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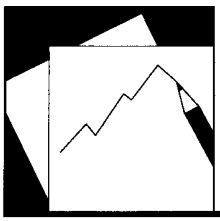

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Macroeconomic Patterns and Monetary Policy in the Run-Up to Asset Price Busts

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Macroeconomic Patterns and Monetary Policy in the Run-up to Asset Price Busts

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Abstract

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

We find that inflation, output and the stance of monetary policy do not typically display unusual behavior ahead of asset price busts. By contrast, credit, shares of investment in GDP, current account deficits, and asset prices typically rise, providing useful, if not perfect, leading indicators of asset price busts. These patterns could also be observed in the build-up to the current crisis. Monetary policy was not the main, systematic cause of the current crisis. But, with inflation typically under control, central banks effectively accommodated these growing imbalances, raising the risk of damaging busts.

Keywords: Asset Prices; Credit; Monetary Policy

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I. INTRODUCTION

The current crisis has prompted many to question what monetary policy can do to prevent asset price busts. The scope and severity of recent busts has been considerable, leading many to conclude that it is no longer adequate to imagine that monetary policy could—and should only—pick up the pieces after asset prices crash. But before requiring monetary policymakers to address asset price cycles, we need to know what is possible.

This paper examines the historical evidence to see whether there are consistent macroeconomic patterns that could be used as reliable leading indicators of asset price busts. We find that inflation and output do not typically display unusual behavior ahead of asset price busts. By contrast, credit, the share of investment in GDP, current account deficits, and asset prices typically rise, providing useful leading indicators of asset price busts. These patterns can also be observed in the build-up to the current crisis.

In the period since 1985, we find that the stance of monetary policy—as measured by real policy rates or deviations from a Taylor rule—has generally not been a good leading indicator of future house price busts, consistent with the evidence that inflation and output are poor leading indicators. We also examine the role of monetary policy in the current crisis. Policy makers face two charges: that they created the current crisis by reacting insufficiently to growing inflationary pressure; or that they raised the likelihood of an asset price bust by placing insufficient weight on credit and asset prices when setting interest rates. There is some evidence for loose monetary policy in the years leading up to the current crisis in some countries, but it is not the main, systematic cause of the boom and consequent bust. If monetary policymakers are to blame, it is mainly for acting too narrowly and not reacting strongly enough to indications of growing financial vulnerability.

The focus on the run-up to house price and stock price busts in this paper is a relatively novel contribution to the literature. The papers that are closest to the present study are Borio and Lowe (2002) and Gerdesmeier, Reimers and Roffia (2009), which present empirical evidence that show how booms in credit, asset prices, and investment have predictive power with respect to the occurrence of banking crises and a composite indicator of asset price busts respectively. In this chapter, house prices and stock prices are examined separately, leading to new results. In particular, we find a recurring pattern of deteriorating current account balances in the run-up to house price busts. Furthermore, this paper identifies patterns in asset price busts after 1985 that are unique from busts that occurred before 1985. A related strand of literature focuses on asset price booms. Adalid and Detken (2007) and Detken and Smets (2004), for example, document stylized facts on real and financial variables around asset price booms and analyze the influence of liquidity shocks and monetary policy during these episodes.[1]

[1]A related paper is Mendoza and Terrones (2008), which looks at booms in domestic credit and the associated behavior of macroeconomic and microeconomic variables around these episodes.

The analysis on the predictive content of macroeconomic variables with regards to asset price busts that also ties this paper to the literature on early warning systems (see Berg et. al., 2000, for a survey). Indeed, the "indicator" approach that will be presented later was initially popularized by Kaminsky, Lizondo and Reinhart (1998) and Kaminsky and Reinhart (1999) in the context of currency and banking crises.[2] Other papers that utilized different statistical procedures, such as probit models, include Frankel and Rose (1996) and Milesi-Ferretti and Razin (1998).

The paper is structured as follows. Section 2 establishes stylized facts about asset price booms and busts and looks for potential leading indicators of asset price busts. The predictive power of candidate indicators is assessed in Section 3. Section 4 examines macroeconomic patterns leading up to the current crisis, with particular emphasis on the role of monetary policy. Conclusions are presented in Section 5. An Appendix details data sources.

II. Asset Price Busts in the Modern Era

This section examines busts in house and stock prices over the last forty years. The focus of the analysis will be on the behavior of key macroeconomic variables in the period prior to the busts. In so doing, we attempt to address the question of whether there were systematic patterns in the behavior of these variables leading up to asset price busts.

A. Defining Asset Price Busts

The first task for this analysis is to define asset price busts. This paper uses a simple methodology, similar to that used by Bordo and Jeanne (2002).[3] Busts are defined as periods when the four-quarter trailing moving average of the annual growth rate of the asset price, in real terms, falls below a particular threshold. The threshold is set at –5 percent for real house prices and –20 percent for real stock prices.[4] A higher threshold (in absolute terms) is used

[2]Berg and Pattillo (1999) and Edison (2003) extend the methodology and perform robustness tests.

[3]Bordo and Jeanne define a bust as a period when the three-year moving average of the growth rate of asset prices is smaller than the average growth rate minus a multiple of the standard deviation of growth rates. The thresholds that are used in this chapter for housing and equity busts are roughly equal to the average growth rate of the respective asset prices across the whole sample minus one standard deviation of the growth rates. Bordo and Jeanne use a multiple of 1.3 times the standard deviation of growth rates.

[4]To be clear, a bust occurs when the following condition holds:

$$\frac{g_{t-3} + g_{t-2} + g_{t-1} + g_t}{4} < x$$

where g is the growth rate of the asset price and x is the relevant threshold (–5 for house prices and –20 for stock prices). If the condition holds, then the periods t-3 through t are labeled as a bust.

for stock prices due to the fact that stock prices are typically more volatile. This methodology is objective, easily reproducible, and can be applied consistently across countries. In addition, the thresholds used also pick up the major well-known asset price busts—Japan in the early 1990s, the dot-com episode in the 2000s—while still leaving asset price busts as relatively infrequent episodes.

Applying this technique to data for real stock and real house prices identifies 47 house price busts and 98 stock price busts from 1970 to 2008 (Table 1).[5] House price busts are generally longer lasting and are associated with greater output loss. The average house price bust lasts for two and a half years, whereas stock price busts last for about one and a half years.[6] The cumulative decline in output below trend is roughly 4¼ percent for the first year after the onset of a house price bust,[7] compared with a 1¼ percent decline after stock price busts. These findings mirror those of IMF (2003, 2008), as well as those of Claessens, Kose and Terrones (2008).

Figure 1 shows that asset price busts are relatively evenly distributed before and after 1985—a year that broadly marks the beginning of the "Great Moderation," a period characterized by substantially lower macroeconomic volatility in advanced economies (see McConnell and Pérez-Quirós, 2000, and Galí and Gambetti, 2009). Several episodes are clustered across countries, including busts in 1974-75, 1983, 1992, and 2008. The current episode is the most widespread cluster of busts for both house prices and stock prices.

B. Patterns in Macroeconomic Variables in the Run-Up to a Bust

Asset price busts, particularly house price busts, are long and costly. Can they be predicted? Theory suggests that it is not possible to predict the timing of asset price movements, particularly large drops, with a high degree of accuracy. If it were, investors would sell, or short, these assets, and there would be no boom-bust cycles. Even so, there may be some regular patterns in the behavior of macroeconomic variables that can help indicate the likelihood of a bust, even if they provide only limited insight into its timing.

Before exploring whether there are such macroeconomic patterns, we must first correct for slow-moving trends. Although this analysis focuses, to a large extent, on growth rates, there are slow-moving trends in these rates over the four decades covered by the sample. For example, for almost all the countries, inflation rates were markedly lower during

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[5]The dataset consists of quarterly observations on asset prices and macroeconomic variables for 21 advanced economies from 1970 to 2008. Subject to data limitations, the sample includes the following countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. Details are in the Appendix.

[6]The duration of a bust is the amount of time the four-quarter moving average of the growth rate of the asset price remains below the relevant threshold. Because periods *t*-3 to *t* are labeled as a bust, there is a minimum duration of one year for all busts.

[7]Trend output is measured using a one-sided Hodrick-Prescott (HP) filter with a smoothing coefficient of 1600.

the 1990s than during the 1970s, and therefore looking at deviations from an average calculated on the basis of the full sample would be misleading. The same holds true for output growth, reflecting a diminishing impetus from post–World War II catch-up and population aging. To correct for such slow-moving trends, a trailing eight-year moving average is used as a filter to isolate large or abnormal movements in these variables. The choice of filter was based on three factors. First, it is easily reproducible. Second, the trends for the variables under study are fairly slow moving. Third, this measure—unlike centered moving averages or the popular two-sided Hodrick-Prescott (HP) filter—does not include any information regarding future movements of the indicator variables.

However, results derived using a one-sided filter should be interpreted carefully. For a variable experiencing a temporary but persistent increase in its growth rate, the deviation from a trailing moving average eventually gets smaller as the trend "catches up" with the higher growth rate. This could, erroneously, be interpreted as a return to normal behavior, even though the variable continues to experience high growth. The choice of an eight-year window for the moving average mitigates this problem somewhat because it lengthens the period over which a boom must persist in order for the trend to catch up. As a robustness check, the analysis was also carried out using a rolling HP filter with a slow-moving trend. Qualitatively similar patterns were obtained (see Figures 16 and 17). The smoothness parameter was set to 400,000 following Borio and Lowe (2004).

What patterns do we observe using this detrending procedure? Figure 2 shows the behavior of eight key macroeconomic variables around the onset of house price busts before 1985 and during 1985 and after. Three factors motivated the decision to split the sample. As mentioned, 1985 marks roughly the beginning of the Great Moderation. Second, the dynamics of asset price busts in the pre-1985 period may have been very different because of the different nature of shocks, such as the two oil crises of the 1970s. Third, during the post-1985 period financial markets were more liberalized and monetary policy was more consistent—a macroeconomic environment much more similar to today's than to the one before 1985.

Several interesting findings emerge from Figure 2. Run-ups to house price busts in 1985 and after feature higher-than-normal growth rates of credit relative to GDP, large deteriorations in current account balances, and higher-than-normal ratios of investment to GDP. Asset prices also grow faster than the eight-year moving average trend, though the difference does not vary significantly from zero within the two years before the busts. Of equal interest, output growth does not display any significant deviation from the measured trend, and inflation is actually *below* its eight-year moving average. Before 1985, there is no pattern of rapid increases in credit relative to GDP or deteriorating current account balances in the run-up to busts, although there are large deviations in inflation coinciding with the two oil crises.

The post-1985 period shows a similar pattern of large increases in credit growth and in the ratio of investment to GDP during the run-up to stock price busts, as shown in Figure 3. There are, however, two notable differences between the behavior of macroeconomic variables before stock price busts and before house price busts. First, output growth tends to

be significantly higher than trend during the run-up to stock price busts. Second, there is no deterioration in current account balances as there is for house price busts. Even though the median current account balance deteriorates in the year leading up to a stock price bust, the level is not significantly different from zero.

As shown in Table 1, asset price busts, particularly house price busts, are costly events. Do macroeconomic variables display different patterns in the run-up to particularly costly house price busts? Figure 4 shows the behavior of the same set of variables, solely for house price busts from 1985 to 2008. The observations are divided into house price busts that were associated with large falls in output and those that were not.[8] The growth rate of credit relative to output, the share of residential investment in GDP, and the rate of increase of house prices themselves are all higher in costly busts than in episodes that were not as costly. Interestingly, there is no significant difference in inflation and output growth in the run-up to a high-cost bust compared with other busts.

With regards to the monetary policy indicators, the data suggest that, since 1985, monetary policy conditions are generally not a good leading indicator of both house price and stock price busts. The last two panels in Figures 2 and 3 track two standard measures of monetary policy stance in the run-up to house price busts: real policy rates[9] and the deviation of these rates from a standard Taylor rule, which takes into account business cycle developments.[10] There is some evidence of loose monetary policy in the run-up to house price and stock price busts before 1985. One interpretation is that monetary policy during that period did not react sufficiently to inflation, such as that generated by the oil shocks. In the period since 1985, taken as a whole, real policy rates were typically above trend in the run-up to a house price busts and high when compared with those implied by a Taylor rule. Furthermore, the dynamics of real rates suggest that, if anything, rates actually increased in the years leading up to a bust.

III. How Good Are These Variables as Indicators of Asset Price Busts?

There are then some common patterns in the run-up to asset price busts, specifically, a significant expansion in domestic credit, asset prices, and investment shares, in conjunction with current account deficits, during the two to three years before a bust. But how predictive are these variables? From a policymaker's perspective, monitoring, or even reacting to, abnormal growth in these macroeconomic variables can be justified only if they help gauge the risks of asset price busts.

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[8]Output losses are computed over the entire duration of a bust. Those that fall in the bottom quartile in terms of total change in output are labeled "high-cost" losses.

[9]As in the previous section, these data are presented as deviations from an eight-year trailing average.

[10]The rule has weights of 1.5 on deviations of inflation from its target level and 0.5 on the output gap. See Taylor (1993).

To assess the predictive ability of these variables, we use an approach pioneered by Kaminsky, Lizondo and Reinhart (1998) and Kaminsky and Reinhart (1999).[11] The approach involves determining whether excessively large movements in particular variables are associated with subsequent busts. Large movements are defined as deviations from an underlying trend, for which the eight-year moving average is used. When the deviation from trend exceeds a particular threshold, we say an "alarm" has been raised. The percentiles for each indicator is computed based on a "real time" approach, using observations over the previous 15 years (see Alessi and Detken, 2009). As such, the statistics are calculated only for the post-1985 period. Whether these alarms are deemed informative depends on their association with subsequent busts.

The choice of a threshold above which an alarm is raised presents an important trade-off between the desire for some warning of an impending bust and the costs associated with a false alarm. A very high threshold, for example, leads to infrequent alarms, because only extreme movements in the variables are captured. These extreme movements may be strong signals of impending asset price busts—and thus reduce the likelihood of a false alarm—but they may miss a large number of busts. With a low threshold, on the other hand, less extreme movements in the variables would more frequently raise alarms. Policymakers would very likely be alerted to impending busts, but would also be subject to a lot of false alarms. Choosing thresholds that minimize the ratio of false to legitimate alarms balances this trade-off. Here, the same percentile threshold is used for a particular variable across all countries, but the actual cut-off value differs from country to country because of the varying distributions of the variables. More specifically, we choose the threshold based on percentiles of the distribution of deviations such that the noise-to-signal ratio—defined as the ratio of the share of false alarms to legitimate alarms—is minimized.[12] To avoid the influence of extreme observations, we limit our grid search to four percentiles: 70th, 75th, 80th and 90th.[13,14]

Each observation for a given variable can be classified into one of four categories, as shown in Table 2. Deviations in the credit-to-GDP ratio illustrate how the observations can be classified. The 90th percentile of the distribution of this variable has the smallest ratio of false alarms to legitimate alarms, which makes this a suitable threshold. An observation on this variable above the 90th percentile is considered to raise an alarm, placing the observation

[11]The analysis of the predictive ability of macroeconomic variables with regard to asset price busts is related to the literature on early warning systems (see Berg and others, 2000, for a survey).

[12] In the literature, the noise-to-signal ratio is typically defined as [B/(B+D) / A/(A+C)] (see Table 2 for the classifications), but as noted in Berg and Patillo (1999), this is equivalent to minimizing B/A, i.e. the ratio of false alarms to legitimate alarms.

[13] The thresholds used are shown in Table 3.

[14] An alternative methodology for choosing the optimal threshold is to specify a loss function for the policymaker that trades off Type I errors against Type II errors (see Gerdesmeier, et. al., for example). Type I errors in this case refer to bust episodes for which there was no alarm, while Type II errors refer to false alarms. The procedure used in this paper—minimizing the ratio of false to legitimate alarms—results in a similar choice of thresholds to that which is obtained when the policy maker has a high aversion to false alarms.

in the first row of the matrix. If an asset price bust occurs within a particular time frame (discussed later) after the alarm, that alarm is considered a legitimate alarm and is placed into cell A. If there is no bust, that alarm is considered to be only noise and is placed into cell B. An analogous classification procedure determines the placement of observations into cells C and D. Ideally, all observations would fall into cells A or D, which correctly predict the occurrence or nonoccurrence of a bust.

Two statistics that can be derived from this approach are of particular interest. The first is a measure of the conditional probability of a bust, which is the probability that a bust will occur within a particular time horizon once an alarm has been raised based on a particular variable.[15] The second is a measure of the predictive ability (or lack thereof) of the variables, which essentially captures the proportion of periods during which a bust occurred one to three years in the future but for which no alarm was raised.[16] These two statistics capture the trade-off involved in the choice of a suitable threshold. An extremely high threshold that identifies only one observation from the sample will perform well on the conditional probability measure if a bust occurs within a particular time horizon, but will fare poorly on the other measure because no alarm would be raised for most of the busts.

Computing these probabilities also involves selecting the appropriate time horizon. If the horizon is too short, the alarm will have no operational relevance because any action by policymakers would be too late to affect the economy and forestall or mitigate the bust. If the horizon is too long, the alarm becomes uninformative, meaning that it loses its predictive ability. We chose a horizon that considers an alarm legitimate if it successfully predicts a bust within three years, with a minimum lead time of one year.

Figure 5 shows the difference between the conditional probability of a bust occurring one to three years after an alarm has been raised and the unconditional probability of a bust over the same horizon. This gauges the predictive ability of the conditional probability measures. In the sample, the unconditional probability of a house price bust occurring one to three years in the future is 14 percent during the post-1985 period. For stock price busts, the corresponding probability is 29 percent.

In the post-1985 period, large deviations in credit relative to GDP, in the current account balance, in the residential investment share of GDP, and in house prices themselves are particularly predictive of an impending house price bust. Large deviations in the credit-to-GDP ratio, for example, are associated with a 28 percent probability of a house price bust one to three years in the future, which is twice the unconditional probability of such a bust. Large deviations in output and inflation—the conventional components of monetary policy rules in the academic literature—have little ability to predict house price busts. For stock price busts, output and inflation perform slightly better as leading indicators, but credit, the current account balance, and residential investment have much more predictive ability, as for house price busts.

[15]In terms of the matrix presented in Table 2, this statistic can be computed as A divided by (A+B).

[16]In this case, the relevant statistic is C divided by (A+C).

These results suggest that large deviations in the ratios of credit, the current account, and residential investment to GDP are significant predictors of asset price busts. What happens when all three variables raise alarms at the same time? The bottom bars in each panel of Figure 5 indicate that 56 percent of these occasions were associated with a house price bust one to three years in the future.[17] The ratio is roughly the same in the case of predicting stock price busts.

These results should be interpreted with caution. As mentioned, the most predictive thresholds for these variables may be those that result in identification of just a few observations that yield particularly reliable alarms. When considering the simultaneous raising of alarms by all three variables, this restriction becomes more severe. To complement the analysis, therefore, we look at the proportion of periods during which the indicators fail to raise an alarm one to three years ahead of a bust (Figure 6). Large deviations in variables such as credit to GDP, current account to GDP, and residential investment to GDP raise alarms in advance of a bust only one-quarter to one-half of the time during the post-1985 period. The most reliable indicator is credit, which raises an alarm in one-half of all cases.

In summary, large booms in credit and investment, as well as deteriorating current account balances, substantially increase the probability of a bust occurring in the near future. When these indicators raise an alarm, the probability of a bust is more than twice the unconditional probability. Nonetheless, even the best indicator failed to raise an alarm one to three years ahead of roughly one-half of all busts since 1985. Thus, asset price busts are difficult to predict.

Probit Analysis

Two issues related to the analysis presented in the last section still need to be addressed. First, in most cases, the indicators of impending asset price busts could be highly correlated, such that the marginal information from some of the variables is insignificant when the information from other variables is accounted for. Second, it is not straightforward to compute the statistical significance of these indicators, making it difficult to state the level of confidence associated with particular indicators. To remedy these problems, the analysis is complemented with a probit model. Probit models are nonlinear regressions that seek to explain binary variables. In the case of this exercise, the binary variable in question takes on a value of one if there is an asset price bust between one and three years in the future and zero otherwise.[18]

The results from the probit analysis are shown in Table 4. The coefficients represent the marginal increase in the probability of a bust occurring evaluated at the mean level of the

[17]The percentage is computed as the sum of the percentage indicated in the bar and the unconditional probability of each type of bust.

[18]Probit models have been used in the context of predicting currency crises (Frankel and Rose, 1996, and Milesi-Ferretti and Razin, 1998).

other variables.[19] For the post-1985 sample, a 10 percentage point increase in the credit to GDP ratio relative to an 8-year moving average—the typical increase in the run-up to a house price bust—increases the probability of a house price bust occurring by 4.4 percent, which is roughly one third higher than the unconditional probability of about 15 percent. Current account balances, residential investment, and house price growth are also significant predictors of house price busts; for example, a 1½ percentage point deterioration of the current account relative to its 8-year moving average, a magnitude that is typically found in the run-up to a bust, implies a one third increase in the probability of a house price bust over the unconditional probability. Meanwhile, for house price busts in the post-1985 period, we find that output growth and inflation are not significantly associated with the likelihood of a bust.

Deviations in credit is also found to be significant predictors of a stock price bust. A 10 percentage point increase in the credit to GDP ratio is associated with an increase in the probability of a stock price bust 6.4 percent—roughly 20 percent higher than the unconditional probability of a stock price bust. The coefficient on current account balances with regards to stock price busts, however, appears to be of the wrong sign for the latter half of the sample

IV. Macroeconomic Patterns Ahead of the Current Crisis

These findings lead to the following question: Do the patterns associated with previous episodes of asset price busts show up ahead of the current crisis? Undoubtedly, recent years saw several important developments, such as innovations in securitization, that might suggest the current crisis is fundamentally different from previous crises. However, for house prices, this crisis had a very familiar macroeconomic pattern: house price busts were preceded by strong growth in credit, worsening current account balances, and house price booms.

Figure 7 shows the average annual real house and stock price growth across all economies in the sample from 1995:Q1 to 2008:Q4. Apart from the current episode, stock prices experienced one other boom-bust cycle during this period. Real house prices registered strong growth rates, on average, up until 2007. Subsequently, most economies experienced falls in asset values that are severe by historical standards. Asset price paths differ widely across countries. During 2001:Q4–2006:Q3, real house prices rose strongly in Ireland, New Zealand and Spain, but fell in Austria, Germany, and Japan.[20] Consistent with the results from previous issues of the *World Economic Outlook* (April 2003 and April 2008), larger house price increases have generally, though not uniformly, been followed by larger decreases from recent peaks. Except for Germany and Japan, which have been experiencing

[19]Variables are measured as deviations relative to the 8-quarter trailing moving average, as used earlier.

[20]These dates were chosen because they cover the period during which most economies (except for Austria, Germany, and Japan) experienced steady rises in house prices, ending with the peak in house prices in Ireland. Germany and Japan have experienced steady declines in both real and nominal house prices since the 1990s.

long-term declines in real house prices, the correlation between house price rises and subsequent falls is 0.79.[21] In contrast, the recent fall in stock prices was relatively uniform across countries and was largely unrelated to previous stock price rises.

Were the macroeconomic indicators identified in the previous section associated with the recent asset price busts? Figure 8 shows the proportion of countries that experienced house price busts for which the credit-to-GDP, residential-investment-to-GDP, and current-account-to-GDP variables were raising alarms, based on the definitions in the previous section. Signs of a residential investment boom, in some cases funded by current account declines, are apparent in at least half the economies one to three years before the onset of house price busts. Credit growth was unusually high in roughly half the economies over almost the entire three-year period. The alarm from the current account is more muted until about one year ahead of the bust, when it was raised for nearly half the countries.

Figure 9 shows how recent cross-country variations in house price changes are associated with variations in credit growth, residential investment, and current account relative to GDP. Economies with the largest house price appreciations during 2001:Q4–2006:Q3 also had large increases in residential investment as a share of GDP, large current account deficits as a share of GDP, and large expansions of credit relative to expansion in output.[22] Furthermore, stronger credit growth was also typically matched by more severe deteriorations in household balance sheets: a version of a household "quick ratio"—the ratio of liabilities to liquid assets (deposits and currency)—was found to be highly associated with house price growth (Figure 10).[23] At a macroeconomic level, therefore, the evidence suggests that this was a conventional crisis in that it displayed patterns historically evident in asset price booms and busts. A key question, then, is whether these boom-bust cycles resulted from monetary policy actions.

A. The Role of Monetary Policy

Two criticisms have been leveled against monetary policymakers:

- The first criticism is that monetary policy was too loose from 2002 to 2006—in particular, that central banks held the policy rate below the level specified by a simple rule for reacting to an output gap and inflation.[24] Had monetary

[21]House price falls are defined as the percentage difference between the recent peak in the economy's house prices and the latest data available (either 2008:Q3 or 2008:Q4, depending on the economy).

[22]Because the busts are ongoing and likely to continue for a prolonged period in some economies, we have not checked correlations with the decline in house prices since 2006:Q3.

[23]These measures were constructed from nonconsolidated household balance sheet data from the Organization for Economic Cooperation and Development (OECD). See Appendix 3.2 for details. The ratio of loans to disposable income fitted poorly. The United Kingdom and United States stand out with very high maturity ratios (ratios of long- to short-term liabilities), but these do not have explanatory power for house price changes during this period.

[24]See Taylor (2007 and 2008). Taylor cites Ahrend, Cournède, and Price (2008) as support for the argument that policy failures were widespread and not limited to the Federal Reserve.

policymakers not deviated from a Taylor rule, goes the argument, the rise in asset prices—and, by implication, the current crisis—would have been avoided. Note that the essence of this argument is that monetary excesses were the main cause of the booms and subsequent busts.

- The second criticism argues that setting monetary policy by looking only at consumer price index (CPI) inflation and the output gap is too narrow an approach: in a simple version, monetary policy should lean against potentially unsustainable asset price rises or developments that raise financial vulnerability, even at the cost of more variability in inflation and output.[25]

These criticisms are difficult to answer conclusively because they require assessing the counterfactual—what would have happened had different policy choices been made. However, an analysis of monetary conditions and asset prices during the years before the recent asset price busts sheds some light on the issues.[26]

Figure 11 shows that both real interest rates and residuals from Taylor rules in the United States, the euro area, and, on average, other advanced economies (with the exception of Japan) were low and even negative leading up to the current crisis. This may be taken as evidence of overly loose monetary policy. However, in most economies, policymakers looking only at CPI inflation would not have seen obvious signs of a problem during this period. Figure 12 shows that core inflation stayed within 1–3 percent throughout the period during which credit was expanding and asset prices were booming. One interpretation advanced at the time is that higher asset prices and demand for credit reflected expected gains in productivity.

If monetary policy were the fundamental cause of house price booms over the past decade, there would be a systematic relationship between monetary policy conditions and house price gains across economies. Certainly, average real policy rates were low and even negative in some economies, and Taylor rule residuals were mostly negative, suggesting that monetary policy was generally accommodative across economies during this period. But there is, at best, a weak association with house price developments within the euro area (Figure 13, dashed lines).[27] And there is virtually no association between the measures of

[25]See, among others, Borio and Lowe (2002 and 2004) and White (2006). A more far-reaching version of this criticism is that current implementations of best practice monetary policy—especially in formal inflation-targeting regimes—can themselves raise overall macroeconomic instability by focusing exclusively on too narrow a definition of stability—namely, goods market inflation. A related criticism—the "paradox of credibility"—is that success at lowering and anchoring inflation expectations may encourage a form of money illusion (see, for example, Borio and Shim, 2007).

[26]For a model-based analysis of these issues, see Kannan, Rabanal and Scott (2009).

[27]The real policy rate here is constructed by deflating nominal gross policy rates by Consensus Economics expectations of gross CPI inflation one year forward. (Consensus Economics expectations data are not available for all economies in the sample before 1995, which prevented their use in measuring real rates in the previous sections.)

monetary policy stance and house price increases in the full sample (Figure 13, solid lines). For example, whereas Ireland and Spain had low real short-term rates and large house price rises, Australia, New Zealand, and the United Kingdom had relatively high real rates and large house price rises. Moreover, the association between measures of the monetary policy stance and real stock price growth is extremely weak, whether assessed during the global house price boom (2001:Q4–2006:Q3; not shown) or during a later period, when stock markets rallied from their troughs (2003:Q1) through the stock market declines of 2007 (Figure 14). Finally, the association across economies between real monetary policy conditions and the rates of credit expansion is very weak (Figure 15).[28]

This evidence, taken together, suggests that monetary policy was not the main or systematic source of the excesses that led to recent price busts. At the same time, evidence outlined in previous sections underscores that the asset price bust that started in 2007 did not come out of the blue, in the sense that key macroeconomic variables showed patterns similar to those ahead of historical asset price booms and busts. While not conclusive, the evidence is more consistent with the second criticism of monetary policy, that monetary policymakers did not take sufficient heed of signs of emerging macrofinancial risks.

V. CONCLUSIONS

The aim of this paper is to see if there are consistent macroeconomic patterns leading up to asset price busts. We have found that asset price busts have typically been preceded by rising investment, expanding credit, and deteriorating current account balances. Large deviations in these variables from local trends have some value as indicators of future asset price busts. Just as importantly, however, the stance of monetary policy has not been a good leading indicator of future asset price busts, consistent with the evidence that inflation and output are poor leading indicators.—evidenced by both the event study analysis and the probit regressions.

Monetary policy also does not appear to have been the main cause of the recent asset price booms. To the extent that monetary policy bears responsibility for the crisis, it is for acting too narrowly, in the sense of paying too little attention to emerging signs of financial vulnerability, rather than for failing to control output and goods price inflation over the medium run. By accommodating loosening credit conditions and rising debt, it allowed the risks of a bust to rise.

The evidence suggests that, if avoiding asset price busts is a policy concern, then a narrow focus on output and inflation is not sufficient. Other variables, such as excessive credit expansion, overinvestment, and deteriorating external balances merit greater concern.

[28]One assumption in this analysis is that monetary policy decisions in one economy were independent from those in other economies, which is a common conclusion given floating exchange rates and a free flow of capital. Some argue that monetary policy decisions in the United States have more influence on monetary conditions in other economies than this assumption allows. This awaits rigorous empirical testing.

However, it is not immediately clear that policy rates are the appropriate tool. In a companion paper (Kannan, Rabanal and Scott, 2009), we consider the case where policy makers are equipped with an additional macroprudential tool that works directly on lending margins. We find that such an instrument is useful to tackle problems in financial markets, which may help limit the need for aggressive monetary policy reactions. The coordination of monetary and macroprudential policy is important and may require an expansion of central bank mandates to include concern for financial vulnerabilities. That said, the evidence in this chapter implies it is important to be realistic about what could be achieved with a broader approach to monetary policy: even the best leading indicators of asset price busts are imperfect, such that, in the process of trying to reduce the probability of a dangerous bust, central banks may raise costly false alarms.

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DATA APPENDIX

Data Sources

Variable	Source
Nominal house prices[29]	Bank of International Settlements (BIS), Haver Analytics, OECD
Real house prices[30]	Organization for Economic Cooperation and Development
Real stock prices	Bloomberg Financial Markets, International Financial Statistics (IFS) database
Real credit	International Financial Statistics
Nominal credit	International Financial Statistics
Real private consumption	Organization for Economic Cooperation and Development
Real residential investment	Organization for Economic Cooperation and Development
Output	Organization for Economic Cooperation and Development
Current account	Organization for Economic Cooperation and Development
Consumer Price Index (CPI)	Haver Analytics (Core PCE), OECD, and IFS
Quick ratio	Organization for Economic Cooperation and Development
Policy rates	Bloomberg Financial Markets, National Authorities, and Thomson Datastream
Real long-term rates	International Financial Statistics

[29]Haver Analytics used to obtain nominal house price data for Austria, Greece and Portugal. BIS used to obtain nominal house price data for Belgium.

[30]Real house price data on Austria, Greece, Portugal and Belgium obtained by taking the nominal series and deflating by CPI data taken from the OECD.

Table 1. House Price and Stock Price Busts from 1970 to 2008

	Full Sample		Before 1985		1985–2008	
	House prices	Stock prices	House prices	Stock prices	House prices	Stock prices
Total number of busts	47	98	22	41	25	57
Number of busts per country	2.76	4.67	1.29	1.95	1.47	2.71
Cumulative decline in prices (percent)[1]	–17.71	–37.38	–19.43	–35.27	–15.58	–38.90
Duration (quarters)	10.02	6.98	11.22	7.92	9.74	6.29
Cumulative decline in output (percent relative to trend)[2]	–4.27	–1.31	–5.41	–1.33	–3.27	–1.29

Note**:** Values are mean values.

[1]Cumulative price decline is measured over the entire duration of the bust period.

[2]Cumulative decline in output is measured as the accumulated deviation from a one-sided Hodrick-Prescott filter with a smoothness parameter of 1600 for the first four quarters of a bust.

Table 2. Classification of Observations Based on Variable Thresholds

	Asset Price Bust 1–3 Years Later	No Asset Price Bust 1–3 Years Later
Alarm raised	A	B
No alarm	C	D

Table 3. Percentiles Used as Thresholds for Alarms

	House Price Bust	Stock Price Bust
Credit/GDP	90	90
Current account/GDP	90	90
Residential investment/GDP	90	90
House price growth	90	70
Stock price growth	70	70
Growth	75	80
Inflation	90	90

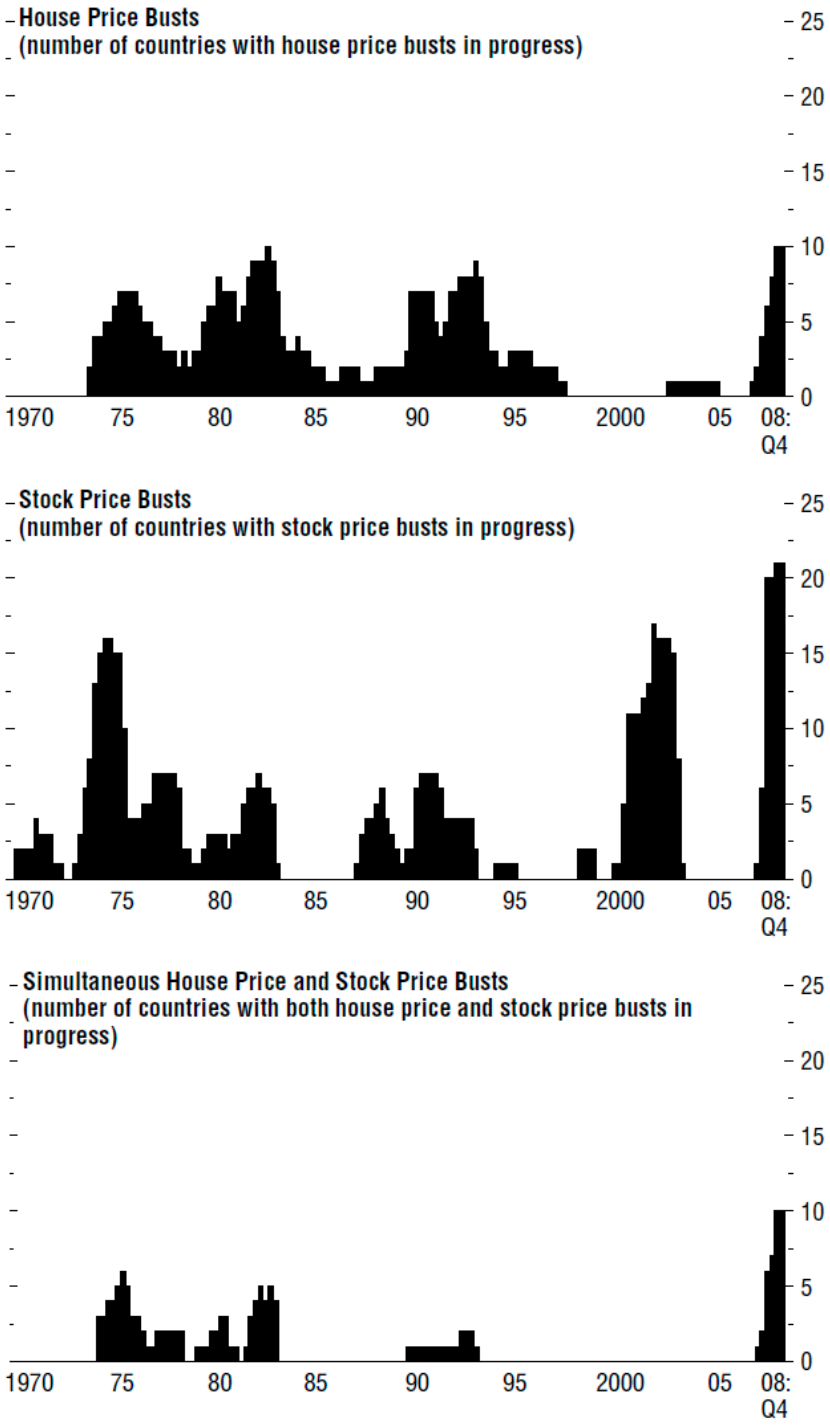
Notes: Entries in table denote the percentile of the distribution of the respective variable where the noise-to-signal ratio (defined as the ratio of false alarms to correct alarms) is minimized. The grid search was limited to the 70th, 75th, 80th and 90th percentiles.

Table 4. Marginal Probabilities Based on Probit Regressions

	Full Sample		Before 1985		1985–2008	
	House price bust	Stock price bust	House price bust	Stock price bust	House price bust	Stock price bust
	(1)	(2)	(3)	(4)	(5)	(6)
Credit/GDP	0.241**	0.546***	–0.864*	0.052	0.443***	0.638***
	(2.180)	(4.070)	(–1.740)	(0.130)	(4.280)	(4.210)
Current account balance	–3.910***	0.691	–3.472***	–2.851***	–3.191***	1.768**
	(–7.560)	(1.200)	(–3.640)	(–2.990)	(–5.440)	(2.510)
Residential investment/GDP	1.956	6.392***	4.621	4.801	2.456*	7.327***
	(1.520)	(5.280)	(1.370)	(1.550)	(1.930)	(5.290)
House price growth	0.798***	0.577***	2.147***	1.046***	0.455***	0.318
	(5.240)	(3.110)	(5.140)	(3.170)	(2.910)	(1.340)
Stock price growth	0.249***	0.337***	0.577***	0.323***	0.111***	0.349***
	(6.060)	(5.250)	(4.890)	(2.660)	(2.680)	(4.660)
Output growth	–0.413	1.686**	–0.916	0.280	–0.160	2.428
	(–0.810)	(2.540)	(–0.940)	(0.290)	(–0.300)	(2.620)
Inflation	2.511***	4.373***	3.786***	4.721***	0.681	3.732***
	(7.180)	(7.030)	(5.460)	(5.470)	(1.640)	(4.130)
N	1699	1580	435	419	1264	1161
Pseudo R^2	0.14	0.10	0.16	0.15	0.15	0.10

Note**:** Dependent variable takes a value of 1 if there is a bust between 12 and 4 quarters ahead and zero otherwise. Estimation is carried out using robust standard errors. *Z*-statistics are reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level, respectively. Marginal probabilities computed at the mean values of other variables are reported. Variables are measured as deviations from an eight-year moving average.

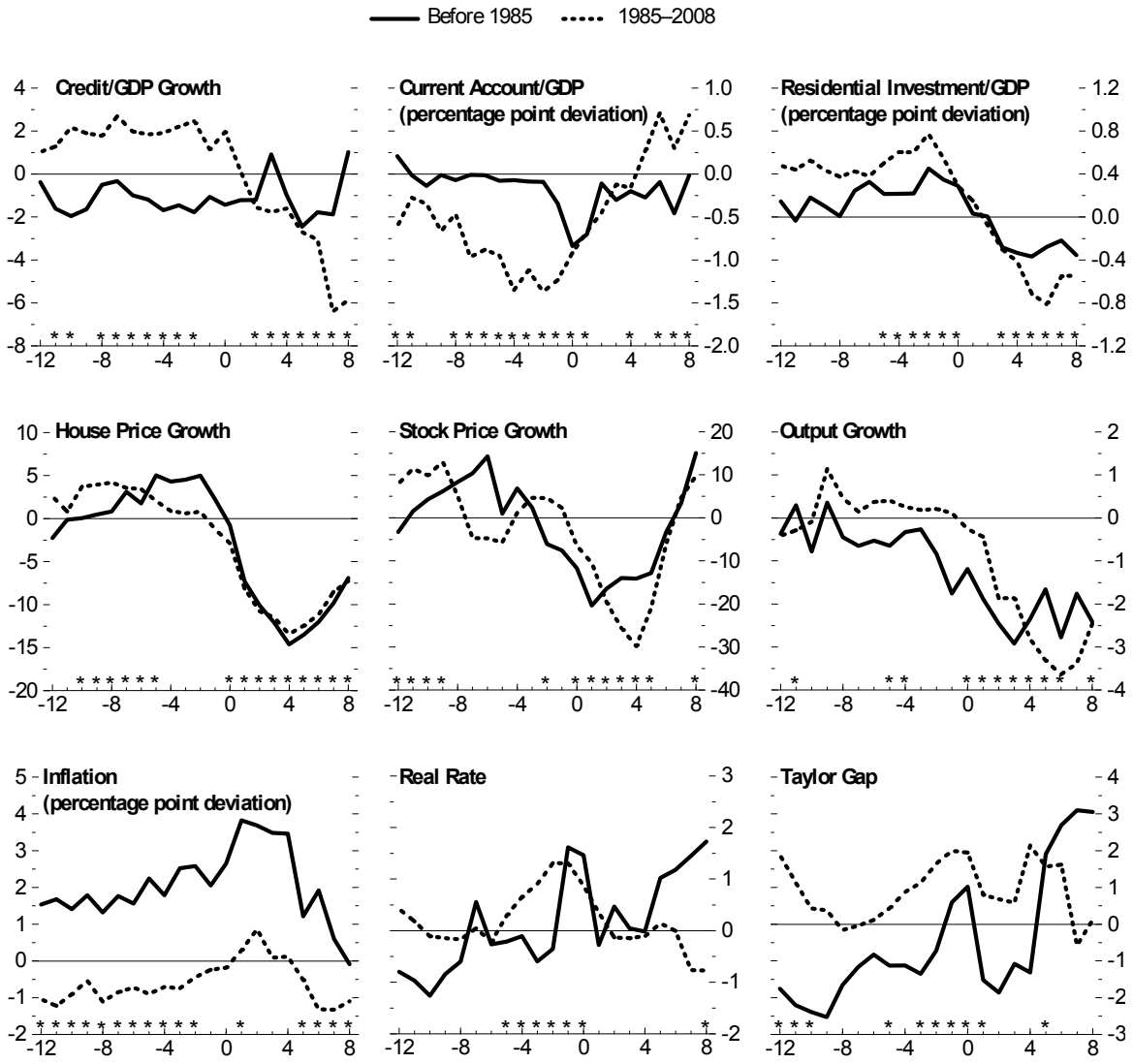
Figure 1. Asset Price Busts



Source: IMF staff calculations.

Figure 2. Selected Macro Variables before and during House Price Busts

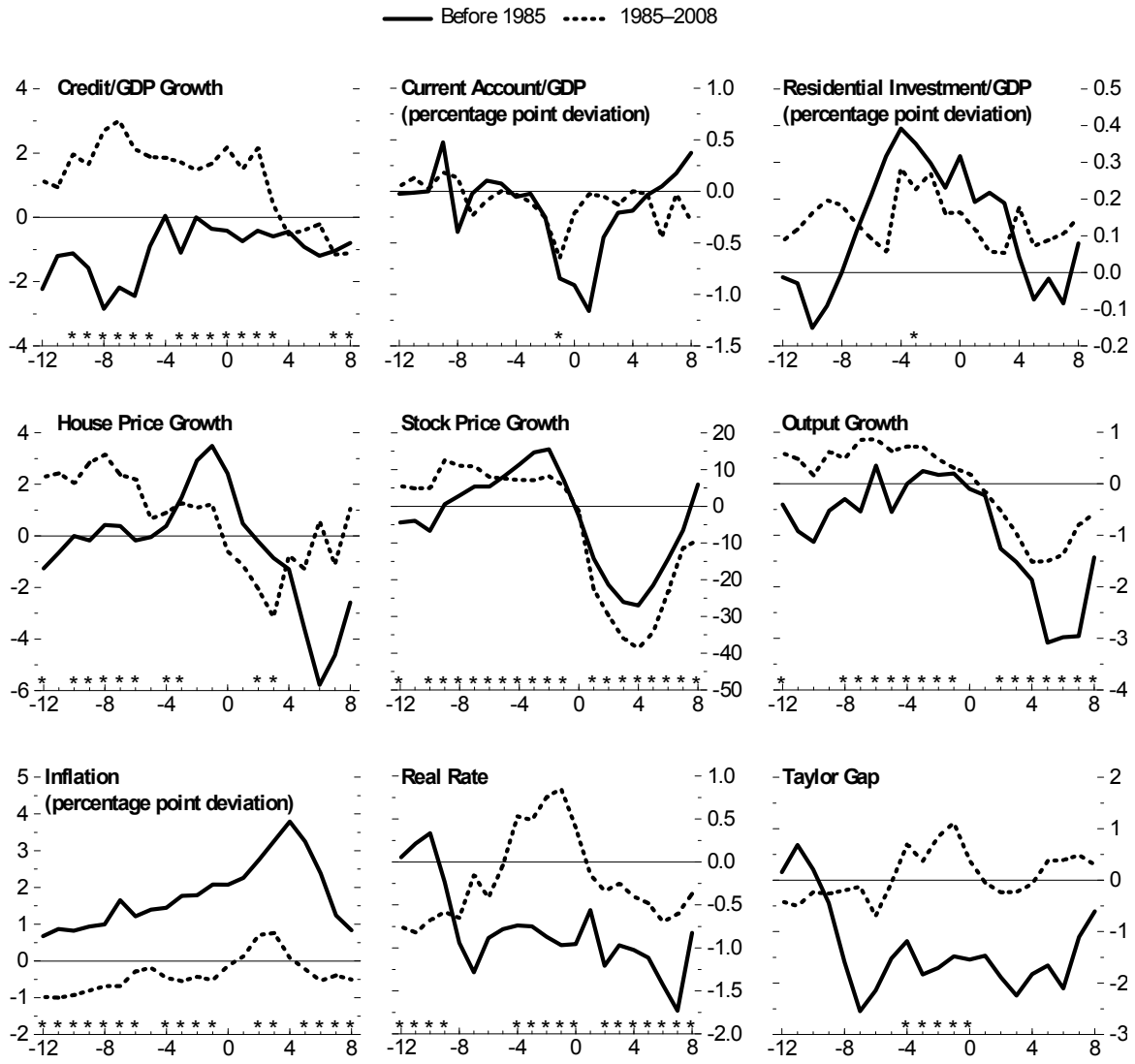
(Median percent deviation from trailing eight-year moving average, unless otherwise noted; asterisk indicates statistically significant difference of post-1985 deviation from zero; t = *1 denotes first quarter of bust)*



Source: IMF staff calculations.

Figure 3. Selected Macroeconomic Variables before and during Stock Price Busts

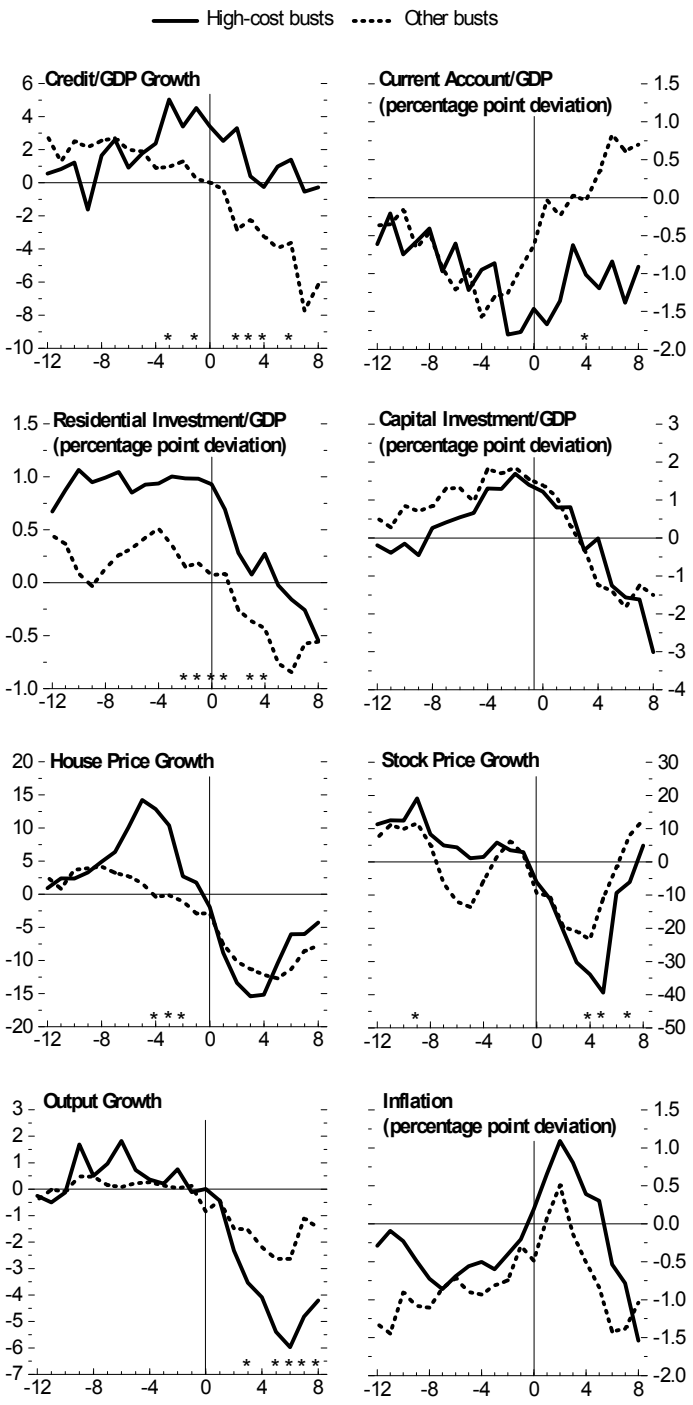
(Median percent deviation from trailing eight-year moving average, unless otherwise noted; asterisk indicates statistically significant difference of post-1985 deviation from zero; t = *1 denotes first quarter of bust)*



Source: IMF staff calculations.

Figure 4. Selected Macroeconomic Variables before and during High-Cost and Other House Price Busts, 1985–2008

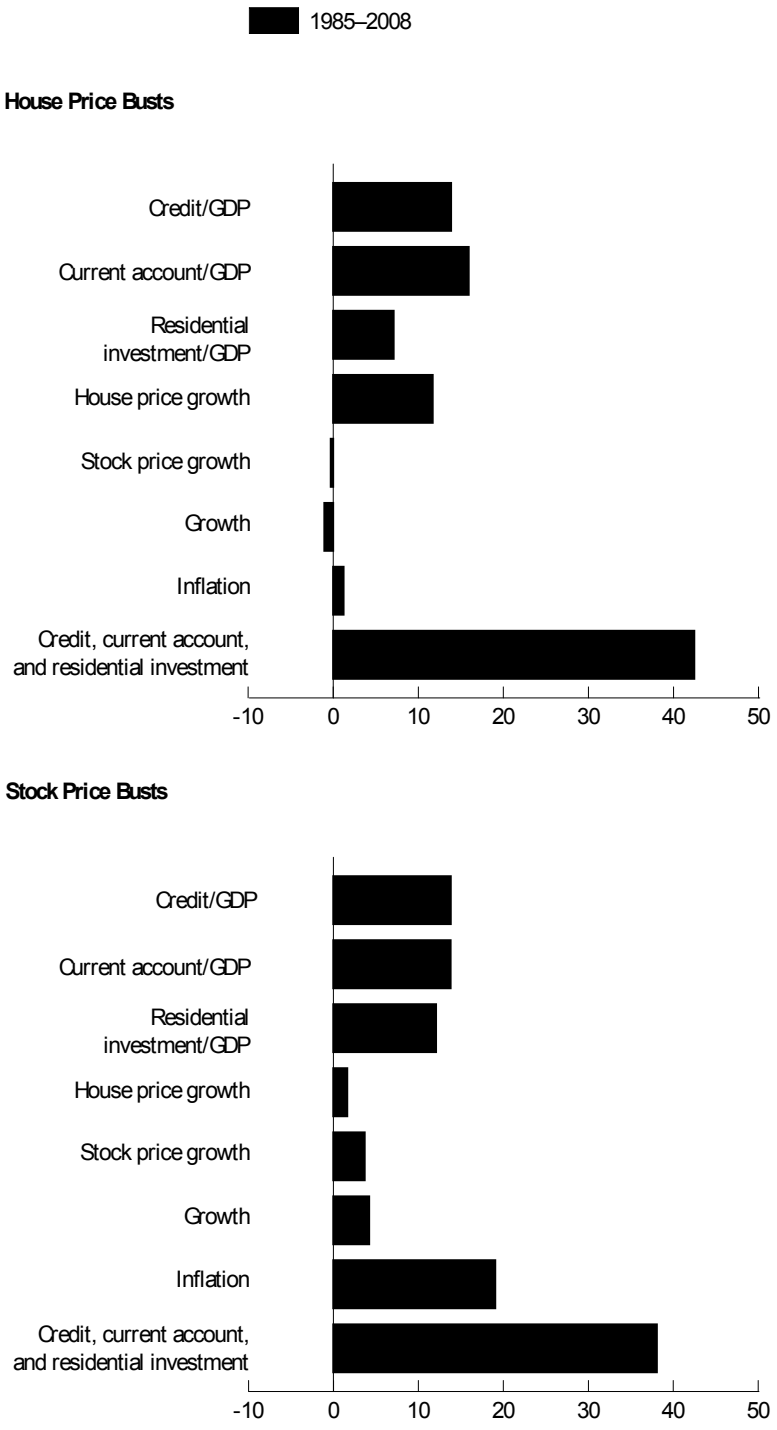
(Median percent deviation from trailing eight-year moving average, unless otherwise noted; asterisk indicates statistically significant difference between medians; t *= 1 denotes first quarter of bust)*



Source: IMF staff calculations.

Figure 5. The Probability of an Asset Price Bust

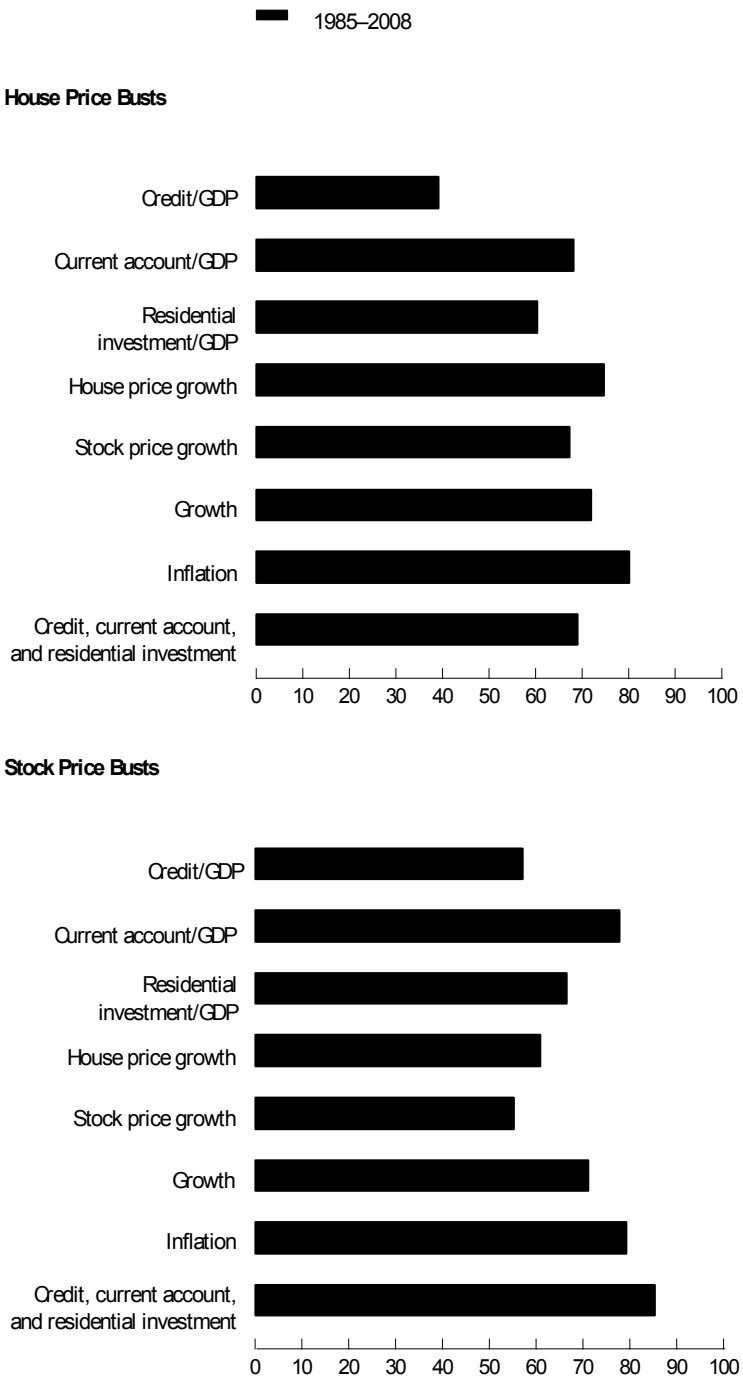
(Percent of times a bust occurs 1–3 years after an alarm is raised relative to the unconditional probability of a bust)



Source: IMF staff calculations.

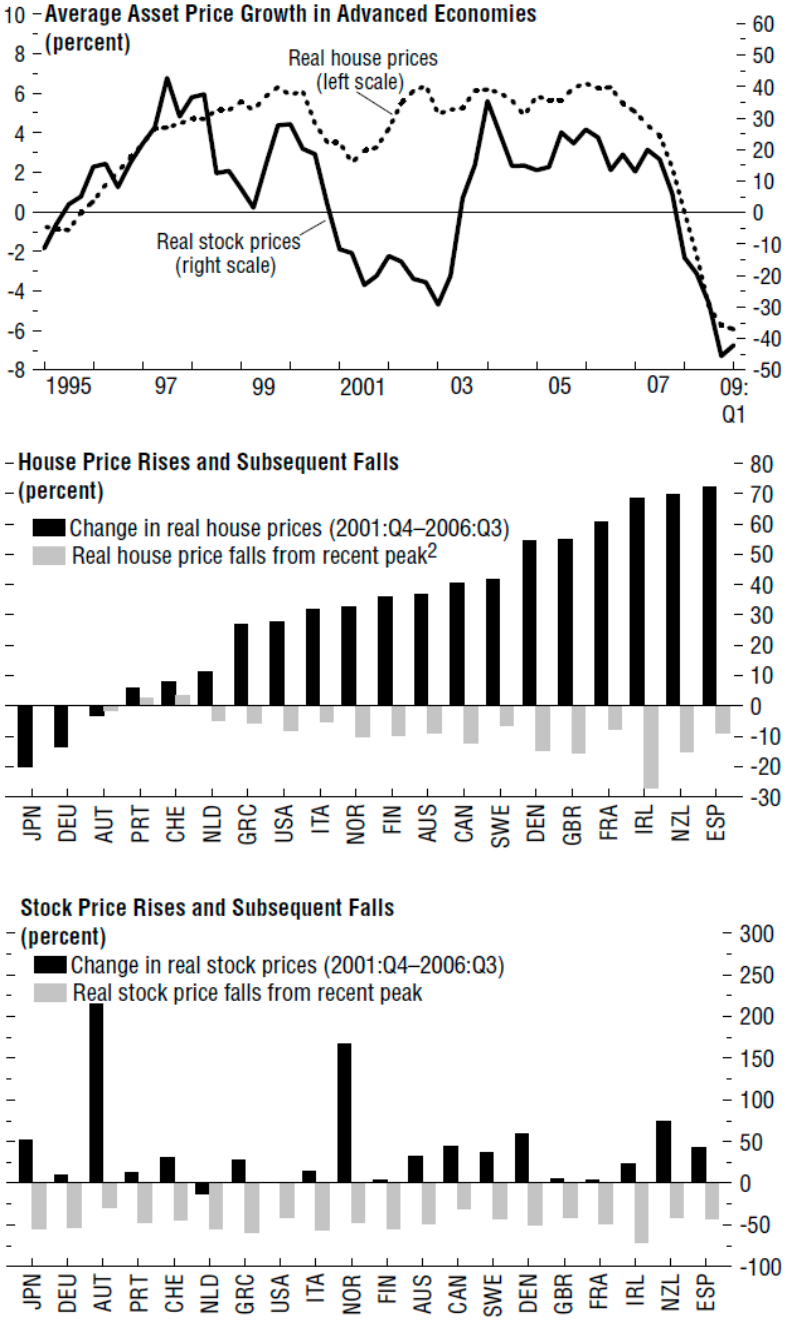
Figure 6. The Failure of the Indicators to Predict an Asset Price Bust

(Percent of quarters the variables failed to raise an alarm 1–3 years before a bust)



Source: IMF staff calculations.

Figure 7. Recent Developments in House and Stock Prices[1]

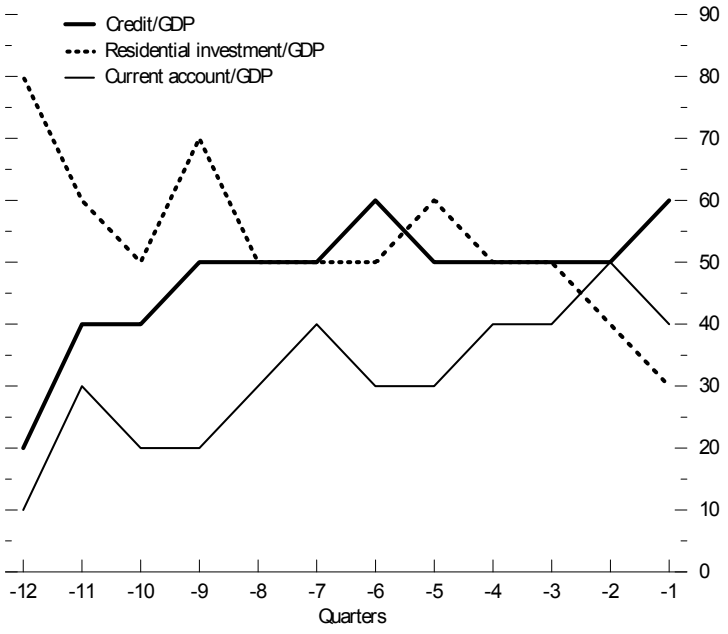


Sources: Bank for International Settlements; Bloomberg Financial Markets; Haver Analytics; IMF, *International Financial Statistics;* Organization for Economic Cooperation and Development; and IMF staff calculations.

[1]AUS: Australia; AUT: Austria; BEL: Belgium; CAN: Canada; CHE: Switzerland; DEN: Denmark; DEU: Germany; ESP: Spain; GBR: United Kingdom; GRC: Greece; FIN: Finland; FRA: France; IRL: Ireland; ITA: Italy; JPN: Japan; NLD: Netherlands; NOR: Norway; NZL: New Zealand; PRT: Portugal; SWE: Sweden; USA: United States.

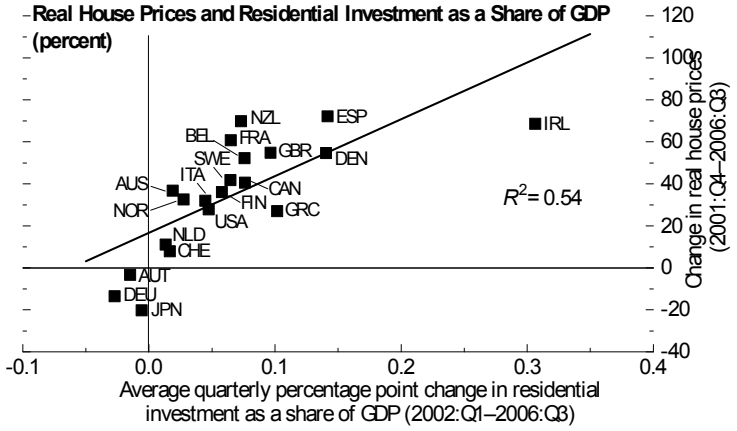
[2]Not shown for Germany and Japan as real prices declined through the 2001:Q4–2006:Q3 period.

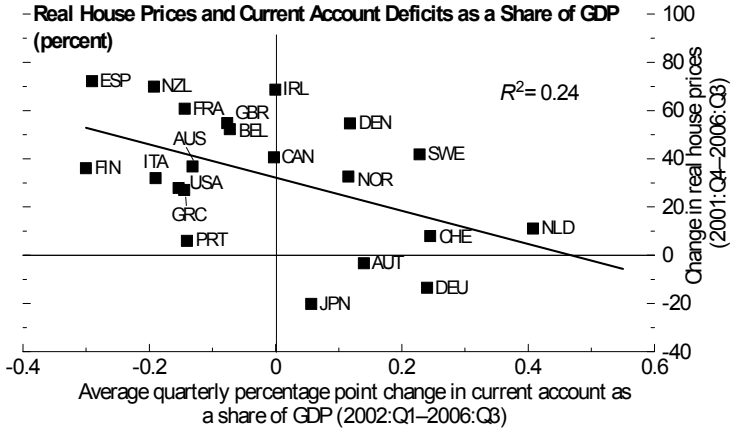
Figure 8. Warning Signs for Recent House Price Busts
(Percent of countries with recent house price busts that raised alarms)

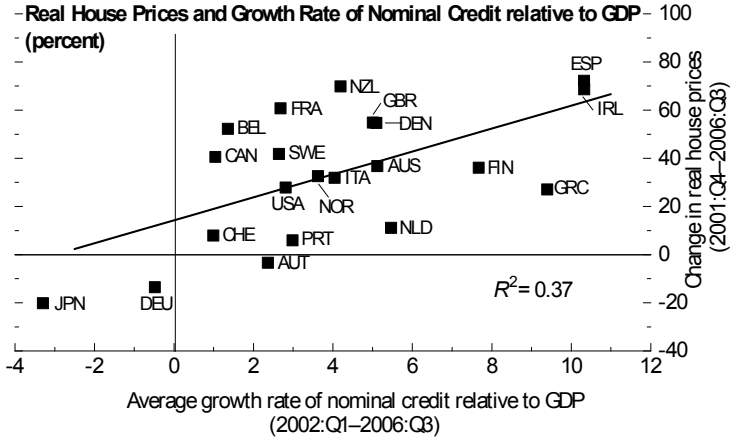


Source: IMF staff calculations.

Figure 9. Macroeconomic Patterns underlying Recent House Price Booms[1]



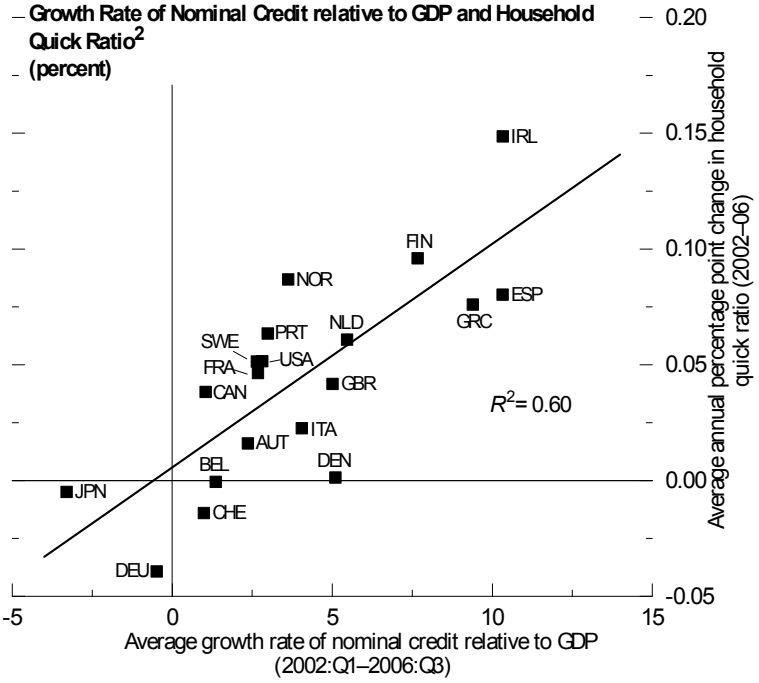




Sources: Bank for International Settlements; Bloomberg Financial Markets; Haver Analytics; IMF, *International Financial Statistics;* Organization for Economic Cooperation and Development; and IMF staff calculations.

[1]See Figure 7 for country abbreviations.

Figure 10. Recent House Price Booms and Household Balance Sheets[1]

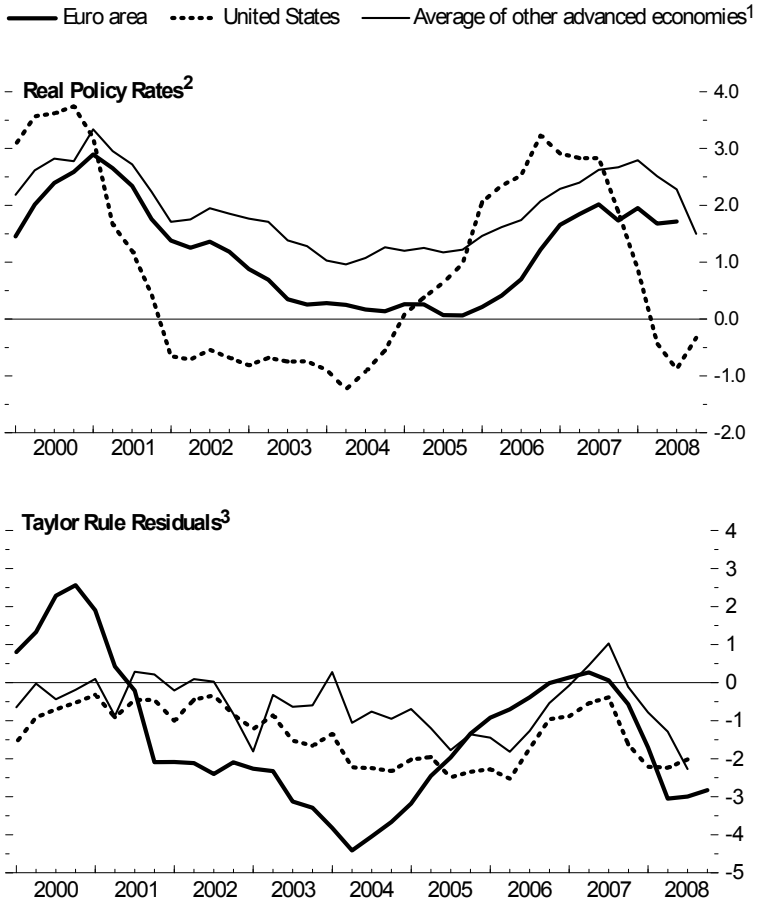


Sources: Bank for International Settlements; IMF, *International Financial Statistics;* Haver Analytics; Organization for Economic Cooperation and Development; and IMF staff calculations.

[1]See Figure 7 for country abbreviations.

[2]Ratio of liabilities to liquid assets (deposits and currency).

Figure 11. Monetary Conditions Leading up to the Current Crisis



Source: IMF staff calculations.

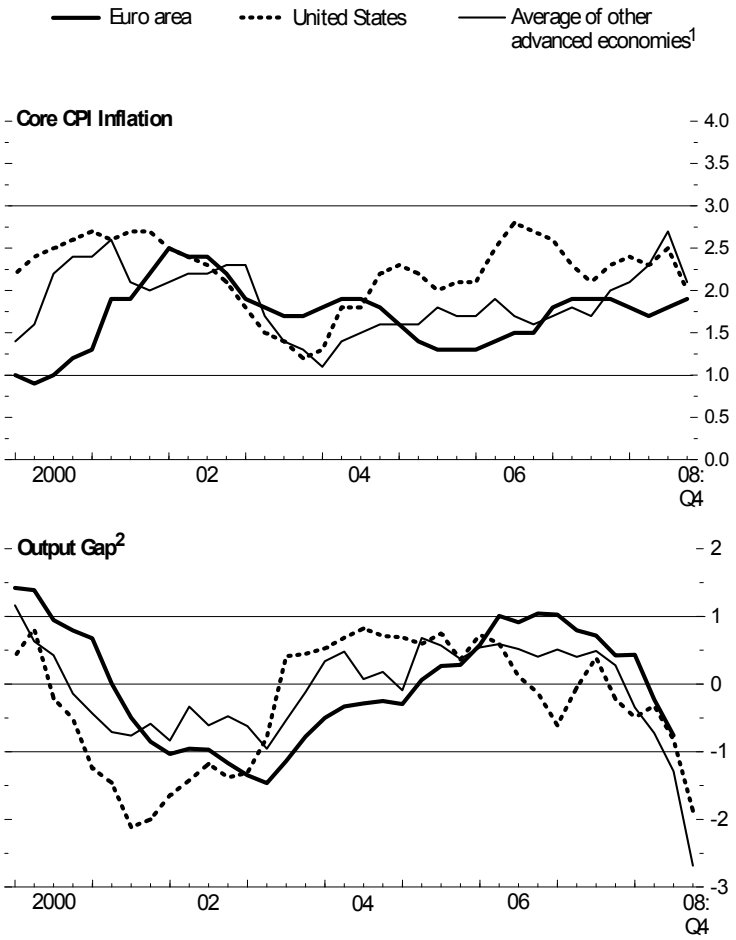
[1]Japan is omitted.

[2]Consensus one-year ahead inflation forecasts were used to define the real policy rates.

[3]Assumptions for the natural real rate of interest and inflation targets are those used in Ahrend et al. (2008).

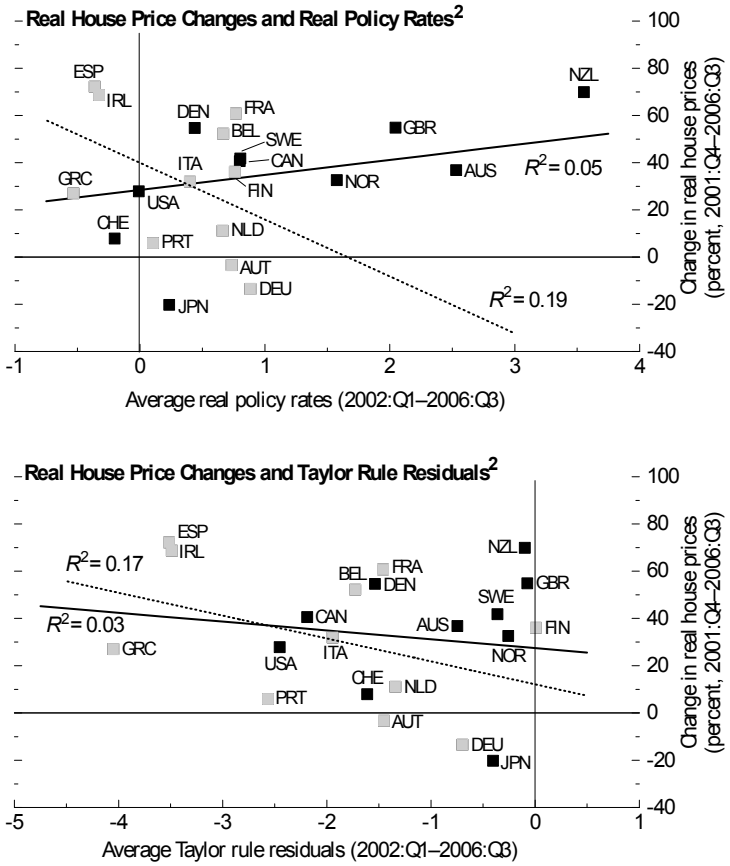
Figure 12. Inflation and Output for Advanced Economies in Recent Years

(Percent)



Sources: Haver Analytics; and IMF staff calculations.
[1]Japan omitted.
[2]Estimate of output gap using rolling Hodrick-Prescott filter.

Figure 13. House Prices and Monetary Conditions[1]

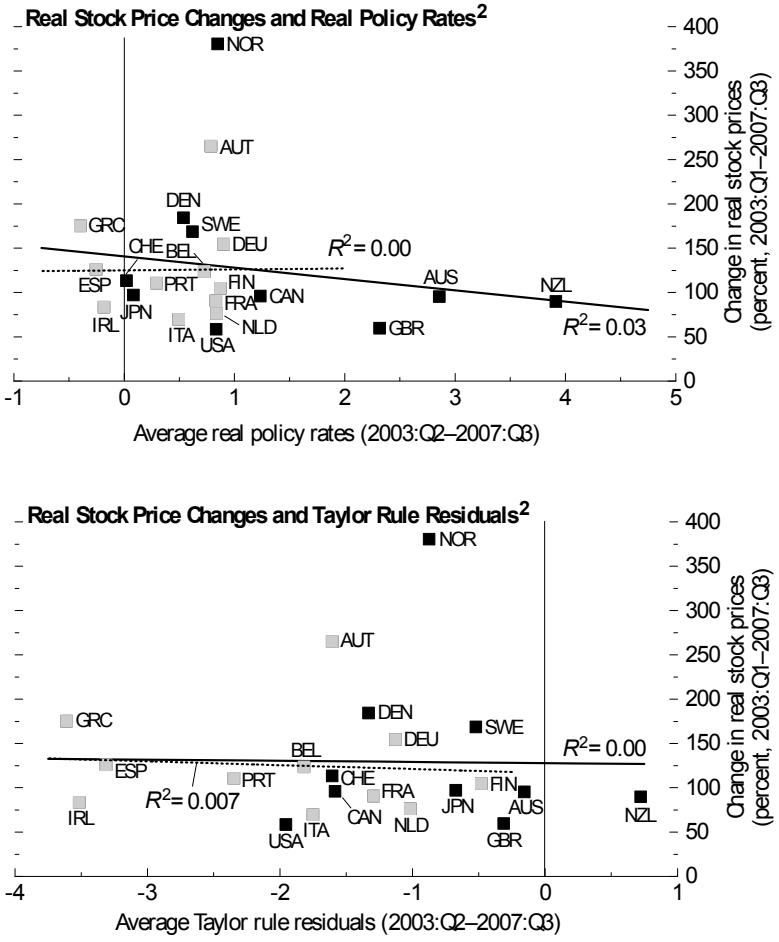


Sources: Bank for International Settlements; Bloomberg Financial Markets; Haver Analytics; national authorities; Organization for Economic Cooperation and Development; Thomson Datastream; and IMF staff calculations.

[1] See Figure 7 for country abbreviations.

[2] Euro area economies are designated by blue squares. Other advanced economies are designated by red squares. Blue lines are fitted to a subsample of euro area economies. Black lines are fitted to the whole sample of advanced economies.

Figure 14. Stock Prices and Monetary Conditions[1]

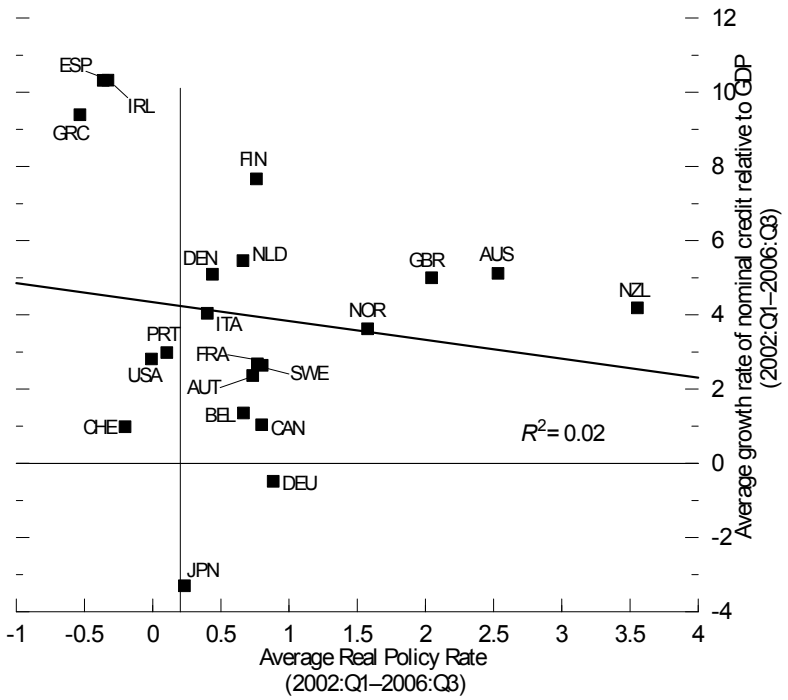


Sources: Bloomberg Financial Markets; IMF, *International Financial Statistics;* and IMF staff calculations.

[1] See Figure 7 for country abbreviations.

[2] Euro area economies are designated by blue squares. Other advanced economies are designated by red squares. Blue lines are fitted to a subsample of euro area economies. Black lines are fitted to the whole sample of advanced economies.

Figure 15. Growth Rate of Nominal Credit Relative to GDP and Real Policy Rates[1]

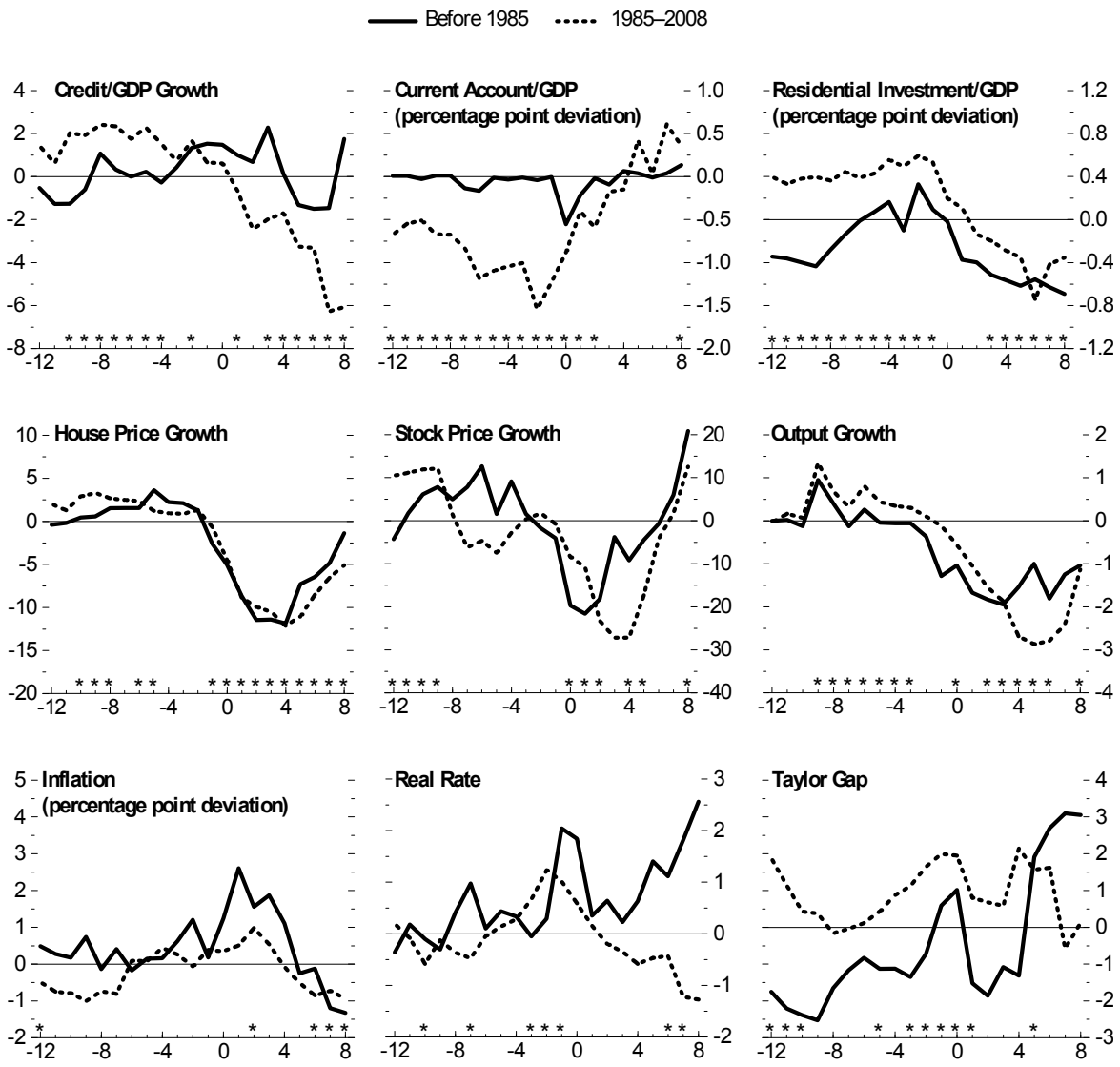


Sources: Bank for International Settlements; IMF, *International Financial Statistics;* Haver Analytics; Organization for Economic Cooperation and Development; and IMF staff calculations.

[1]See Figure 7 for country abbreviations.

Figure 16. Selected Macro Variables before and during House Price Busts

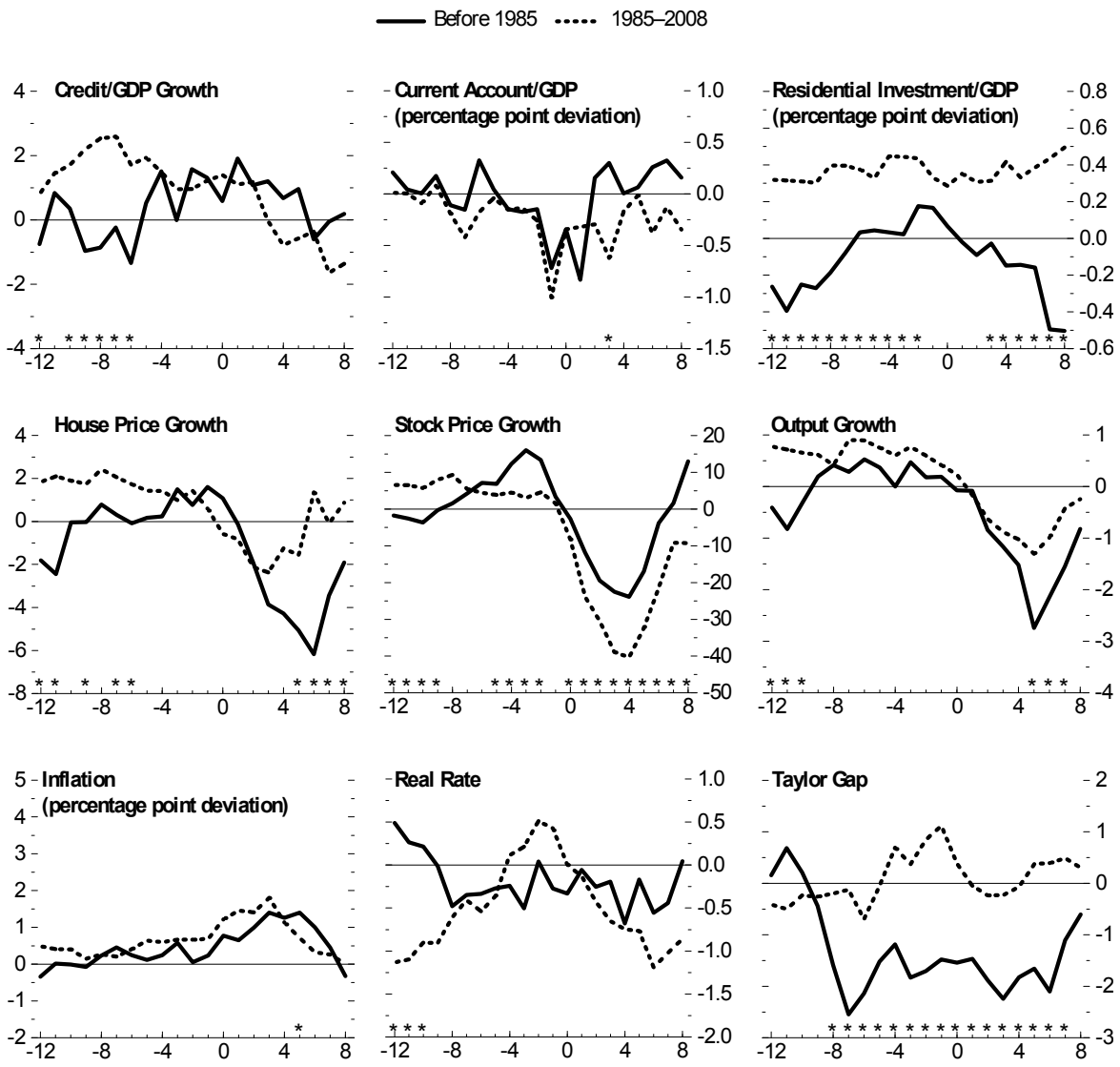
(Median percent deviation from a rolling Hodrick-Prescott filter, unless otherwise noted; asterisk indicates statistically significant difference of post-1985 deviation from zero; t *= 1 denotes first quarter of bust)*



Source: IMF staff calculations.

Figure 17. Selected Macroeconomic Variables before and during Stock Price Busts

(Median percent deviation from a rolling Hodrick-Prescott filter, unless otherwise noted; asterisk indicates statistically significant difference of post-1985 deviation from zero; t *= 1 denotes first quarter of bust)*



Source: IMF staff calculations.