economic Journals: Macroeconomics*.

International Monetary Fund (2009) *World Economic Outlook*. Fall. Washington, DC.

Jarociński, Marek, and Frank R. Smets (2008). "House Prices and the Stance of Monetary Policy," Federal Reserve Bank of St. Louis, *Review*, vol. 90, July/August, pp. 339-65, http://research.st.louisfed.org/publications/review/08/07/Jarocinski.pdf.

Keys, Benjamin J., Tanmoy Mukherjee, Amit Seru, and Vikrant Vig (2009). "Financial Regulation and Securitization: Evidence from Subprime Loans," *Journal of Monetary Economics*, vol. 56, pp. 700-20.

Kiley, Michael T. (2008). "Estimating the common trend rate of inflation for consumer prices and consumer prices excluding food and energy prices," Finance and Economics Discussion Series 2008-38, Board of Governors of the Federal Reserve System.

Kiley, Michael T. (2009) "Output Gaps," Mimeo, Federal Reserve Board, Washington, DC.

Kindleberger, Charles P. (2000). *Manias, Panics, and Crashes: A History of Financial Crises*, 4th ed. New York: Wiley.

Kohn, Donald L. (2002). "The U.S. Current Account Deficit," speech delivered at the 12th Frankfurt European Banking Congress, Frankfurt, Germany, November 22, www.federalreserve.gov/boarddocs/speeches/2002/20021122/default.htm.. (http://www.federalreserve.gov/boarddocs/speeches/2002/20021122/default.htm)

Kohn, Donald L. (2003). "The Strength in Consumer Durables and Housing: Policy Stabilization or Problem in the Making?" speech delivered at the Conference on Finance and Macroeconomics sponsored by the Federal Reserve Bank of San Francisco and Stanford Institute for Economic Policy Research, San Francisco, Calif., February 28, www.federalreserve.gov/boarddocs/speeches/2003/20030228.

Kohn, Donald L. (2004). "The United States in the World Economy," speech delivered at the Federal Reserve Bank of Atlanta's Public Policy Dinner, Atlanta, Ga., January 7, www.federalreserve.gov/boarddocs/speeches/2004/20040107/default.htm.. (http://www.federalreserve.gov/boarddocs/speeches/2004/20040107/default.htm)

Kohn, Donald L. (2005). "Central Bank Communication," speech delivered at the Annual Meetings of the American Economic Association, Philadelphia, PA, January 9.

Kohn, Donald L. (2007). "John Taylor Rules," speech delivered at the Conference on John Taylor's Contributions to Monetary Theory and Policy, Federal Reserve Bank of Dallas, Dallas, Tex., October 12, www.federalreserve.gov/newsevents/speech/kohn20071012a.

Kohn, Donald L. (2008). "Monetary Policy and Asset Prices Revisited," speech delivered at the Cato Institute's 26th Annual Monetary Policy Conference, Washington, DC, November 19. www.federalreserve.gov/newsevents/speech/kohn20081119a.htm.

Leamer, Edward E. (2007). "Housing IS the Business Cycle," NBER Working Paper Series 13428. Cambridge, Mass.: National Bureau of Economic Research, September.

Lehnert, Andreas, Wayne Passmore, and Shane M. Sherlund (2006). "Financial Innovation, Household Mortgage Choice and the Social Benefits of Hybrid ARMs," unpublished paper. Working Paper.

LeRoy, Stephen F. (1996). "Mortgage Valuation under Optional Prepayment," *The Review of Financial Studies*, vol. 9 (Autumn), pp. 817-44.

MacGee, James (2009) "Why Didn't Canada's Housing Market Go Bust?" Federal Reserve Bank of Cleveland Economic Commentary, September 2009.

Mayer, Christopher J., and Karen M. Pence (2009). "Subprime Mortgages: What, Where, and to Whom?" in Edward L. Glaeser and John M. Quigley, eds., *Housing Markets and the Economy: Risk, Regulation, and Policy. Essays in Honor of Karl E. Case*. Cambridge, Mass.: Lincoln Institute of Land Policy, pp. 149-196.

Mayer, Christopher, Karen Pence, and Shane M. Sherlund (2009). "The Rise in Mortgage Defaults," *Journal of Economic Perspectives*, vol. 23 (Winter), pp. 27-50.

McCarthy, Jonathan and Richard W. Peach (2004). "Are home prices the next "bubble"?," Economic Policy Review, Federal Reserve Bank of New York, December, pp. 1-17.

Mian, Atif, and Amir Sufi (2009). "The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis," *Quarterly Journal of Economics*, vol. 124, November, pp. 1449-96.

Minsky, Hyman P. (1975). *John Maynard Keynes*. New York: Columbia University Press.

Nadauld, Taylor D., and Shane M. Sherlund (2009). "The Role of the Securitization Process in the Expansion of Subprime Credit," Finance and Economics Discussion Series 2009-28. Washington: Board of Governors of the Federal Reserve System, April, www.federalreserve.gov/pubs/feds/2009/200928/200928pap.pdf.

Obstfeld, Maurice, and Kenneth S. Rogoff (2005). "Global Current Account Imbalances and Exchange Rate Adjustments," *Brookings Papers on Economic Activity*, issue 1, pp. 67-146.

Obstfeld, Maurice, and Kenneth S. Rogoff (2009). "Global Imbalances and the Financial Crisis: Products of Common Causes," paper prepared for the Federal Reserve Bank of San Francisco Asia Policy Conference, Santa Barbara, Calif., October 18-20, http://elsa.berkeley.edu/~obstfeld/santabarbara.pdf.October. (http://elsa.berkeley.edu/~obstfeld/santabarbara.pdf)

Orphanides, Athanasios, and Volker Wieland (2008). "Economic Projections and Rules of Thumb for Monetary Policy," Federal Reserve Bank of St. Louis, *Review*, vol. 90, July/August, pp. 307-24.

Passmore, Stuart W. (1993). "Econometric Models of the Eleventh District Cost of Funds Index," *Journal of Real Estate Finance and Economics*, vol. 6, March, pp. 175-88.

Posey, Lisa L., and Abdullah Yavas (2001). "Adjustable and Fixed Rate Mortgages as a Screening Mechanism for Default Risk," *Journal of Urban Economics*, vol. 49, January, pp. 54-79.

Reifschneider, David and John C. Williams, 2000. "Three lessons for monetary policy in a low-inflation era," Federal Reserve Bank of Boston Conference Series, pp 936-978.

Shiller, Robert (2007) "Understanding Recent Trends in House Prices and Homeownership," Federal Reserve Bank of Kansas City Symposium Proceedings, pp. 89-123.

Smith, Gary, and Margaret Hwang Smith (2006). "Bubble, Bubble, Where's the Housing Bubble?" *Brookings Papers on Economic Activity*, issue 1, pp. 1-50.

Stanton, Richard, and Nancy Wallace (1995). "ARM Wrestling: Valuing Adjustable Rate Mortgages Indexed to the Eleventh District Cost of Funds," *Real Estate Economics*, vol. 23, Fall, pp. 311-45.

Stanton, Richard, and Nancy Wallace (1999). "Anatomy of an ARM: The Interest-Rate Risk of Adjustable-Rate Mortgages," *Journal of Real Estate Finance and Economics*, vol. 19, July, pp. 49-67.

Stewart, Suzanne and Ike Brannon (2006) "A Collapsing Housing Bubble?," *Regulation,* vol. 29, issue 1 (Spring), pp.15-16.

Svensson, Lars E. O. (2009). "Evaluating Monetary Policy," NBER Working Paper Series 15385. Cambridge, Mass.: National Bureau of Economic Research, September, www.nber.org/papers/w15385.

Taylor, John B. (1993). "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy*, vol. 39, December, pp. 195-214.

Taylor, John B. (1999). "An Historical Analysis of Monetary Policy Rules," in John Taylor, ed., *Monetary Policy Rules*. Chicago: University of Chicago Press.

Taylor, John B. (2007). "Housing and Monetary Policy," NBER Working Paper Series 13682. Cambridge, Mass.: National Bureau of Economic Research, December, www.nber.org/papers/w13682.pdf.

Taylor, John (2008). "The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong," speech delivered at a Festschrift in Honour of David Dodge's Contributions on Canadian Public Policy at the Bank of Canada, November, www.bankofcanada.ca/en/conference/2008/taylor.pdf.

Taylor, John B. (2009). "The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong," NBER Working Paper Series 14631. Cambridge, Mass.: National Bureau of Economic Research, January. www.nber.org/papers/w14631.

Van Order, Robert and Rose Neng Lai (2006) "A Regime Shift Model of the Recent Housing Bubble in the United States," University of Michigan, Ross School of Business, Working Paper (November).

Waggoner, Daniel F., and Tao Zha (1999). "Conditional Forecasts in Dynamic Multivariate Models," *Review of Economics and Statistics*, vol. 81, November, pp. 639-51.

Woodford, Michael (2007). "Central Bank Communication and Policy Effectiveness." Federal Reserve Bank of Kansas City Symposium Proceedings, pp. 399-474.

Woodford, Michael (2007). "The Case for Forecast Targeting as a Monetary Policy Strategy," *Journal of Economic Perspectives*, vol. 21 (4), pp. 3-24.

Appendix

Figure A1: Comparison of Policy Rates and Taylor Rules in the Advanced Foreign Economies

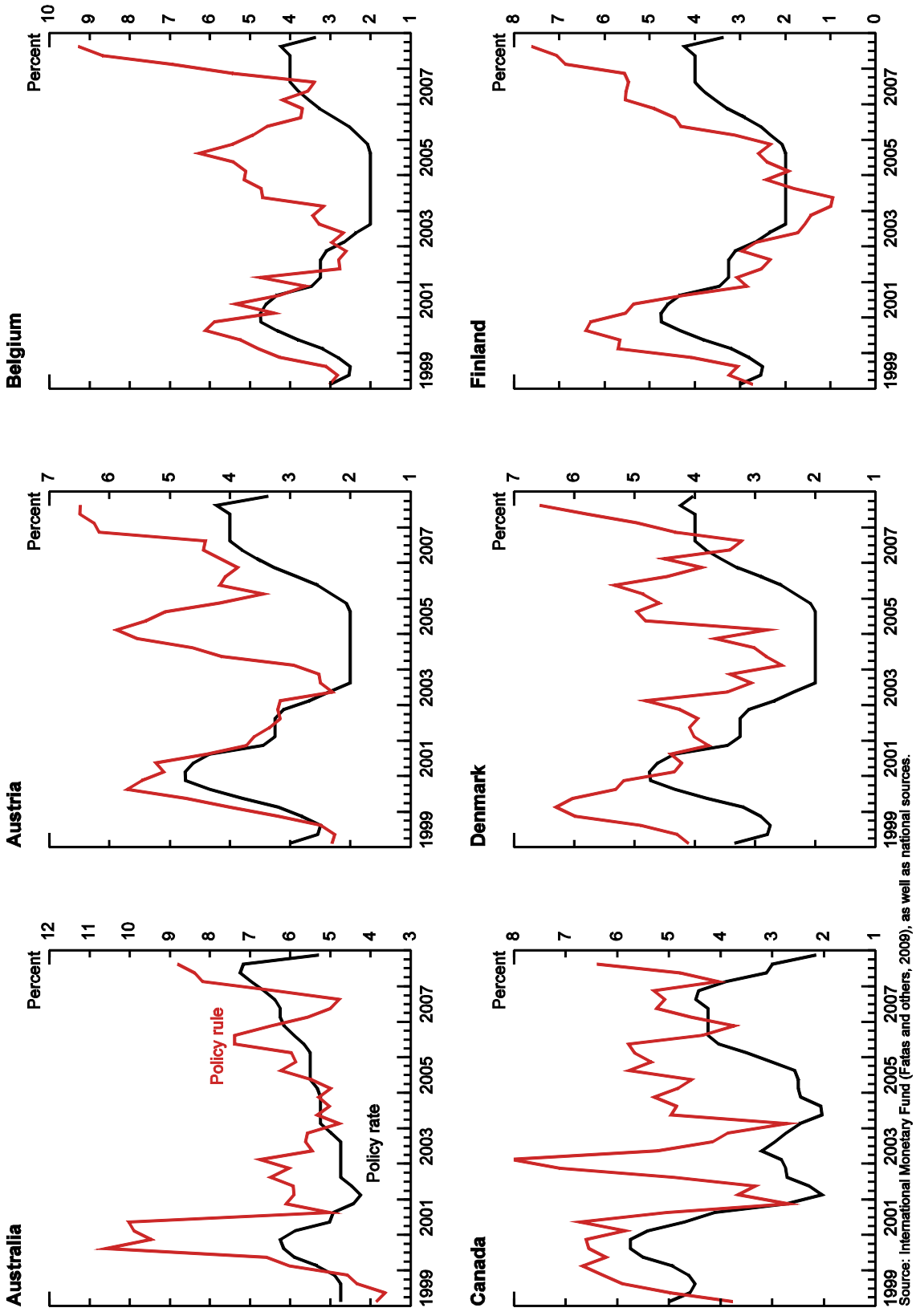
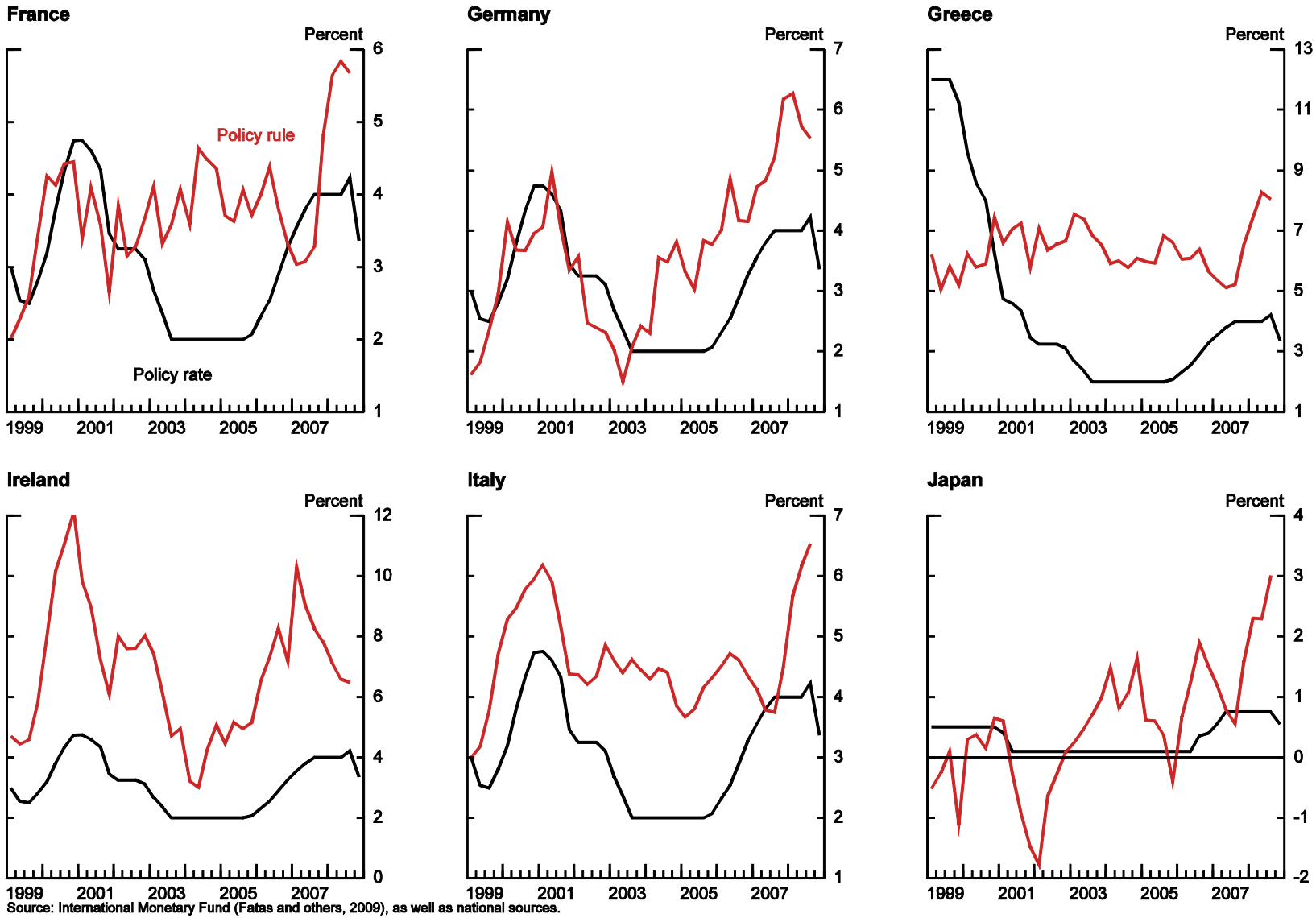
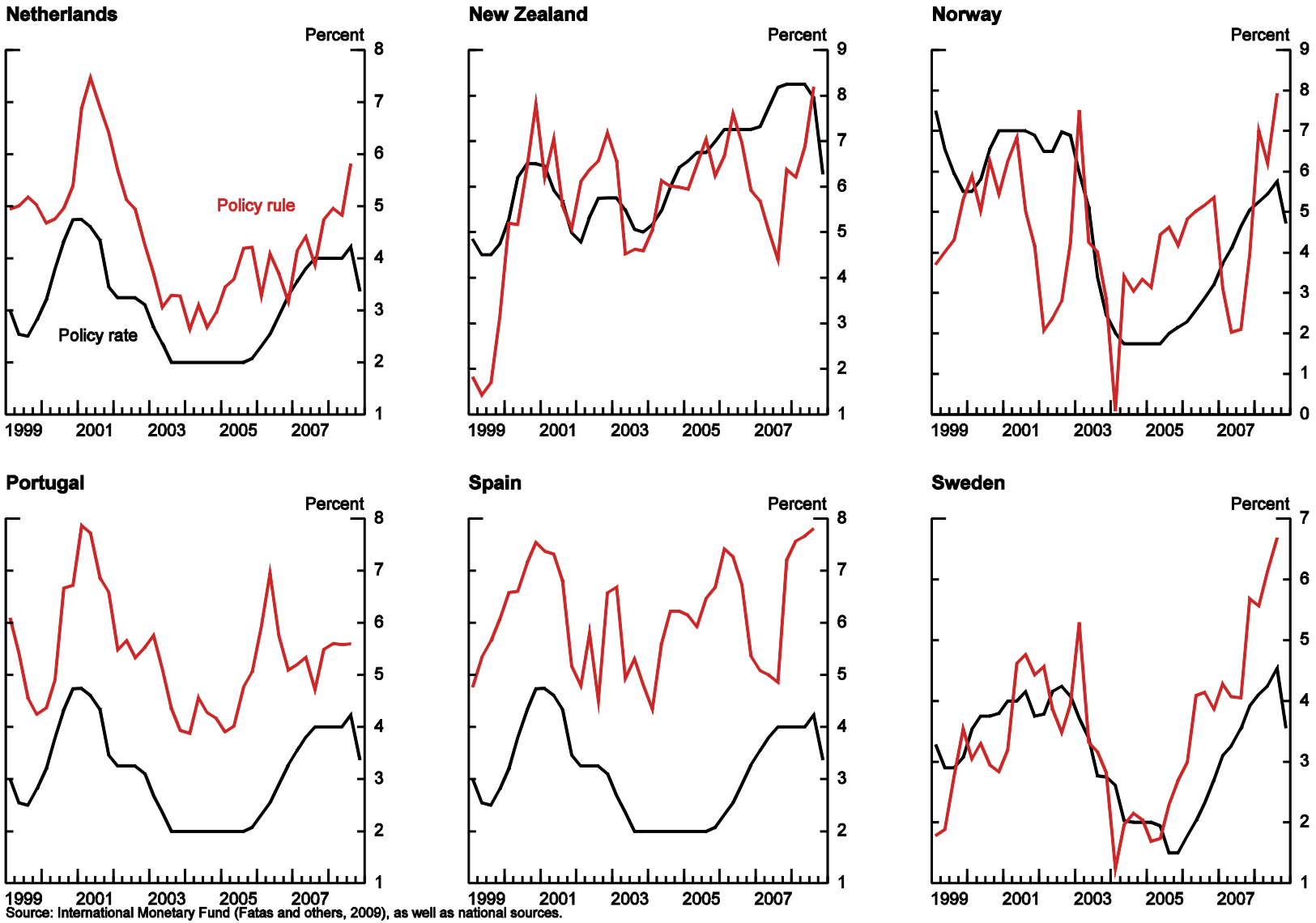


Figure A1: Comparison of Policy Rates and Taylor Rules in the Advanced Foreign Economies



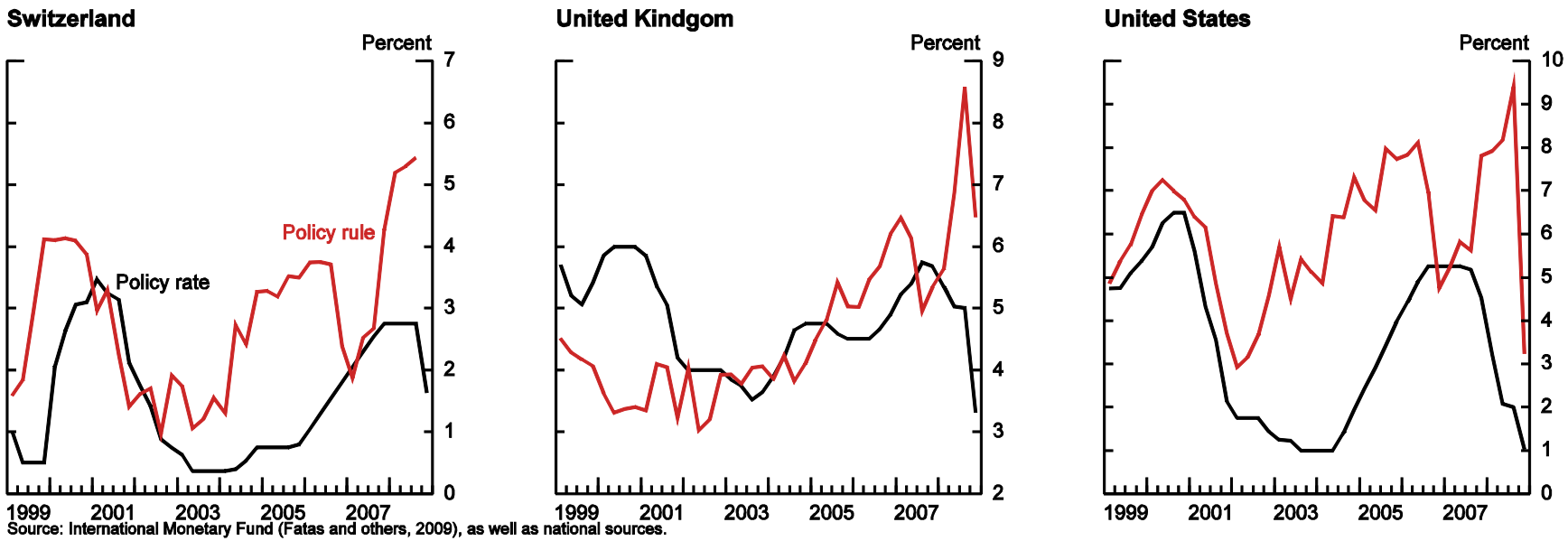
Source: International Monetary Fund (Fatas and others, 2009), as well as national sources.

Figure A1: Comparison of Policy Rates and Taylor Rules in the Advanced Foreign Economies



Source: International Monetary Fund (Fatas and others, 2009), as well as national sources.

Figure A1: Comparison of Policy Rates and Taylor Rules in the Advanced Foreign Economies



Source: International Monetary Fund (Fatas and others, 2009), as well as national sources.