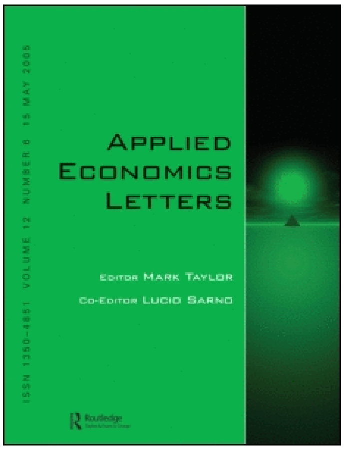

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Recurring patterns in the run-up to house price busts

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Recurring patterns in the run-up to house price busts

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We present evidence that shows that large increases in credit and residential investment shares, along with deteriorating current account balances, provide useful leading indicators of house price busts. These variables also explain cross-sectional patterns in the build-up to the 2007 crisis. Interestingly, movements in output and inflation have little ability to predict house price busts.

I. Introduction

Could we have predicted the 2007 global financial crisis? Although many aspects of the crisis were new and unanticipated, at the heart of the crisis was a familiar pattern of booms and busts in housing markets. In this article, we undertake a systematic examination of historical evidence to see whether there are consistent macroeconomic patterns that could be used as reliable leading indicators of house price busts. We find evidence that private sector credit, the share of residential investment in Gross Domestic Product (GDP), and current account deficits typically display larger-than-usual growth in the run-up to these episodes. Interestingly, these patterns are also observed in the build-up to the current crisis.

The focus on house price busts in this article is novel and marks a distinct contribution to the literature and policy discussions. The 'early warning' tools used in this article were initially popularized by Kaminsky *et al.* (1998) and Kaminsky and Reinhart (1999) in the context of currency and banking crises.[1] More recently, Borio and Lowe (2002) and Gerdesmeier *et al.* (2009) have presented empirical evidence that shows 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. The focus on house prices in this article leads to new and interesting results. In particular, we find a recurring pattern of deteriorating current account balances in the run-up to house price busts. Furthermore, we identify patterns in house price busts after 1985 that are different from those that occurred before 1985.

The article is structured as follows: Section II establishes stylized facts about booms and busts in house prices and looks for potential leading indicators of house price busts. The predictive power of candidate indicators is assessed in Section III. Section IV examines macroeconomic patterns leading up to the current crisis. Finally, conclusions are presented in Section V.

II. House Price Busts over the Past Four Decades

Our first task is to define house price busts. We use a simple methodology, similar to that used by Bordo and Jeanne (2002). Busts are defined as periods during which the four-quarter trailing moving average of the annual growth rate of house prices, in real terms, falls below a particular threshold. Specifically, a bust occurs when the following condition holds:

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

where g_t is the growth rate of the asset price in period t. In what follows, we set $x = -5\%$ as the relevant

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[1] See also Berg and Pattillo (1999).

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Table 1. Summary statistics of house price busts from 1970 to 2008

	Full sample	1970–1984	1985–2008
Total number of busts	47	22	25
Number of busts per country	2.76	1.29	1.47
Cumulative decline in prices (%)[a]	−17.71	−19.43	−15.58
Duration (quarters)	10.02	11.22	9.74
Cumulative decline in output (% relative to trend)[b]	−4.27	−5.41	−3.27

Notes: Values are mean values.
[a]Cumulative price decline is measured over the entire duration of the bust period.
[b]Cumulative decline in output is measured as the accumulated deviation for the first four quarters of a bust from a one-sided Hodrick–Prescott filter with a smoothness parameter of 1600.

threshold. This threshold is approximately equal to 1 SD below the average growth rate of house prices across all countries.[2]

Applying this procedure to a sample of 17 advanced economies identifies 47 house price busts from 1970 to 2008 (Table 1).[3] House price busts generally last for 2.5 years.[4] These episodes also entail substantial output costs – the cumulative decline in output below trend is 4.27% for the first year after the onset of a house price bust.[5] Figure 1 shows that house price busts for this set of advanced economies are relatively evenly distributed before and after 1985 – a year that broadly marks the beginning of the 'Great Moderation'.

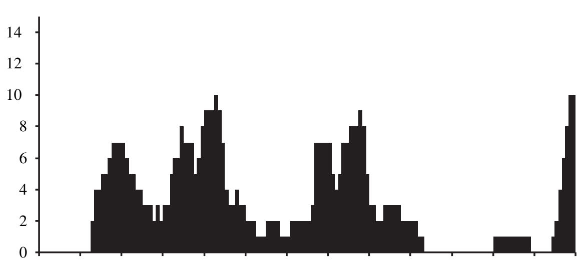

Fig. 1. House price busts in progress (number of countries)

Are there regular patterns in the behaviour of macroeconomic variables in the run-up to these events, which may help indicate the likelihood of a bust? Before exploring whether there are such patterns, we must first correct for slow-moving trends. Although our analysis focuses, to a large extent, on growth rates, there still exist 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 the 1990s than during the 1970s. 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-Second World War catch-up and population ageing. To correct for such slow-moving trends, we detrend the data using a rolling Hodrick–Prescott (HP) filter. The rolling HP filter – unlike centred moving averages including the more popular two-sided HP filter – does not require any information regarding future movements of the indicator variables. The smoothness parameter was set to 400 000, following Borio and Lowe (2004), to account for the slow-moving nature of these trends.

What patterns do we observe? Figure 2 shows the behaviour of six key macroeconomic variables around the onset of house price busts before 1985 and during 1985 and after.[6] Several interesting findings emerge from Fig. 2. Run-ups to house price busts post-1985 feature higher-than-normal growth rates of credit relative to GDP, larger-than-normal deteriorations in current account balances and higher-than-normal ratios of residential investment to GDP. House prices also grow faster than trend, although the difference does not vary significantly from 0 to 1 year before the busts. Output growth also displays a significant deviation from trend, although the magnitude of the deviation is fairly small. Finally, there is no systematic pattern associated with inflation, although the median is actually below its trend. The pictures are very different 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. At the same time, there are large deviations in inflation coinciding with the two oil crises.

[2] For our sample of countries, the average growth rate of house prices is 2.4%, with an SD of 8%.
[3] Subject to data limitations, the sample includes the following countries: Australia, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States. Data on real house prices were obtained from the Organization for Economic Cooperation and Development (OECD).
[4] 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 labelled as a bust, there is a minimum duration of 1 year for all busts.
[5] Trend output is measured using a one-sided HP filter with a smoothing coefficient of 1600.
[6] The data source for all variables, except credit, is the OECD Analytical Database. Data on domestic credit to the private sector were obtained from the IMF's International Financial Statistics.

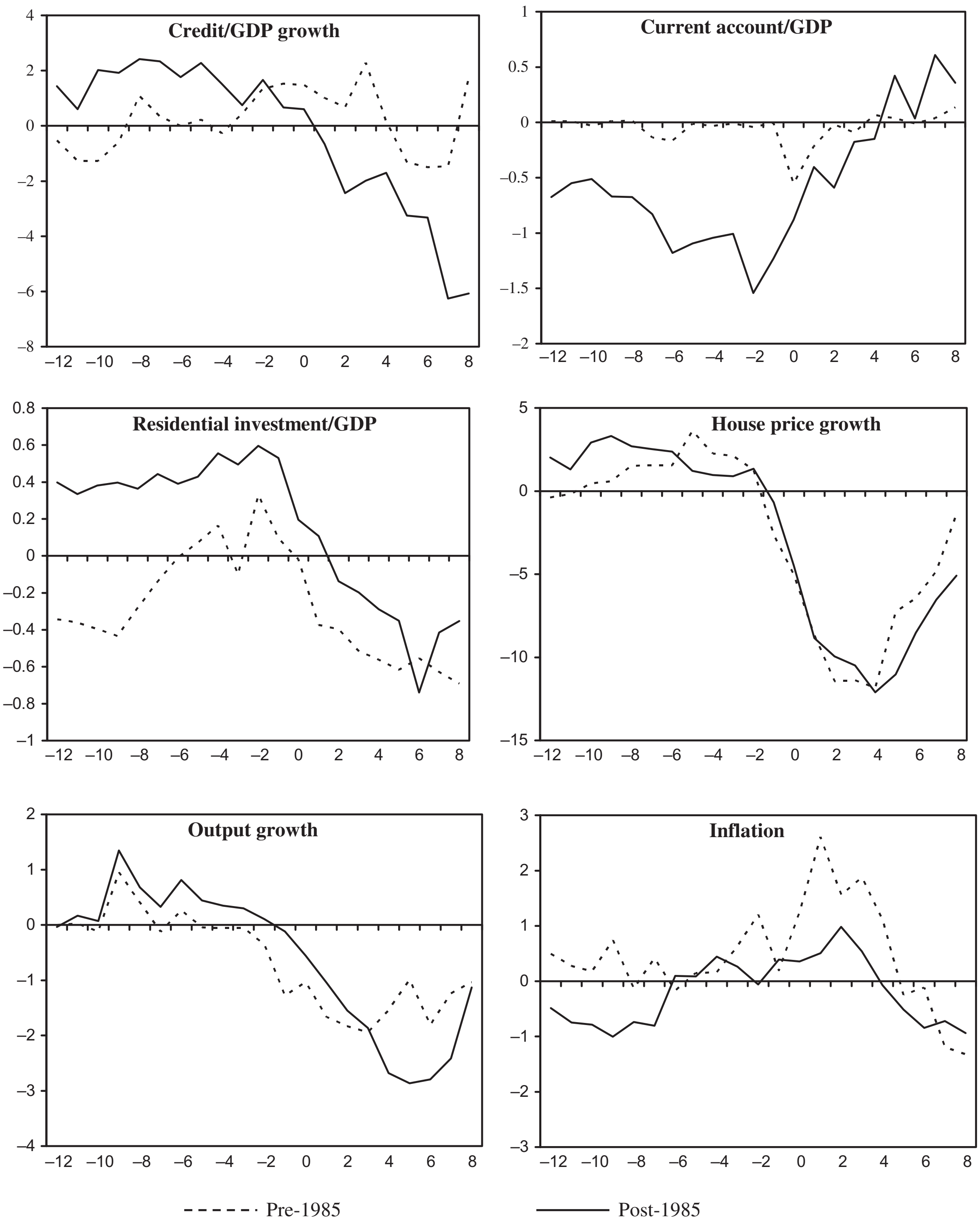

Fig. 2. Key macroeconomic variables around house price busts (median deviation from trend in per cent, 0 marks the start of the bust measured in quarters)

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

There are then some common patterns in the run-up to house price busts in the post-1985 period, 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 to gauge the risks of house price busts.

To assess the predictive ability of these variables, we use an approach featured in Kaminsky and Reinhart (1999). 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 rolling HP filter is again used. Each observation for a given variable can be classified into one of four categories, as shown in Table 2. When the deviation from trend exceeds a particular threshold, we say an 'alarm' has been raised, placing the observation in the first row of the matrix. 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.

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

These extreme movements may be strong signals of impending house 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 contrary, 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. In our analysis, we follow the literature and choose the threshold based on percentiles of the distribution of deviations such that the noise-to-signal ratio is minimized.[7]

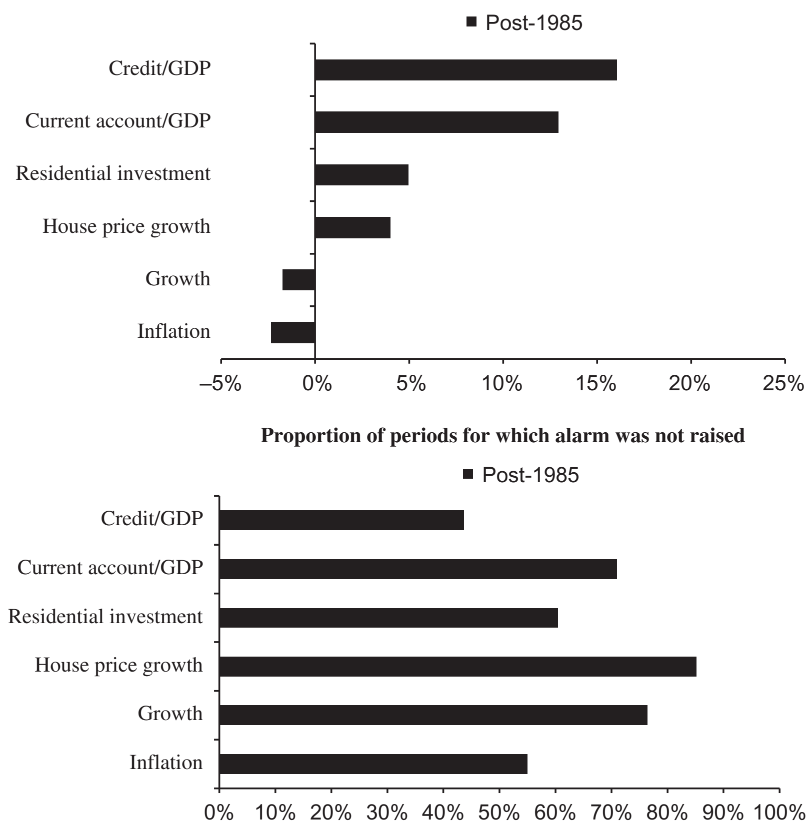

Fig. 3. The probability of an asset price bust (difference relative to the unconditional probability)

[7] The noise-to-signal ratio is typically defined as [B/(B + D)/A/(A + C)] (see Table 2 for the classifications). To avoid the influence of extreme observations, we limit our grid search to four percentiles: 70th, 75th, 80th and 90th. The percentiles for each indicator are 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.

Two statistics that can be derived from this approach are of particular interest. The first is a measure of the probability of a bust occurring within a particular time horizon conditional on an alarm being raised.[8] The second is a measure of the predictive ability of the variables, which essentially captures the proportion of periods during which a bust occurred in the future but for which no alarm was raised.[9] 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 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. Balancing these concerns, we chose a horizon that considers an alarm legitimate if it successfully predicts a bust within 3 years, with a minimum lead time of 1 year.

The top panel of Fig. 3 shows the difference between the conditional probability of a bust occurring 1–3 years after an alarm has been raised and the unconditional probability of a bust over the same horizon.[10] 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 twice the unconditional probability of a house price bust 1–3 years in the future. Interestingly, large deviations in output growth and inflation – the traditional focus of policy – have little ability to predict house price busts.

These results should be interpreted with caution. The most predictive thresholds for these variables may be those that result in identification of just a few observations that yield particularly reliable alarms. To complement the analysis, we look at the proportion of periods during which the indicators fail to raise an alarm 1–3 years ahead of a bust (Fig. 3, bottom panel). Large deviations in credit, residential investment and the current account raise alarms in advance of a bust only one-third to one-half of the time. The most reliable indicator is credit, which raises an alarm in 60% of all cases.

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 house 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

Table 3. Marginal probabilities based on probit regressions

	Full sample	Before 1985	1985–2008
Credit/GDP	0.48*** (3.74)	–0.21 (–0.40)	0.50*** (4.25)
Current account balance	–3.92*** (–7.17)	1.73 (1.40)	–4.67*** (–7.45)
Residential investment/GDP	–0.06 (–0.05)	4.47 (1.54)	4.10*** (2.63)
House price growth	0.54*** (2.93)	1.76*** (4.14)	0.10 (0.58)
Output growth	0.39 (0.71)	0.60 (0.62)	0.70 (1.28)
Inflation	0.86** (2.15)	3.10*** (4.47)	–0.56 (1.46)
N	1724	445	1264
Pseudo R^2	0.08	0.06	0.15

Notes: Dependent variable takes a value of 1 if there is a bust between 12 and 4 quarters ahead and 0 otherwise. Estimation is carried out using robust SEs. Z-statistics are reported in parentheses. Marginal probabilities computed at the mean values of other variables are reported. Variables are measured as deviations from a rolling HP filter.
***, ** and * denote significance at 1, 5 and 10% levels, respectively.

[8] In terms of the matrix presented in Table 2, this statistic can be computed as A divided by (A + B).
[9] In this case, the relevant statistic is C divided by (A + C).
[10] In the sample, the unconditional probability of a house price bust occurring 1–3 years in the future is 14% during the post-1985 period.

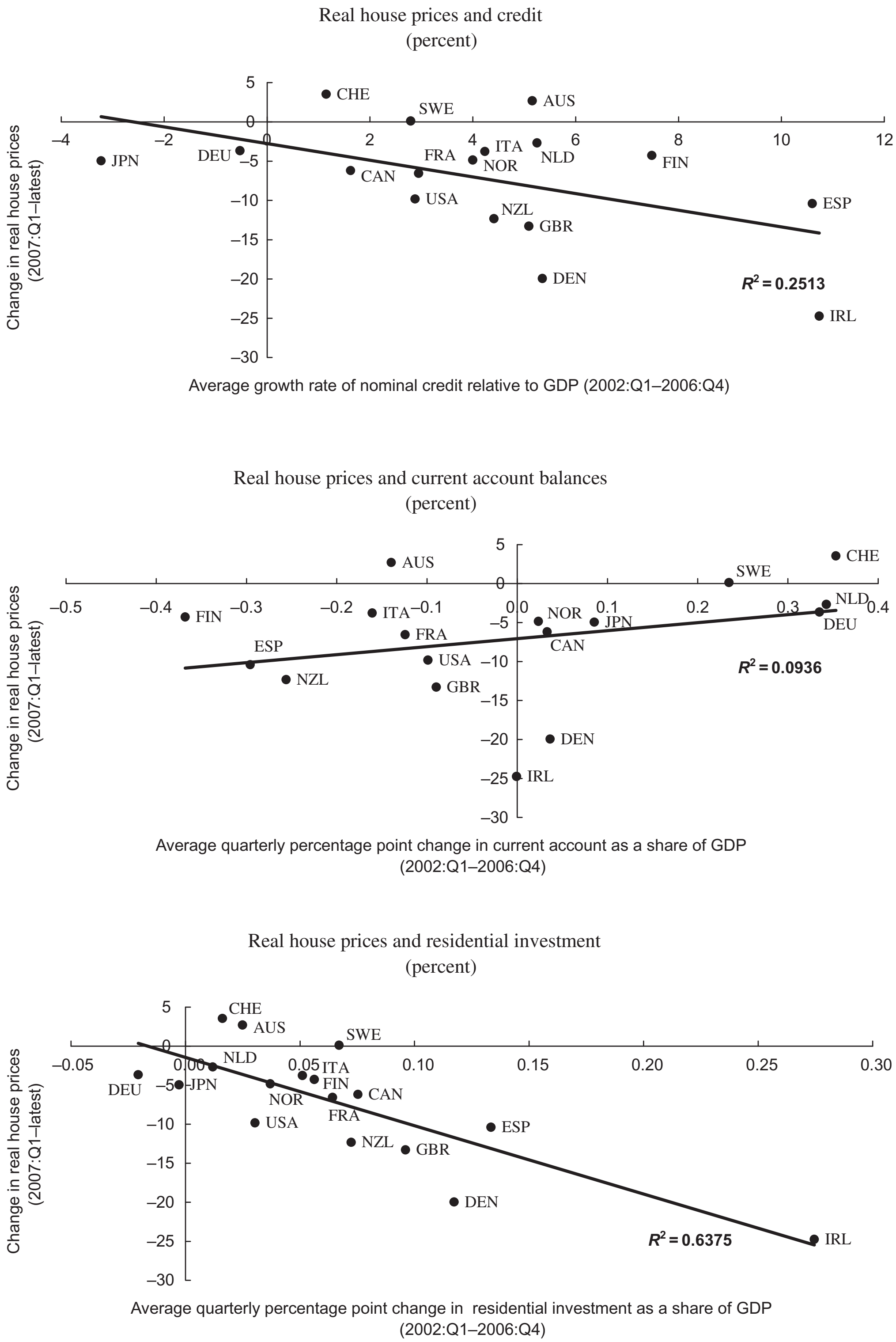

Fig. 4. Patterns in the run-up to the most recent house price bust

Notes: Country abbreviations are as follows: AUS = Australia, CAN = Canada, DEN = Denmark, FIN = Finland, FRA = France, DEU = Germany, IRL = Ireland, ITA = Italy, JPN = Japan, NLD = Netherlands, NZL = New Zealand, NOR = Norway, ESP = Spain, SWE = Sweden, CHE = Switzerland, GBR = United Kingdom and USA = United States.

particular indicators. To remedy these problems, the analysis is complemented with a probit model.[11] In the case of this exercise, the binary variable in question takes on a value of 1 if there is an asset price bust between 1 and 3 years in the future and 0 otherwise.

The results from the probit analysis are shown in Table 3.[12] For the post-1985 sample, a 10-percentage point increase in the credit-to-GDP ratio relative to its trend – the typical increase in the run-up to a house price bust – increases the probability of a house price bust occurring by 5%, which is roughly one-third higher than the unconditional probability. Current account balances, residential investment and house price growth are also significant predictors of house price busts. Consistent with earlier evidence, we find that output growth and inflation are not significantly associated with the likelihood of a house price bust in the post-1985 period.

IV. Macroeconomic Patterns Ahead of the Current Crisis

These findings naturally lead to the following question: Do the patterns associated with previous episodes of asset price busts show up ahead of the current crisis? To address this question, we examine whether the variation in our key macroeconomic indicators can explain the cross section of subsequent house price declines.

The scatterplots in Fig. 4 show some interesting patterns. Economies with the largest house price depreciations from 2007 onwards also had large expansions of credit relative to GDP, large increases in residential investment shares and large deteriorations in current account balances, with the fit being the poorest for current account balances.[13] At a macroeconomic level, therefore, the evidence suggests that the recent crisis displayed much the same pattern as previous house price busts, indicating that some part of it could have been foreseen.

V. Conclusions

We have found that house 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 house price busts. Our findings suggest that these variables should be part of any early warning exercise aimed at detecting impending asset price busts. These proximate causes, however, do not obviate the need for deeper analysis on the underlying source of these movements. We leave this for future research.

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

[12] Variables are measured as deviations relative to the rolling HP filter, as used earlier.

[13] The run-up period was chosen to be from 2002 to 2006, as it represented the period over which there was a uniform house price appreciation across all countries (with the exception of Germany and Japan, which have experienced secular declines).