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In 2009 all ECB publications feature a motif taken from the €200 banknote.

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CONTENTS

Abstract

This paper contributes to the literature on the properties of money and credit indicators for detecting asset price misalignments. After a review of the evidence in the literature on this issue, the paper discusses the approaches that can be considered to detect asset price busts. Considering a sample of 17 OECD industrialised countries and the euro area over the period 1969 Q1 – 2008 Q3, we construct an asset price composite indicator which incorporates developments in both the stock price and house price markets and propose a criterion to identify the periods characterised by asset price busts, which has been applied in the currency crisis literature. The empirical analysis is based on a pooled probit-type approach with several macroeconomic monetary, financial and real variables. According to statistical tests, credit aggregates (either in terms of annual changes or growth gap), changes in nominal long-term interest rates and investment-to-GDP ratio combined with either house prices or stock prices dynamics turn out to be the best indicators which help to forecast asset price busts up to 8 quarters ahead.

Keywords: Asset prices, house prices, stock prices, financial crisis, asset price busts, probit models, monetary aggregates, credit aggregates

JEL Classification: E37, E44, E51

Non-technical summary

During the past decades, asset markets have played an increasingly important role in many economies, and the large swings in asset prices have become a relevant issue for policy-makers, thus bringing new attention on the linkages between monetary policy and asset markets. Monetary policy has been cited as both a possible cause of asset price booms and a tool for defusing those booms before they can cause macroeconomic instability. Consequently, economists and policymakers have focused on how monetary policy might cause an asset price boom or turn a boom caused by real phenomena, such as an increase in aggregate productivity growth, into a "bubble", which may burst unexpectedly rendering damage to the economy.

Generally speaking, it is important to note that, while on the one hand central banks need to understand the underlying sources (fundamental versus non-fundamental) of asset price changes in order to calibrate their policy response, on the other hand, at a practical level, it is recognised that distinguishing the nature of the sources of asset price movements in real time is an extremely difficult task, as estimates of the equilibrium value of asset prices are usually surrounded by a high degree of uncertainty.

This notwithstanding, for central banks it is important to have early indicators to assess the possible implications of large asset price movements and the building up of financial imbalances in the economy. In this respect, several studies have shown that the analysis of monetary and credit developments may be very useful in this respect (see, for instance, Adalid and Detken, 2007; Borio and Lowe, 2002 and 2004; Issing, 2002; Machado and Sousa, 2006; Detken and Smets, 2004). This paper contributes to this literature for investigating whether money and credit indicators can play an important role in detecting asset price misalignments, by focusing on the evidence stemming from a sample of 17 OECD industrialised countries and the euro area over the period 1969 Q1 – 2008 Q3. As a matter of fact, as high money/credit growth are associated with an asset price boom in the near future (say up to four quarters ahead), consequently it can be expected that high money/credit growth rates can be thought to be connected to the following asset price bust that occurs eight or more quarters later in the future.

After providing a critical review on the current evidence in the literature on this issue, the paper discusses possible approaches that can be considered to detect asset price busts. The analysis focuses on illustrating a new method for the construction of an asset price composite indicator which incorporates developments in both the stock price and house price markets. This method is borrowed from the literature on currency crises and, to our best knowledge, applied for the first time to asset prices. Furthermore, we propose a criterion to be used to select the periods characterised by asset price busts, based on a combination of the methodologies developed by Berg and Pattillo (1999) and Andreou et al. (2007) which again are commonly applied in the context of the currency crises literature based on the paper by Kaminsky et al. (1998). According to the results, the asset price busts detected on the basis of this criterion vary from a number of two to nine, are in parts common to almost all countries (such as in early 80s), while at the current end 13 out of 16 countries experienced a bust in the second half of 2008. The length of the busts also varies across the countries, lasting either two quarters or more than one year. An empirical analysis is also carried out based on a pooled probit-type approach, which considers several macroeconomic variables, belonging to the monetary, financial, real and prices categories.

According to statistical tests, credit aggregates (either in terms of annual changes or growth gap), changes in nominal long-term interest rates and the investment-to-GDP ratio combined with developments in either house prices or stock prices turn out to be the best indicators which help to forecast asset price busts up to 8 quarters ahead.

Overall, while differing with respect to the precise quantification and identification of asset price booms and busts, the results of this paper based on this new approach are in line with the theoretical findings and a number of studies in the literature, and confirm that it is useful to look at monetary and credit developments as early indicators of the building up of financial imbalances.

1 Introduction

During the past decades, asset markets have played an increasingly important role in many economies, and fluctuations in asset prices have become a relevant issue for policy-makers. As a matter of fact, at least since the Great Depression in the 1930s, economists and policy-makers have become aware of the potentially damaging effects of large fluctuations in asset prices, such as equity and property prices. At the same time, it remains a well-established fact that asset prices are often subject to sizeable changes and, sometimes, significant corrections. The experiences in the 1970s and in the 1990s in Japan and other countries have confirmed that, in some circumstances, boom and bust cycles in asset prices can be very damaging as they may lead to financial and ultimately to macroeconomic instability.

Against this background, movements in exchange rates, equity values and prices for real assets ─ such as housing and real estate ─ have been also in the focus of interest of central banks. On the one hand, it is clearly important for central banks to be able to understand the underlying sources of asset price changes in order to calibrate their policy response. This also implies the possibility of distinguishing whether asset price changes are driven by changes in current and expected future "fundamentals" (e.g. an improved productivity which would justify an increase in equity prices) or by deviations from those fundamentals (e.g. over-optimistic expectations of future earnings).[1] The latter case is often referred to as "asset price bubbles", whose subsequent bursts can be destabilising for the financial system and the real economy. On the other hand, at a more practical level, it is also recognised that distinguishing fundamentals from non-fundamental sources of asset price movements in real time is an extremely difficult task, as estimates of the equilibrium value of asset prices are usually surrounded by a high degree of uncertainty.

This notwithstanding, for central banks it is important to have early indicators to assess the possible implications of large asset price movements and the building up of financial imbalances in the economy. In this respect, several recent studies have shown that the analysis of monetary and credit developments may be very useful. As was already pointed out long ago by pioneering studies on the topic, historically, boom and bust cycles in asset markets have been strongly associated with large movements in monetary and credit aggregates.[2]

There are, in fact, several reasons why monetary and asset price developments tend to be positively correlated. One reason is that both sets of variables may react in the same direction to monetary policy or cyclical shocks to the economy. For example, strong money and credit growth may be indicative of a too lax monetary policy which leads to the creation of excessive liquidity in the

[1] For a discussion, see ECB (2002).
[2] For a detailed survey of the theoretical approaches linking liquidity and asset price developments, see Adalid and Detken (2007).

economy and fuels excessive price changes in the asset markets.[3] Moreover, there can be self-reinforcing mechanisms at work. For example, during asset price booms the balance sheet positions of the financial and non-financial sectors improve and the value of collateral increases, permitting a further extension of the banking credit for investment which may reinforce the increase in asset prices. The opposite mechanism can sometimes be observed during asset price downward adjustments. Overall, given that high money/credit growth is associated with an asset price boom in the near future (say up to four quarters ahead), consequently it can be expected that high money/credit growth rates are also connected to the following asset price bust that occurs eight or more quarters later in the future.

This paper contributes to the literature on the properties of money and credit indicators for detecting asset price misalignments, in so far as it presents a new approach to construct a "composite" asset price indicator which takes into account developments in both stock and house prices and a new method to detect asset price busts. It is structured as follows. Section 2 briefly summarizes the available evidence on the indicator properties of money and credit for detecting asset price developments and financial imbalances, with a focus on the most recent contributions. Section 3 briefly describes the data used for the empirical analysis. Section 5 describes the procedure to define a criterion for detecting a bust. We then present some results based on a probit-type approach, using the pooled estimation procedure. Section 6 draws some conclusions. A detailed description of the series used in the analysis is contained in Annex 3 at the end of the paper.

2 Literature review on money, credit, asset price developments and asset price busts

As mentioned above, the idea that money and credit could be important for the analysis of asset price developments is not new. Already in 1932, Fisher (1932) had investigated the reasons for various booms and depressions, emphasising, among other things, the role of the debt structure and, in particular, the debt contracted to leverage the acquisition of speculative assets for subsequent resale as possible sources of financial instabilities. Moreover, he stressed the role of monetary factors by pointing to the fact that, basically, in all cases, real interest rates had been too low and thus monetary factors had been "fuelling the flames".

Forty years later, Kindleberger (1978) provided a comprehensive history of financial crises, stretching back to before the South Sea bubble (1717-1720), to illustrate common threads that may have linked these different periods of turbulence over the centuries in almost all corners of the financial

[3] In this respect, as pointed out by Nelson (2003), money demand can be thought of as a function of a broad set of yields, besides those observed in securities markets, most of which are of crucial importance for the transmission mechanism. Hence, movements in monetary aggregates can convey information on the stance of monetary policy which the central bank would not otherwise be able to extract from alternative indicators. Therefore, particularly in periods of financial turbulence, monetary quantities might have a powerful role to play as indicators of the actual stance of monetary policy with respect to other measures, such as the simple and widely-used benchmark of the Taylor rules.

world. His work is illustrative of the idea that historically booms and bursts in asset markets had been strongly associated with large movements in monetary and, especially, credit aggregates.

The view that credit developments may contain useful indications in times of sharp asset price fluctuations was further explored by Borio, Kennedy and Prowse (1994). They constructed an aggregate asset price index for several industrialised countries (combining together residential property, commercial property and share prices) and investigated the factors (*inter alia* credit and money) behind the observed movements in the index over the 1970s and 1980s. They find that the ratio of total private credit to nominal GDP contains useful incremental information to predict movements in the real asset price index, in addition to more standard determinants such as real profits, nominal GDP growth and the long-term nominal interest rates.[4] These results were consistent with the authors' view that the relaxation of credit constraints (in the wake of financial liberalization) had played a significant role in facilitating the observed ample movements in the aggregate price index during the 1980s.

More recently, various authors have analyzed past episodes of asset price booms and busts which apparently involved substantial, if unintentional, monetary policy mistakes.[5] The evidence is suggestive of the effect that monetary aggregates would have provided useful information on the appropriate monetary policy stance, over and above standard benchmarks such as those provided, for example, by simple Taylor rules.[6] With specific reference to the euro area, looking at the linkages between monetary and credit aggregates and asset price imbalances in the three episodes of stock market instability that have characterized the euro area since the 1980s (i.e. 1986-1987, 1993-1994 and 1996-2001)[7], the evidence is suggestive of a significant positive link between credit and asset price developments. At the same time, the correlation with monetary aggregates is weaker, even when structural measures of monetary developments ─ as the monetary overhangs derived from money demand models ─ are employed.

Along the above lines, a recent strand of the literature has investigated in a systematic manner episodes of asset price misalignments and/or financial crises with the aim to derive common stylized facts across the different episodes and, more specifically, to identify possible early indicators that could provide warning signals to policy-makers. Borio and Lowe (2002) conducted a comprehensive analysis of the performance of various indicators in predicting episodes of financial crises in some industrial and emerging countries since the 1960s.[8] Specifically, they focused on asset prices, investment and credit as leading indicators for financial distress.[9] For each of these indicators the authors define a

4 However, the incremental explanatory power of the (broad) money stock (also as a ratio to GDP) is generally found to be negligible in their work.

5 See, among others, McCallum (1999), Meltzer (2000) and Issing (2002).

6 See, for instance, Bordo and Filardo (2004) and Christiano, Motto and Rostagno (2003).

7 The three episodes are characterised by a price-earnings ratio of at least 15 or above.

8 More precisely, 34 countries are analysed – including all G10 – which are selected on the basis of the credit-to-GDP ratio (which had to be in excess of 35% at some point between 1960 and 1999), GDP per capita in 1995 (which had to be higher than $4,000 at PPP exchange rates) and total GDP in 1995 (which had to larger than $20 billion). The authors base their analysis on annual data over the period 1960 to 1999.

9 The paper also investigates the relationship between financial stability and monetary policy.

threshold value that, when exceeded, would signal an impeding financial crisis. In particular they construct: (a) a *credit gap*, which identifies a credit boom as a period in which the ratio of (private sector) credit to GDP[10] deviates from its trend by a specified amount; (b) an *asset price gap*, which manifests itself when real asset prices − i.e. equity prices deflated by consumer prices − deviate from their trend by a specified amount, and (c) an *investment gap* which, similarly, is defined by a deviation from trend of the developments in the ratio of investment to GDP.[11] The gap measures are calculated as percentage deviations from a trend which is estimated using a 'rolling' Hodrick-Prescott filter. Since imbalances generally build up over an extended time period, the focus of the gap measures is on the cumulative deviation from the estimated trend. The three indicators are assessed in isolation and in combination for their usefulness in predicting the timing of a financial crisis within one, two or three years.[12] The performance of the indicators is assessed in terms of noise-to-signal ratios, i.e. the ratio of size of Type II errors (i.e. the percentage of non-crisis periods in which a crisis is incorrectly signaled) to one minus the size of Type I errors (i.e. the percentage of crises that are not correctly predicted). This procedure is denoted in the literature as a "signalling" approach. As for the results, the credit gap is the best financial crisis indicator, with a threshold value of around 4% allowing for the prediction of about 80% of the crisis at a one-year horizon. Furthermore, cumulative processes over several years are better indicators than just one-year developments. In addition, the asset price and the investment gaps provide relatively noisy signals at a one-year horizon. For the asset price gap, a threshold value of 40% or 50% appears to produce the best results. For the investment gap the threshold value should not be set above 4% or 5%. The performance of the indicators improves considerably when the time horizon of forecasting is extended, especially for the asset price and credit gaps. For example, if the horizon is extended from one year to three years and a 4% threshold is used for the credit gap, the number of false positive signals falls by around 20%. For the asset price gap, the reduction is even larger and the share of crisis predicted also increases as the horizon is lengthened. Finally, and more importantly, the combination of a credit gap of around 4% and an asset price gap of 40% gives the best combined threshold values. As the horizon is extended, the noise-to-signal ratio falls considerably, i.e. the indicator becomes more reliable.[13]

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10 For each country, they use the broadest definition of credit to the private sector for which historical series are available.

11 The authors also consider an additional indicator represented by the real credit growth which, however, yields worse results than the credit gap.

12 However, for the asset price indicator a lead of two years is used (i.e. when measuring whether the asset price gap exceeds a particular threshold, the authors use the level of equity price gap two years earlier).

13 At one year horizon, the number of false positive signals falls by almost 75% when asset prices are added to credit, and at three-year horizon they fall by 80%.

An extension of this analysis[14] is contained in Borio and Lowe (2004), where the set of indicators is extended to include also a money gap and the output gap indicators and their performance is tested also with reference to episodes of weak output developments and deflation.[15] The rationale is that episodes of financial distress tend to go together with economic weakness and to reinforce it, and economic weakness tends to exert deflationary pressures. The *money gap* is calculated using the ratio of money to GDP, where money is represented by historical series for a broad monetary aggregate – roughly equivalent to M2 or M3 – while the output gap is calculated as the deviation of GDP from its trend.

As regards the prediction of episodes of financial crises, the results of the authors' previous study are broadly confirmed. Over a three-year horizon, the credit gap (with a threshold of 4%) is the best indicator, predicting 80% of the crises, and clearly outperforms the equity price gap (with a threshold of 60%). The output gap is clearly inferior to either the equity gap or the credit gap, while the money gap is the least helpful indicator (it has the highest noise to signal ratio and the lowest percentage of crisis predicted). Generally, with the only exception of the credit gap, all the indicators taken individually tend to perform better as the horizon is extended. The performance of composite proxies of financial imbalances turns out to be superior to that of individual indicators. The best proxy for a financial imbalance is the combination of the credit gap of 4% with an equity price gap of 60%.[16]

With regard to output predictions, the composite credit-cum-equity gap indicator does well and is far superior to either of the two taken in isolation. The probability of observing an economic slack when the threshold values are reached rises from almost 40% in the second year ahead to 66% and 75% respectively in the third and fourth year ahead. The performance of money is inferior to that of credit and it improves when combined with the equity gap. As regards predicting deflation events, the preferred credit-cum-equity gap indicator contains information which is additional to the output gap. While an output gap in excess of 2% tends to be followed by a decline in inflation over three-fours years ahead, the credit and equity price gaps or both combined tend to reduce the probability of observing a decline in inflation over two years but to increase it thereafter, thus suggesting some upward pressure on inflation which is then reversed, as imbalances unwind. Finally, combining the financial indicators with the output gap improves the performance considerably, as it raises the probability of a price decline to over 90% in the fourth year ahead. The money gap in excess of 2%

14 From the technical point of view, this analysis also differs with respect to the previously illustrated in the following: (a) the authors consider quarterly frequencies − instead of annual frequencies − of the data to make the analysis better suited for policy; (b) prediction of episodes of crises between three and five years ahead are now considered, while forecasts of output weakness and deflation events are done over two, three and four years ahead; (c) attention is limited to industrial countries which exhibit a more homogeneous set of data.

15 Output events to be predicted are defined as output gaps below minus 1%, while deflation events are defined as an average year-on-year decline.

16 Over a four- or five-year horizon, this composite indicator predicts almost 75% of the crises. The results do not turn out to be very sensitive to varying the credit gap threshold between 3% and 5% and the equity price threshold between 40% and 60%.

helps to predict price declines at three-year horizons or beyond only when combined with the output gap or the equity gap.[17]

Helbling and Terrones (2003) review the experience with equity and property prices boom/bust episodes in industrial countries in the post-war period, seeking to draw out common patterns in macroeconomic and financial developments.[18] By fixing as the starting point the quarter after which a bust begins, they analyze the behaviour of several macroeconomic and financial variables in the 3-year periods before and after the event. As for monetary variables, they find that in the period before the bust (characterized by the phase of asset price inflation) private credit growth expanded in the case of both stock market and housing prices booms. In the latter case the increase is even more evident. Regarding broad monetary aggregates, the behaviour is similar to that of private credit with the only difference that it sends stronger signals for equity than for housing prices. After the bust, credit growth declines, reflecting both lower demand owing to lower investment but also reduced supply on account of the financial accelerator and other supply-side mechanisms. Also the behaviour of broad monetary aggregates shows the same dynamics. While before the bust there is not a clear path in short-term interest rates, they typically fall after the bust of equity prices, which is consistent with the ensuing decline in output growth and monetary easing. In the case of housing price crashes, short-term real interest rates clearly increase prior to the event and remain about constant thereafter, which is consistent with the notion that busts often reflect monetary policy tightening.[19]

Finally, Detken and Smets (2004) provide a comprehensive study aimed at deriving some stylised facts for financial, real and monetary policy developments during asset price booms. Using the same dataset as in Borio and Lowe (2002), they define an asset price boom as a period in which the aggregate asset price index is continuously more than 10% above its trend, calculated recursively using a one-sided Hodrick-Prescott (HP) filter. With this method, they identify 38 aggregate asset price

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17 The importance of credit as an indicator of the incidence of financial crises is also underlined in Tornell, Westermann and Martinez (2003), who analyse the effects of trade and financial liberalization – which may ultimately lead to lending booms and occasional crises – by looking at the experience of Mexico and other developing countries. In particular, the authors find that negative skewness of real credit growth appears to be a good indicator of the incidence of occasional crises, which turns out to be a common feature in fast-growing countries with a medium level of contract enforceability. This measure of fragility indicates that a country that experiences a boom-bust cycle (that typically follows financial liberalization) exhibits rapid credit growth during the boom, a sharp and abrupt fall during the crisis and a slow credit growth during the credit crunch that develops in the wake of the crisis.

18 The authors first identify peaks and troughs in assets prices and then define a bust as a peak-to-trough decline for which the price change is in the top quartile of all declines during bear markets. 52 equity prices busts from 1959 Q1 to 2002 Q3 in 19 countries are identified. The average contraction is a decline of above 37% (from peak to through), and the average duration is 10 quarters. As for housing prices, to be qualified as a bust the contraction has to exceed a decline of 14%. Over the period 1970 Q1-2002 Q3 they identify 20 housing prices crashes in 14 countries. The average contraction is 27%, while the average duration is 16 quarters. The association between booms and busts is stronger for housing than for equity prices.

19 In terms of the quantification of the costs of asset price busts, the analysis shows that housing prices busts are associated with substantial output losses, which are twice as large as those recorded in equity crashes. In the case of asset prices, the decline in output is delayed to three quarters after the busts, but is shorter than in the case of housing busts.

booms in 18 countries over the last three decades. They focus on pre-boom and post-boom periods of two years each and look at a number of real and financial variables in order to depict the general macroeconomic dynamics. All variables taken into account are reported in real growth rates and as percentage deviations from an ex-post trend (again computed using a HP filter).

A first finding of the work is that monetary policy is looser on average by 2 percentage points over the whole boom period with respect to a benchmark derived from a Taylor rule. This behaviour is also confirmed by money and credit aggregates developments around asset price booms. Real credit and real money growth are quite strong before and even more during the boom, while declining strongly after the boom. Overall, given that high money/credit growth is associated with an asset price boom in the near future (say up to four quarters ahead), consequentially it can be expected that high money/credit growth rates are also related to the following asset price bust that occurs eight or more quarters later in the future.

In addition, starting from the observation that not all booms lead to large output losses, the authors proceed by defining high-cost and low-cost asset price booms, depending on the relative post-boom growth performance.[20] Their analysis suggests that the most striking differences in the two kinds of episodes can be found in macroeconomic developments in the post-boom periods (in particular high-cost booms usually entail huge drops in real estate prices and investment crashes in the post-boom periods). However, there are fewer differences during boom and pre-boom periods. During high-cost boom periods real estate prices rise stronger, real credit and monetary growth is larger and, in particular, the difference is significant in the first boom year. In addition, monetary policy appears to be looser than supported by standard Taylor rules, particularly towards the end of the boom periods. Differences in economic developments between high-cost and low-cost booms during the pre-boom periods, which would be most useful to identify at an early stage high-cost booms from a policy maker's perspective, are unfortunately even less significant. The result which appears to be more robust is that real money growth is significantly higher for the high-cost booms during the pre boom period. Overall, therefore the findings are suggestive of the effect that money and credit growth could be useful to distinguish high- from low-cost booms at a relatively early stage.

Most recently, Machado and Sousa (2006) propose to identify asset price booms and bust using quantile regressions. In line with the approach of Detken and Smets (2004), they estimate the trend movement of the real stock prices by a recursive HP filter. In extension to Detken and Smets' proposal, in Machado and Sousa the distribution of real stock prices is defined as a function of fundamental determinants like the real economic activity and the real interest rates. Since the estimation algorithm needs smooth data, the authors use the HP filter to calculate the trend development of real activity and real interest rates. The authors define a boom (bust) phase a period in which the actual index values are

[20] They define as high cost booms those booms that were followed by a drop of more than 3 percentage points in the average real growth (comparing the three years following the boom with the average growth during the boom) as long as the average post-boom growth is below 2.5%.

higher than the 90% (lower than the 10%) quantile. Their results are characterized by three boom and three bust phases for the EMU stock price index, with the swings of the stock prices implying wide quantiles. As an extension with respect to other studies, they relate the booms and busts not only to growth rates of money and credit aggregates but also to money overhangs. They conclude that the link between real money growth and asset price booms seems to be weak. By contrast, asset price booms occur if credit growth is high. Periods of asset price busts seem to lead to higher liquidity in terms of money holding.

Adalid and Detken (2007) focus – along the lines of Detken and Smets (2004) – on asset price booms. The latter are identified as being the consecutive periods with a minimum of 4 quarters in which the real aggregate price index exceeds its trend by at least 10%. The authors divide their booms periods (42 in total) into low cost in terms of post-boom real GDP growth (i.e. benign booms) and high cost booms (i.e. serious) episodes.[21] Their selection depends on the difference between the average real GDP growth in three boom years and the average real GDP growth in the three post boom years. If the difference is more than 2.4%, then the boom will be denoted as a high cost boom.[22]

Residential property prices developments and money growth shocks accumulated over the boom periods turn out to be able to well explain the depth of post-boom recessions. This stresses the major importance of housing prices boom-bust cycles and money growth for the real economy.[23] Besides, liquidity shocks[24] turn out to be driving factors for real estate prices during boom episodes. Also focusing on the housing market, Goodhart and Hofmann (2008) define a house price boom as a positive deviation of real house prices from a smooth trend of more than 5% lasting at least 12 quarters. As regards the link of house price developments and monetary variables, they find evidence of a significant multidirectional link between house prices, monetary variables and the macroeconomy, while the effects of shocks to money and credit are stronger when house prices are booming.

Finally, the most recent paper by Alessi and Detken (2009) tests the performance of a variety of real and financial variables as early warning indicators for high-cost boom/bust cycles, using data for 18 OECD countries between 1970 and 2007. Given the fact that the usefulness of the results may crucially hinge on the relative preferences of policy-makers vis-à-vis their willingness to accept missed crises and false alarms, the authors further proceed by investigating the outcome against the background of a loss function, which aims at mirroring the relative preferences of the policy-makers. In

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21 The trend is estimated using a very slow adjusting HP-filter that is estimate recursively. On a general basis, their method to identify boom periods is a refined version of the one suggested in Detken and Smets (2004), but of the use of quarterly instead of annual data.

22 A similar approach is also used by the IMF (2008) and, in some respects, also by Borio and Lowe (2004) who focus their attention on *ex post* periods characterised by either decreasing output or deflationary episodes.

23 The study shows that real broad money growth seems to be a better indicator than real private credit growth to determine whether the current asset price boom will be followed by a period of low real growth.

24 The derivation by the authors of the liquidity shocks is based on a VAR estimation with variables in growth rates, which allows clean broad money and private credit from endogenous developments due to business or asset price cycles.

a subsequent step, the authors analyse the relative performance of the indicators along various dimensions, i.e. the test for the value added of financial versus real indicators, global versus domestic and money- versus credit-based liquidity indicators. The authors find global measures of liquidity to be among the best performing indicators.

To sum up, the review of the available evidence, the following common findings seem worth noting from the monetary policy perspective. First of all, all studies confirm that the identification and quantification of asset price and/or financial imbalances represents an extremely difficult task, in particular from an *ex ante* point of view. Even from an *ex post* perspective, several criteria can be used – differing, for instance, across the choice of the asset price indicators used, the definition of the boom/bust in terms of size and duration or, for the booms, for the definition of high and low cost –, and all involve a high degree of arbitrariness. This also explains some differences in the findings across various studies.

As regards the question of useful leading indicators of financial imbalances, the studies confirm that – among other variables - monetary and credit developments are an important element to take into account. In particular, one robust finding across the different studies is that measures of excessive credit creation are very good leading indicators of the building up of financial imbalances in the economy. Moreover, excessive money creation is also singled out by some studies, but the evidence is more mixed in this regard, possibly because substitution effects between money and asset prices can be sometimes substantial, particularly at times of high financial turbulence and uncertainty. However, high real money growth appears to be a useful indicator for detecting at a very early stage (i.e. prior to the boom-bust event) the possible building up of asset price misalignments, leading to financial distress and costly adjustments in the economy. The observation that credit and money may be associated with asset price bubbles is often linked to the observation of very low interest rates. Indeed, short-term interest rates appear in some cases to be relatively low as compared with standard benchmark measures such as Taylor rules, particularly towards the end of periods of asset price booms ending up in high-cost downward corrections. Overall, the studies point to the fact that monetary conditions are generally too loose in the pre-crisis periods. They also suggest that monetary and credit aggregates may contain useful additional information on the actual stance of monetary policy, over and above that contained in short-term interest rates.

At the same time, the evidence presented suggests that the analysis of monetary conditions needs to be complemented by a broader analysis of financial conditions in the economy. In particular, it is important to monitor standard indicators of asset price misalignments. In this respect, indicators of misalignments in real estate prices may be particularly relevant to monitor as boom and bust cycles in the real estate market are generally found to be particularly damaging for macroeconomic stability. Moreover, it is crucial to analyze the overall balance sheet conditions of the financial sector, households and firms. Finally, given that the interactions between monetary and asset price developments are rather complex and no mechanical link can be assumed, it is always necessary to interpret the nature of movements in money, credit and asset prices.[25]

3 The data set

The present study analyses the leading indicators properties of financial, real and monetary indicators around periods of busts in stock prices (represented by the share prices indices) and house prices (total dwellings whenever available) markets. As for the macroeconomic indicators we consider historical series of a broad monetary aggregate, roughly equivalent to M2 or M3 (depending on the country considered) and consumer inflation (which is also used to derive the variables measured in real terms). Other variables are represented by the nominal and real GDP, investment and consumption (and the corresponding deflators), while financial variables are represented by the short-term (three-month money market) and long-term (ten-year government bond yield) interest rates, the nominal and real effective exchange rates, the price/earnings ratio and the dividend yield. With regard to credit, we use credit to the private sector (or loans to the private sector whenever available).[26] The main sources of the series are the BIS, DataStream, Euro area wide model (AWM), European Central Bank (both official and internal databases), Eurostat, Global Financial Data, IMF International Financial Statistics, the respective National Central Banks for each country, OECD Main Economic Indicators and Economic Outlook and Reuters. Annex 3 contains a more detailed description of the series used, their construction and their sources.

The dataset used for the analysis consists of quarterly data collected for 18 main industrial economies (also including the euro area as a whole) and spans over more than three decades, starting in 1969 Q1 and ending in 2008 Q3.[27] The countries considered in the sample set are the following: Australia (AU), Canada (CA), Denmark (DK), the euro area (EA), France (FR), Germany (DE), Ireland (IE), Italy (IT), Japan (JP), the Netherlands (NL), New Zealand (NZ), Norway (NO), Portugal (PT), Spain (ES), Sweden (SE), Switzerland (CH), the United Kingdom (UK) and the United States (US).

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25 This notwithstanding, some caveats of the studies reviewed are also worth mentioning. Firstly, a rigorous cross-country empirical analysis has been hampered by data availability. For example, there is hardly any reliable data on property prices covering a sufficiently long period. Moreover, the comparability across countries has also been hampered by the heterogeneity of the series (e.g. national averages versus main cities, different frequencies), which explains why the focus in most studies is on equity prices only. Secondly, the literature has been relying mainly on “event-study” analysis, with a particular focus on the (possibly large) negative effects that the burst of an asset price bubbles may have on the economy. However, from these studies it is usually difficult to detect a direct causality among the variables involved, since no statistical/econometric test can be performed, as well as it is almost impossible to take into account all the other factors that might influence the economic developments during the “event”.

26 All series are seasonally adjusted; whenever possible, quarterly series are calculated as averages of monthly series. For a detailed description of the series used and their sources see Annex 3. As for credit, bank credit does not include loans which are securitized.

27 For a few variables in some counties the starting point may be slightly later (see Appendix 3 for more detail on the starting date for each series for each country).

These variables are measured in different ways, either as annual percentage changes or as deviation from a trend (calculated ex post) or as ratio to GDP.[28]

In the following section, as we are interested in being able to predict periods when the developments of a bubble leads to a bust, we illustrate the definition of an asset price bust and estimate the probability that a bust will occur and the predictive power of some indicators in signalling it.

4 Some preliminary results

4.1 Some preliminary evidence of the detection of an asset price bust

In this subsection we focus on some preliminary evidence of the selection of periods of a bust. As for the definition of a bust, the following choice has been made, based on a combination of the methodologies developed by Berg and Pattillo (1999) and Andreou et al. (2007). A bust occurs when the "composite" asset market indicator declines by more than a pre-defined threshold.[29] In line with this, a composite asset price indicator has been calculated by combining the stock price index with the house price index as follows:[30]

(12) $$\Delta C = \phi_1 \bullet \Delta Stock \quad prices + \phi_2 \bullet \Delta House \quad prices$$

where ϕ_1 is normalised to 1 and $\phi_2 = \sigma_{sp} \big/ \sigma_{hp}$ $\phi_2 = \sigma_{\Delta SP} / \sigma_{\Delta HP}$ (that is the ratio of the standard deviation of the two variables). The weight is calculated recursively throughout the sample period in order to take into account the information available up to each moment in time.

A bust is then defined on the basis of this composite indicator, and, generally speaking, it would be denoted as a situation in which this indicator declines by a certain amount at the end of a certain period with respect to its peak (see Andreou et al., 2007). In our case, we will denote as occurrence of a bust (i.e. a value of 1 of the "bust dummy" variable) a situation in which at the end period (at *r*=12

28 For instance, the choice of the ratio of credit-to-GDP is used as a proxy for a leading indicator that captures the influence of banking crises, with credit expanding prior to a crisis and contracting afterwards; or interest rates and GDP as an expansionary monetary policy and a decline in real activity are usually associated with an onset of a crisis.

29 The intention of basing our analysis on a "composite" asset price index is that such an index would facilitate a comparison of broad asset price movements over time and across countries, give some empirical content to the notion of general asset price "inflation" and "deflation" and highlight patterns of behaviours that would otherwise remained undetected.

30 This approach is a standard practice in the literature on currency crises, whereby the crisis indicators are usually obtained by statistical analysis of the exchange rate and official international reserve series. The weighting scheme used between the two series is generally inversely proportional to their conditional variance. When the pressure indicator goes above a certain threshold, it is deemed that there is a currency crisis. The threshold used is generally two or three standard deviations above the mean. The greater the number of the standard deviations, the smaller the number of identified crises.

quarters) the composite indicator has declined by more than its mean (denoted as $\overline{C}$) minus a factor (in our study δ =1.5 is chosen as fixed across the sample period) multiplied by the standard deviation of the same indicator (σ_C) in the period from 1 to $(t+r)$ with respect to its maximum reached in the same period, i.e.:

(13) $$Dum_t = 1 \quad iff \quad \Delta C_{t+r} \leq (\overline{\Delta C}\,|_1^{t+r} - \delta\sigma_{\Delta C}\,|_1^{t+r})$$

where ΔC represents the composite indicator (expressed in terms of quarterly rate of changes), $\overline{\Delta C} = mean(\Delta C)$ and $\delta = 1.5$. However, along the lines of Berg and Pattillo (1999), we are interested in predicting asset price busts several quarters ($T = 8$ quarters) ahead. In line with this, we define a new "bust dummy" *C8* by making use of the dummy previously derived. More precisely, the "bust dummy" is defined as follows:

(14) $$C8_t = 1 \ iff \ \sum_{k=1}^{8} Dum_{t+k} > 0,$$

where the signalling horizon is defined as the period within which the indicator would be expected to be able to signal an asset price bust up to 8 quarters ahead. Thus a signal that is followed by a bust within 2 years is labeled as a "good" signal, while a signal not followed by a bust within that interval of time is called a "false" signal. It is important to stress that, contrary to Detken and Smets (2004), Adalid and Detken (2007) and the IMF (2008), we do not discriminate between high and low cost booms. This is because, as an example, the classification of Adalid and Detken (2007) depends on the arbitrarily selected threshold of a decrease of 2.4%. Moreover, other measures like the inflation rate or the unemployment rate could also be used to denote a high-cost boom and bust, and the results in terms of severe consequences of a bust might be different with respect to the use of GDP growth. Finally, an investigation of the developments in real GDP in the two years pre and post-the asset price busts that we detect shows that real GDP growth tends to decrease sharply in the two years after the busts, turning even negative in some cases.[31] Therefore, we think it is more sensible to characterize the bust more directly, without discriminating it in terms of any *ex-post* particular macroeconomic development.[32]

On the basis of this construction, we report in Table 1 the overall number of asset price busts detected with this method, which in total sums up to 93.[33] More precisely, the countries of the south and mid of Europe account for about 30% of the busts, while 16.5% of the busts seem to occur in the

31 The results are not shown for matter of space, but are available from the authors upon request.

32 For instance, it has been put forward in the literature that the optimal degree of vulnerability to banking crises must not be zero. Under certain conditions it can be optimal not to be fully insured against liquidity crises in the banking system, in order to spur financial intermediation, increase the amount of credit available for investment and thus foster growth in the long run.

33 The calculation of the indicator is based on running the procedure recursively and in a rolling manner from the beginning of the sample onwards. Of course, the choice of δ =1.5 times the standard deviation is arbitrary.

three biggest currency areas excluding the euro area (i.e. Japan, the United Kingdom and the United States). As far as the euro area is concerned, the busts are only two, and it seems that at the aggregate developments in some countries are counterbalanced by movements in other regions of the euro area. The rest of the asset price busts are distributed between the countries of north of Europe (33%) and the remaining overseas countries (19%).

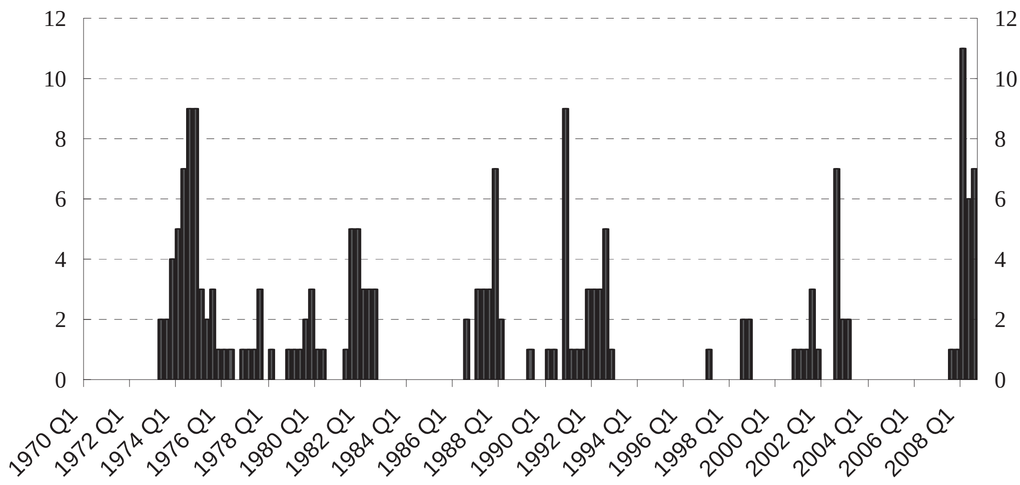
Table 1 Asset price busts detected using the composite indicator

Country	No. of busts	Country	No. of busts	Country	No. of busts
AU	6	**IE**	6	**PT**	4
CA	7	**IT**	2	**ES**	6
DK	4	**JP**	6	**SE**	6
EA	2	**NL**	6	**CH**	6
FR	3	**NZ**	5	**UK**	3
DE	6	**NO**	9	**US**	6

Note: the countries in the table are the following: Australia (AU), Canada (CA), Denmark (DK), the euro area (EA), France (FR), Germany (DE), Ireland (IE), Italy (IT), Japan (JP), the Netherlands (NL), New Zealand (NZ), Norway (NO), Portugal (PT), Spain (ES), Sweden (SE), Switzerland (CH), the United Kingdom (UK) and the United States (US).

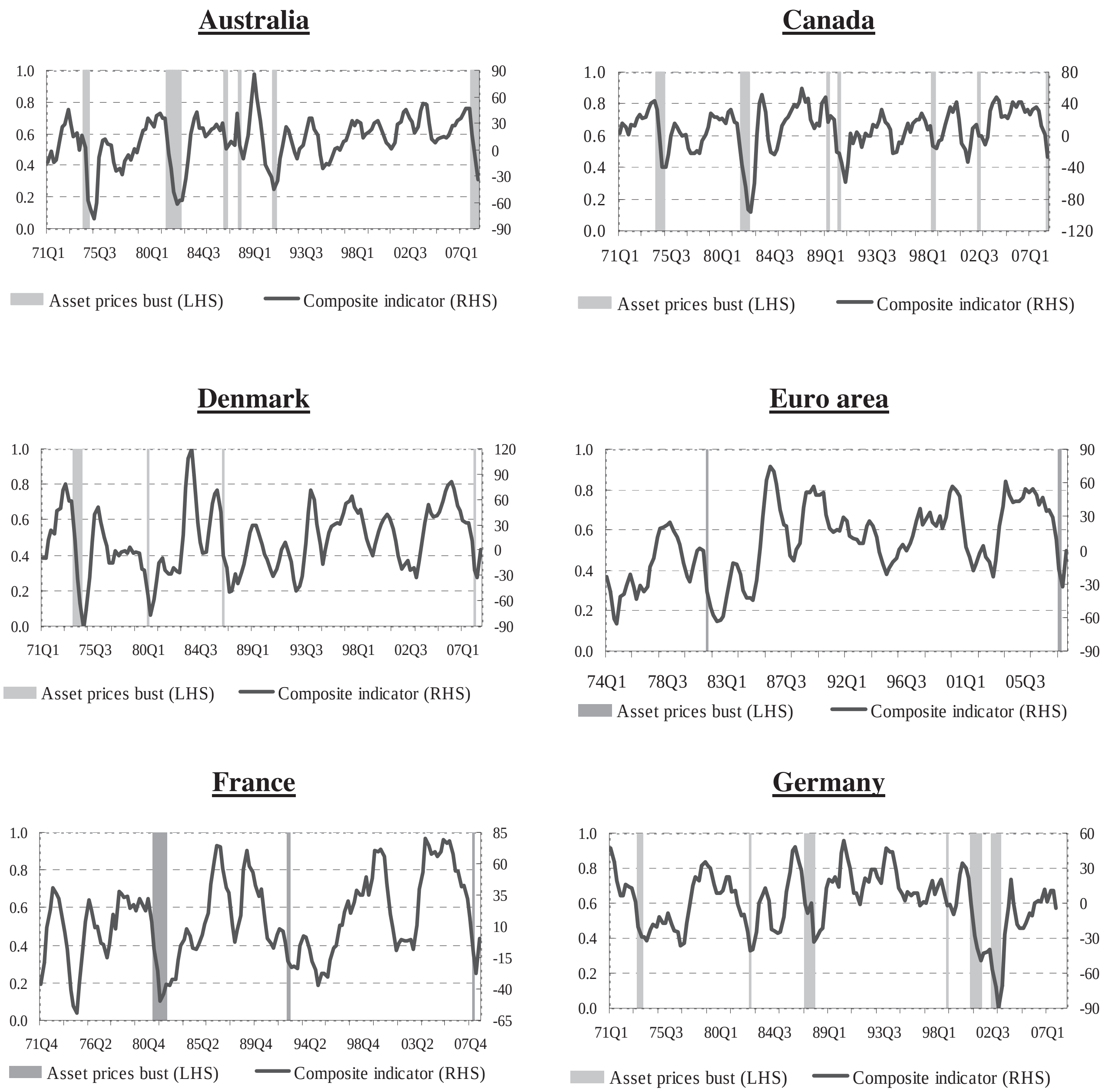
When looking at the occurrence of the busts across time, at the aggregate they seem to be more concentrated around the early/mid-70s (oil crisis), early and late (1987 stock market crashes) 80s, mid-90s (period of banking and currency crises), early 2000 (the period of the dot-com bubble) and very much towards the end of the sample in 2008 (see Figure 1).

Figure 1 Number of countries (out of 18) experiencing asset price busts

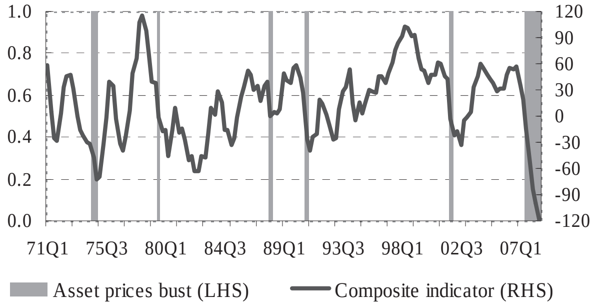


Looking at the disaggregate level, Figure 2 shows, for each country, the composite indicator (measured on the right-hand side of the chart) with the correspondent occurrence of a crisis (measured on the left-hand side of the chart), as detected using the criterion illustrated in eq.(13). As the occurrence of a bust may be driven by specific developments in one of the two markets comprising the aggregate indicator, we also illustrate separately the developments in house prices and stock prices around the period of a bust, which can be informative of the driving forces of the crises (see Annex 1).

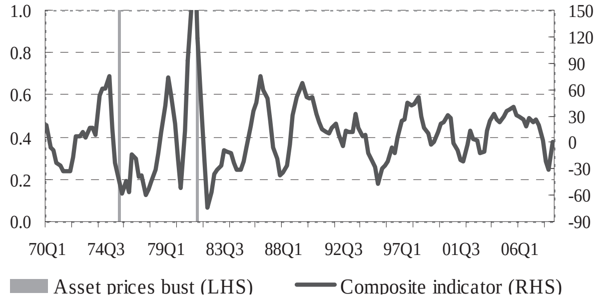
Figure 2 Developments in the composite indicator and busts in 17 OECD countries and the euro area



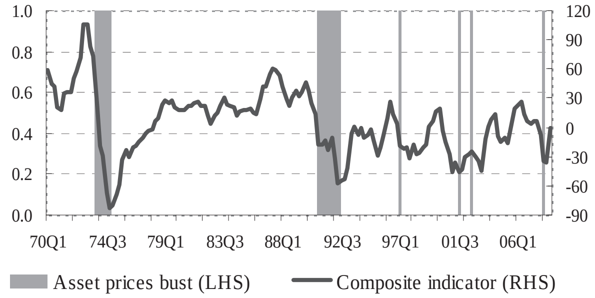
Ireland



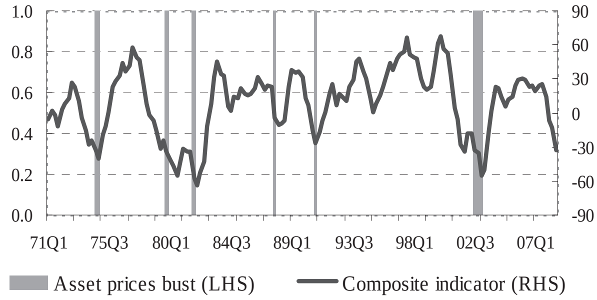
Italy



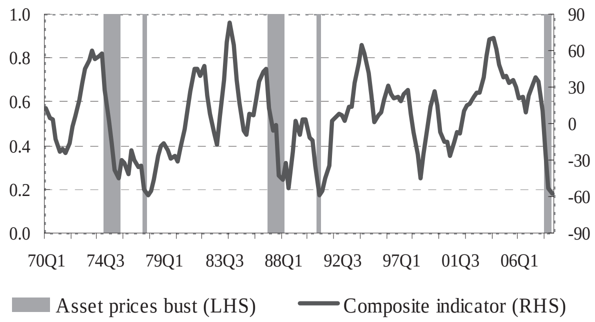
Japan



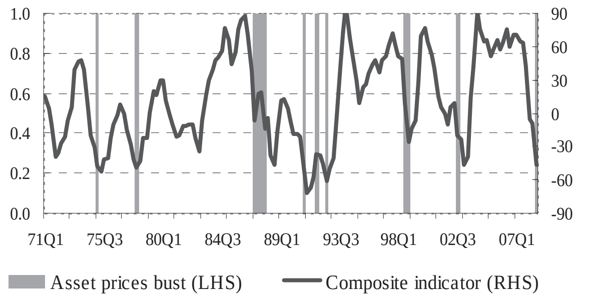
The Netherlands



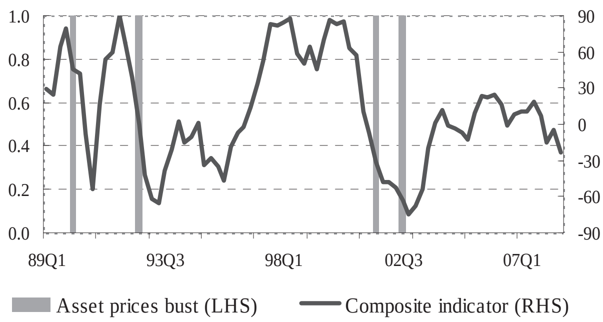
New Zealand



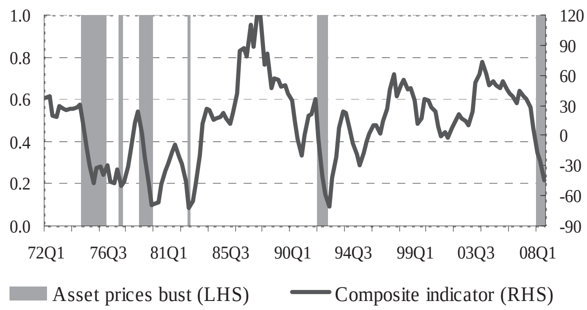
Norway



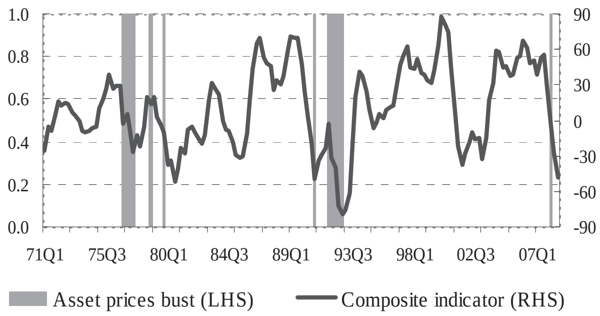
Portugal



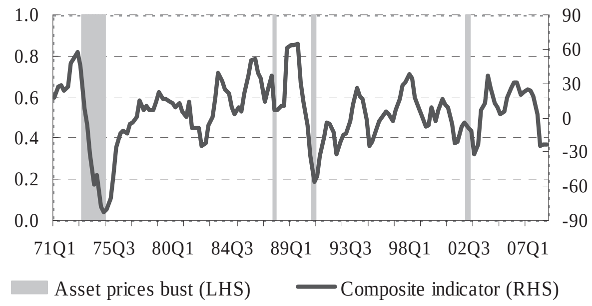
Spain



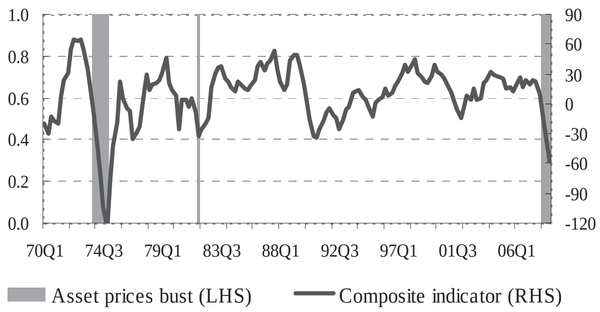
Sweden



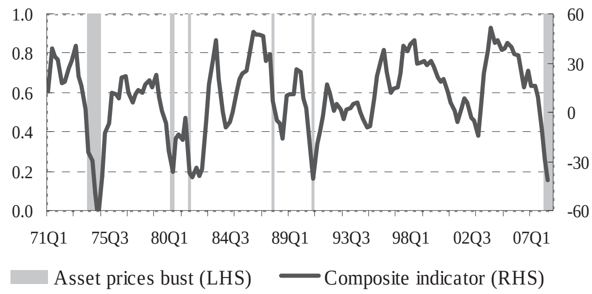
Switzerland



United Kingdom



United States



From Figure 1 and Figure 2 the following observations are worth being made. Firstly, the busts, varying from a number of two to nine, are in parts common to almost all countries (such as in early 80s), while at the current end 13 out of 16 countries experienced the bust of a bubble in the second half of 2008. More precisely, the maximum number of busts is recorded in the first quarter of 2008. Furthermore, over the first three quarters of 2008 13 countries exhibit a bust. Secondly, as regards the bursting of the 2000 dot-com bubble, not all countries experienced a bust. Looking at the developments of the disaggregated components (house price and stock prices, see Annex 1), it turns out that this is mainly due to the fact that in those countries where the bust is not detected is because the housing market was on an expansionary trend, thus counterbalancing – at least partly – the stock market developments. Thirdly, the length of the busts also varies across the countries, lasting either two quarters or more than one year. Overall, these observations lead to the conclusion that an analysis taking into account heterogeneities across countries and time has to be adopted.

4.2 Some results of a probit-type approach based on the pooling procedure

In the literature, many different approaches have been used to anticipate crisis of a different types (such as, for instance, currency crises or, more broadly, financial crises or asset price busts). A first approach, which could be characterized as "indicators" methodology, looks for discrete thresholds and calculates noise-to-signal ratios. The indicators are chosen such that they tend to exhibit unusual behavior prior to a bust, where a bust is defined to occur when certain developments in the variable of interest exceeds its mean by more than a certain value. An indicator issues a signal whenever it moves beyond this level. In order to examine the effectiveness of individual indicators, one could think of considering the performance of each indicator in terms of the following matrix (see also Andreou et al., 2007).

Figure 3 Indicators' performance

	Bust (within 8 quarters)	No bust (within 8 quarters)
Signal was issued	A	B
No signal was issued	C	D

In this matrix, A is the number of months/quarters (in the example 8 quarters, consistent with our analysis) in which the indicator issued a good signal, B is the number of months/quarters in which the indicator issued a bad signal, C is the number of months/quarters in which the indicator failed to issue a signal when the bust occurred and D is the number of months/quarters in which the indicator refrained from issuing a signal when in fact there was no bust. A perfect indicator would only produce observations that belong to A or D cells, or that is it would minimize the noise-to-signal ratio. This is, for example, the approach used by Kaminsky, Lizondo and Reinhart (1997), which apply this specific approach to currency crises. The authors monitor the evolution of a number of economic variables. When one of these variables deviates from its normal level beyond a certain threshold value, this is taken as a warning signal of a possible crisis within a specified period of time. A crisis is defined as a situation in which a sharp fall in the variable of interest exists. In their specific study, for each country in the sample, a crisis is identified (*ex post*) if the monthly percentage change of the variable is above its mean by more than three times the standard deviation.

To sum up, an indicator is said to issue a signal whenever it crosses a given threshold level. Threshold levels are chosen so as to strike a balance between the risks of having many false signals (which would happen if a signal is issued with the smallest possibility of occurrence of a crisis/bust) and the risk of missing many crises/busts (which would happen if the signal is issued only when the evidence of a crisis/bust is overwhelming). For example, more recently, Alessi and Detken (2009) set the thresholds for the indicators at each point in time on the basis of past observations. The specific indicator thresholds for each quarter are derived by applying the fixed optimal percentile to the distribution of the data available up to each specific point in time. Thresholds for each indicator are thus time and country dependent.

An alternative approach makes use of probit regression techniques which test the occurrence of an asset price bust by, for example, using the independent variable as a one/zero variable which takes a value of one if there is a bust on the basis of a specific criterion chosen and zero otherwise. As stressed by Berg and Pattillo (1999), this approach has many advantages. First, it allows to test the usefulness of the threshold concept; second, it allows to aggregate predictive variables more satisfactorily into one composite indicator index, taking into account correlations among different variables; and third, it permits to test the statistical significance of individual variables and the constancy of coefficients across time and countries.[34] In their paper, the two authors run bivariate and multivariate probit regressions on the pooled panel data set and compare several specifications of the probit models, whereby the linear specification performs best in terms of the probability scores and goodness-of-fit. They also investigate the appropriateness of their operational definition by comparing their approach with the one of Kaminsky et al. (1998). In addition, Fuertes and Kalotychou (2006) show that a pooled approach is much more successful in terms of forecast performance than a country-specific approach. Related to this, Davis and Karim (2007) add that a fixed effects model would mean that the country-specific dummy and the financial bust dummy would be perfectly correlated for countries which have never experienced a financial crisis. At the same time, excluding these countries would generate a biased sample and biased coefficients. Therefore, it is preferable to use a sample composed of bust and non-bust countries where the latter represent the control group. In this way, the variation in the explanatory variables is fully used to explain the busts.

In what follows we will conduct our analysis on the basis of a pooled regression procedure, whereby we assume that the intercept and the slope coefficients are constant across time and space and the error term captures the differences over time and individuals.[35] However, in the literature it has been pointed out that the standard errors of the probit estimates of early-warning-system models are incorrect because of serial correlation in the context of panel probit regressions. For this reason, in our estimations we apply the heteroskedasticity and autocorrelation corrected (HAC) procedure as developed by Berg and Coke (2004) which produces accurate estimates, following the methodology proposed by Estrella and Rodrigues (1998).

More formally, the probit equation takes the following general form:

(15) $$Prob(C_{\mathrm{it}}=1)=\alpha_{it}+\beta_{it}\cdot X_{it}+\varepsilon_{it}$$

34 Baltagi (1995) also explicitly discusses the advantages of using panel data set in general. Since panel data relate to countries over time, there is bound to be heterogeneity in these units. The techniques of panel data can take such heterogeneity explicitly into account by allowing for individual-specific variables. By combining time series of cross-section observations, panel data give more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency. By studying the repeated cross-section of observations, panel data are better suited to study the dynamics of change. In addition, panel data can better detect and measure effects that simply cannot be observed in pure cross-section or pure time series date. For example, the effects of minimum wage laws on employment and earnings can be better studied if we include successive waves of minimum wage increases in the federal and/or state minimum wages. Furthermore, panel data enable us to study more complicated behavioural models. For example, phenomena such as economies of scale and technological change can be better handled by panel data than by pure cross-section or pure time-series data. Finally, by making data available for several thousand units, panel data can minimize the bias that might result if we aggregate individuals or firms into broad aggregates.

35 However, we also carried out a robustness check by extending the best specifications selected by using the fixed-effects procedure to probit estimations.

where X_t consist of the fundamental variables and ε_t stands for the error term. In line with some of the earlier literature, we group the fundamental variables in three categories.[36] The monetary variables category comprises broad money and credit, the real variables category comprises investment, consumption and GDP, the financial variables category comprises the long-term and short-term interest rates, stock prices as well as the price-earnings ratio and the dividend yields and the (nominal and real) effective exchange rates, and the prices category all the deflators, consumer prices and house prices. Moreover, some variables are analysed both in levels and in annual growth rates or as deviations from a trend and/or as ratios to GDP.[37]

Using probit techniques for our unbalanced data set we are able to estimate the probability of occurrence of an asset price bust in the next 8 quarters. However, the assessment of whether a bust will occur or not depends on the subjective choice of a threshold which, once crossed, would give a signal of an upcoming bust. As for the value of the threshold, we make a subjective choice which is in line with the literature (see the discussion below for more details)

In order to compare the performance across the several probit models, beside looking at the significance of the coefficients and the McFadden R-squared, we apply the evaluation procedures suggested by Jacobs et al. (2005), who apply the quadratic probability score (QPS), and the log probability score (LPS) analysed by Diebold and Rudebusch (1989), as well as the KS test considered in van der Berg et al. (2008). These scores give an indication of the average closeness of the predicted probabilities and the observed realizations which are measured by a binary variable (the "bust dummy" *C8*). Let P_t be the prediction probability of the occurrences of bust (or no bust) event by the model at time *t* and $C8_t$ the zero-one dummy derived in Section 4.1. The QPS, LPS and KS tests are defined as:

(16) $$QPS = \frac{1}{T}\sum_{t=1}^{T} 2(P_t - C8_t)^2$$

(17) $$LPS = -\frac{1}{T}\sum_{t=1}^{T} ((1 - C8_t)\ln(1 - P_t) + C8_t \ln(P_t))$$

(18) $$KS = \frac{A}{A+C} - \frac{B}{B+D}$$

where T is the sample size, *A* is the number of correctly predicted busts, *B* counts the number of false alarms, *C* are the missed busts and *D* stands for the correctly predicted tranquil periods.

The quality of a model increases as QPS and LPS move close to 0, and KS approaches 1. More precisely, the QPS ranges from 0 to 2 with a lower QPS implying a more accurate forecast. A value of 0 corresponds to perfect accuracy. The implied loss function of the QPS is quadratic and symmetric which may be not appropriate as a forecaster may be penalized more heavily for missing a sign of a

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36 See, for instance, Kumar et al. (1998).

37 To calculate the trend, we make use of the Christiano-Fitzgerald filter (2003), since the Hodrick-Prescott filter is known to suffer from an end-of-sample problem.

busts (making a type II error) than for signalling a false alarm (making a type I error). The LPS has a logarithmic loss function and corresponds to the loss function used in the probit regression, so it has the advantage of coordinating the in-sample estimation criterion with the out-of-sample loss function (see Rudebusch and Williams, 2008) The LPS penalises large mistakes more heavily than QPS and takes value between zero and infinity, with 0 reflecting perfect accuracy. The advantage of the QPS and LPS is that they do not need an *ad hoc* threshold value.

Turning to the probit estimations, in the first step we analyse each of the aforementioned categories of variables separately (see Annex 2). As regards the monetary variables, both money and credit turn out to be significant and with the right signs when considered in growth rates or as deviations from a trend. The same applies to real economic variables, and for both categories the specification of each variable as a ratio to GDP appears to be less satisfying both in terms of sign and/or significance. Prices (deflators apart from the exchange rates) are also behaving quite well, whereas among the financial variables the importance of the short and long-term interest rates seems to be dominating.

As a step forward, we then proceed by combining in pairs the significant variables from the monetary category – more specifically, the credit aggregates which turned out to be superior to the monetary aggregates – with each of those significant variables from the other categories (for matter of space, all the results – although in a selective manner – are put in the tables presented in Annex 2). The following observations are worth being mentioned. First of all, in the bivariate equations annual changes in nominal credit perform better (both in terms of signs and statistics) than credit growth gap measures. Similarly, annual changes in money outperform money-to-GDP ratios. Second, when combining credit with financial variables, stock prices (in annual growth rates) represent the best performing financial variables and dominate house prices. Third, investment performs best among the real variables, especially when measured in terms of ratio to GDP. Finally, long-term interest rates and the spread (calculated as the difference between the long and the short-term interest rates) carry the right sign and are significant.[38]

Finally, the significant variables for each category are selected and combined with the monetary category into one equation. In the table below we show our two preferred specifications. Both contain credit aggregates (either in terms of annual changes or growth gap), changes in nominal long-term

38 As for the spread, on the one hand if the long-term interest rate is high and the short-term one is low, this might indicate an expansionary monetary policy, thus increasing the probability of an asset price bust to occur. On the other hand, it is a well known fact that an inverted yield curve is often indicating a future recession, and thus could also coincide with a higher probability of a future bust. As for the changes in the long-term interest rates, both a positive and negative effect on the probability of a bust would be possible. In particular, a positive expected sign would be associated to increases in long-term interest rates starting from low levels, possibly denoting higher inflation expectations in the context of booming economy and, therefore, an increasing probability of a downturn correction. Moreover, during the booms in the equity market or in the housing market their yield expectations are high and the attractiveness of the alternative investments is low. This would decrease the prices of bonds and increases the corresponding long-term rates.

interest rates and the investment-to-GDP ratio. It can be shown that all coefficients have the expected signs and are statistically significant. The McFadden R-squared is rather low but comparable to the other studies using the same methodology.[39] The equation containing credit in annual changes also includes the stock prices but has a slightly lower McFadden R-squared, while the other equation contains house prices, which are significant at conventional significance levels. Generally speaking, the signs of the coefficients should – quite obviously – be interpreted as having an increasing or decreasing effect on the probability of a bust. This notwithstanding, the values are not as intuitive to interpret. In fact, eq.(15) shows that the coefficients are not constant marginal effects of the variable on bust probability since the variable's effect is conditional on the values of all other explanatory variables. Rather, the slope-coefficients represent the effects of X_t the respective right-hand variables when all other variables are held at their sample means.[40]

Table 2 Best specifications from the multivariate probit model

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.016	1.403	2.540	0.075	0.391	0.578
Annual changes in credit (-4)	+	0.024	2.434	3.907			
Investment-to-GDP ratio	+	0.023	1.846	5.650			
Annual changes in nominal stock prices (-1)	+	0.006	3.268	4.442			
Annual changes in nominal LT	+/-	0.126	4.029	6.247			
c	?	-1.444	-5.143	-14.378			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	0.071	3.428	8.376	0.096	0.378	0.562
Nominal house prices gap (-1)	+	0.029	1.844	5.176			
Annual changes in nominal LT	+/-	0.125	3.551	6.108			
Investment-to-GDP ratio	+	0.020	1.878	5.777			
c	?	-0.978	-3.724	-11.285			

Note: the tables include the t-statistics "gmm", which are based on the autocorrelation-corrected standard errors, as well as the ordinary t-statistics (denoted with the "ml" label).

As already mentioned in Section 2, it has to be noted that designing a good forecasting model requires balancing two types of error: the number of false alarms (predicted asset price busts which do not materialise) and the number of failures (unanticipated asset price busts). In our discrete choice approach, the expected value of busts, given a set of indicators, is a probability measure. Greene (2003) notes that there is no correct answer on the value which should be assigned to the optimal threshold

39 The latter result might be due to the fact that the equation deals with the forecasting of efficient markets.

40 As regards the relative contribution of the determinants in the equations, we have also carried out an exercise to calculate the marginal effects of each right-hand variable. The results show that the long-term interest rate exhibits the strongest impact, followed closely by the credit and then the other macroeconomic variables in the two equations.

level of the probability. In general, the value depends on the costs related to the two different types of errors and their assessment by the policy maker. In the literature often a 25% threshold level is selected.[41] In the case of our exercise, we report in the table below the percentage of the predicted crises, missed calls and false alarms as well as the noise-to-signal ratios, based on a more conservative threshold of 35%. The results suggest that, for the two specifications selected, the models are able to predict correctly around 70% of the busts, while the missed calls for busts are around 25%. The false alarms are of a similar size of the missed calls, while the signal-to-noise ratio is about 36%.[42]

Table 3 Selected statistics of the best specifications from the multivariate probit model

Specifications	N-t-S ratio	Busts called (in %)	Missed busts (in %)	False alarms (in %)
SPECIFICATION A				
Annual changes in credit	0.41	66.33	30.29	28.36
Annual changes in credit (-4)				
Investment-to-GDP ratio				
Annual changes in nominal stock prices (-1)				
Annual changes in nominal LT				
c				
SPECIFICATION B				
Nominal credit growth gap	0.36	70.21	26.41	26.22
Nominal house prices gap (-1)				
Annual changes in nominal LT				
Investment-to-GDP ratio				
c				

The charts below provide an illustration for each country of how well the probit model with specification B predicts a possibile bust in a forecasting horizon up to 8 quarters ahead (see eq.(14)), where the threshold considered is 0.35.[43]

Finally, we have also carried out a robustness check of our model in order to assess whether such an in-sample analysis would also be informative in a real time situation. For doing so we tested the

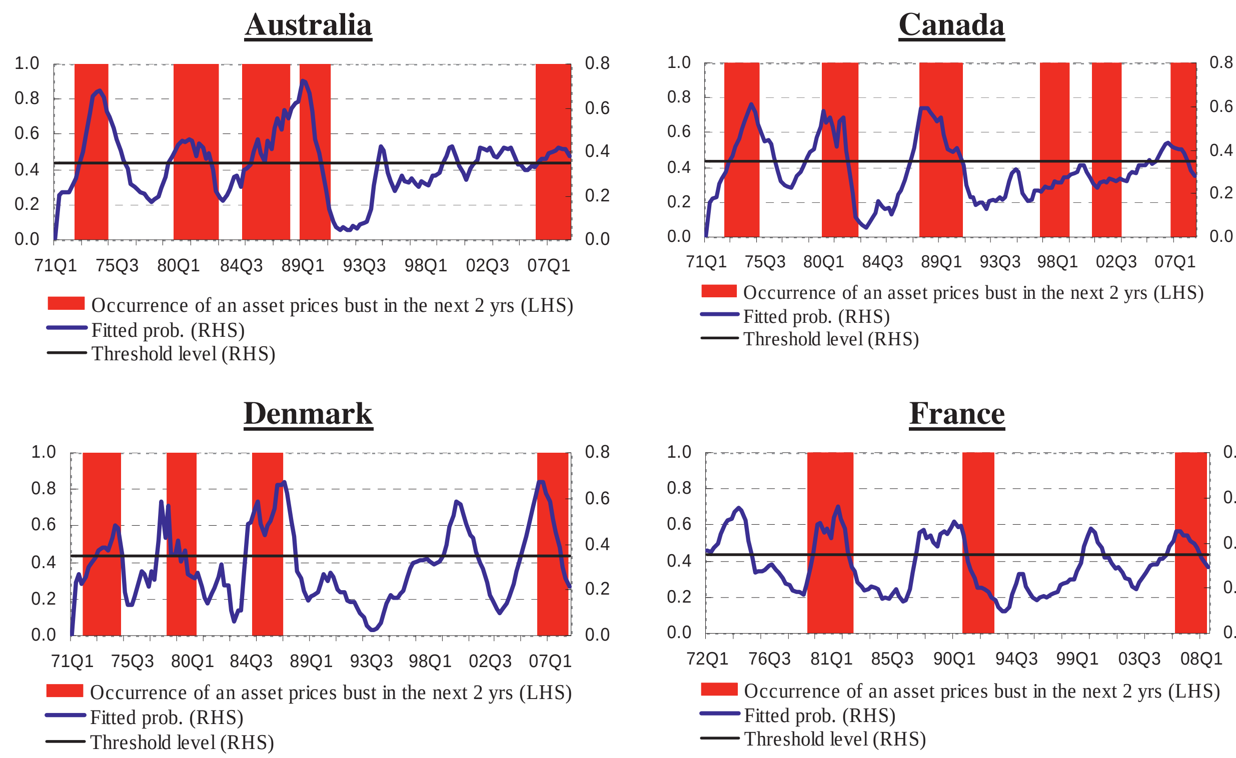
41 For instance, in Berg and Pattillo (1999) the choice of a threshold of 25% leads to an accuracy of predicting crises of about 73%, while that of false alarms is at 41%.

42 In a number of cases the noise-to-signal ratio could be made arbitrarily small by tightening the selectivity of the threshold. However, this underscores the risk of basing conclusions exclusively on minimisation of this ratio. Of course, the choice of the threshold could be carried out more formally by assigning specific weights to the costs of type I and type II errors (see, for instance, Bussière and Fratzscher, 2002; Alessi and Detken, 2009; Borio and Drehmann, 2009).

43 It might, however, be argued that the assumption of restricting the constant and slope coefficients to the same value cannot be seen as particularly realistic. Therefore, a robustness check of the results with other methods is warranted. This notwithstanding, these findings turn out to be robust also to the use of the panel probit estimation with fixed effects. In terms of statistics, in the latter case they improve as the LPS and QPS tests turn out to be lower, while the McFadden R-squared is higher; at the same time, most of the fixed effects coefficients do not seem to be significant at conventional significance levels.

reliability of our two preferred specifications in a sort of “pseudo” real time framework,, i.e. by running recursively our equations from mid-1980s onwards and evaluating the stability of the coefficients with respect to the in-sample results. The exercise[44] shows that the coefficients exhibit a stable pattern throughout the quarters both in terms of size and significance, and that the predictive performance of the model is not affected in real time with respect to an in-sample situation. Furthermore, with respect to this, it should also be kept in mind that house (and especially) stock prices are rarely revised, as well as long-term interest rates and credit data which turn out to be the most important determinants of our probit regressions. Only the variable investment-to-GDP ratio may be subject to some revisions, but the exercise carried out does not point to this factor being important. This leads to the conclusion that a real-time analysis would not significantly change our results.[45]

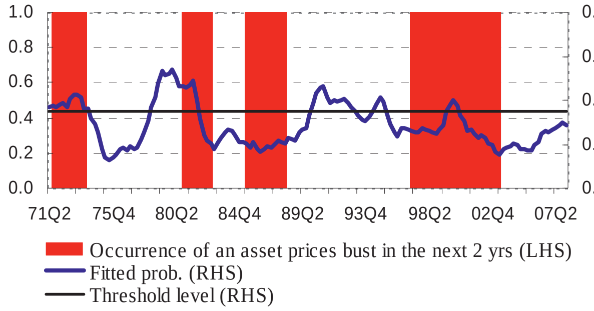
Figure 4 Predictive performance of specification B for asset price busts up to 8 quarters ahead



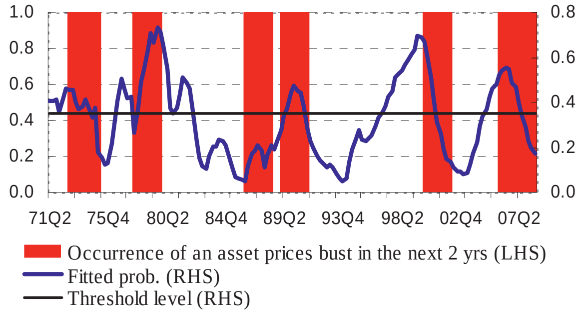
44 The results of the exercise are available from the authors upon request.

45 This is even more true if one considers that, in any case, a real-time dataset of the type we use is basically impossible to compile, so that any real-time exercise would necessarily have to be a “pseudo” real-time.

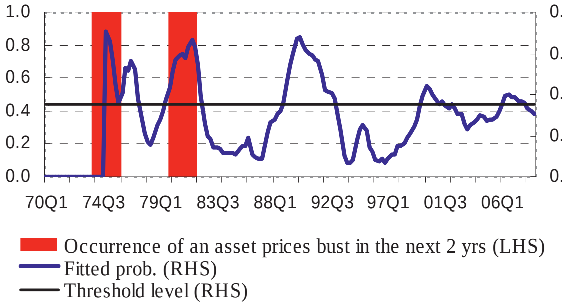
Germany



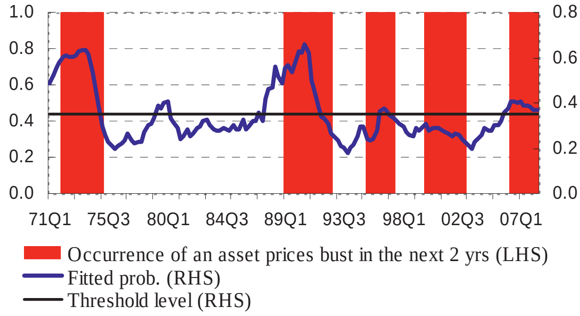
Ireland



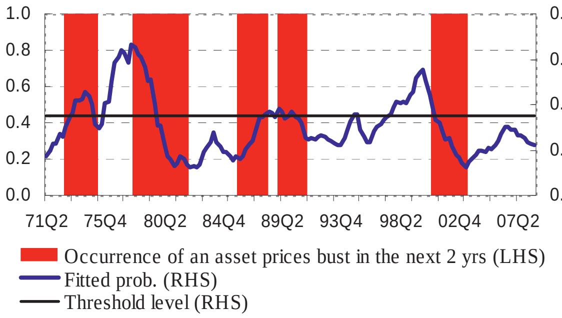
Italy



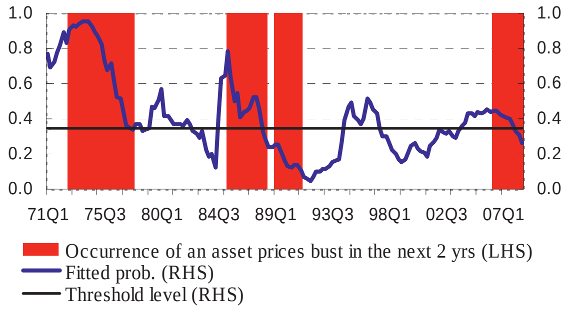
Japan



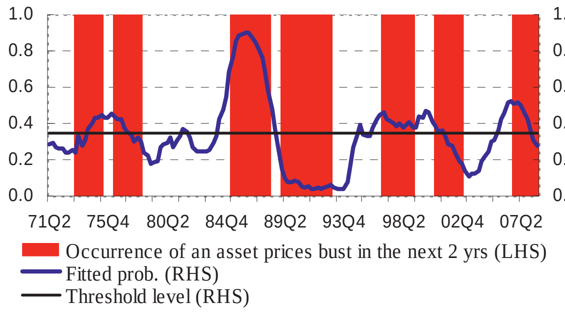
The Netherlands



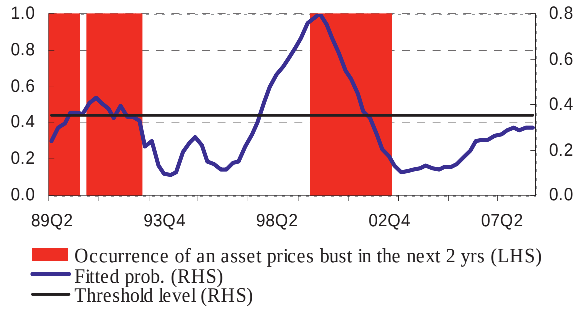
New Zealand



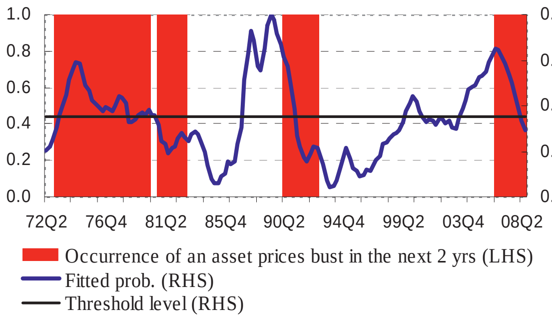
Norway



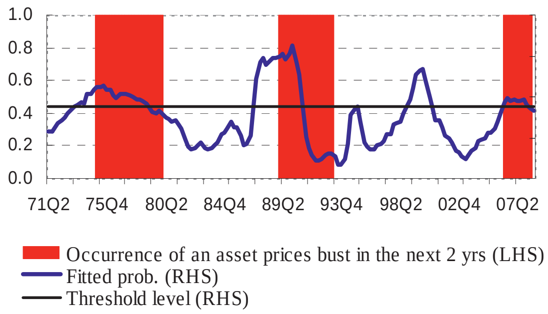
Portugal



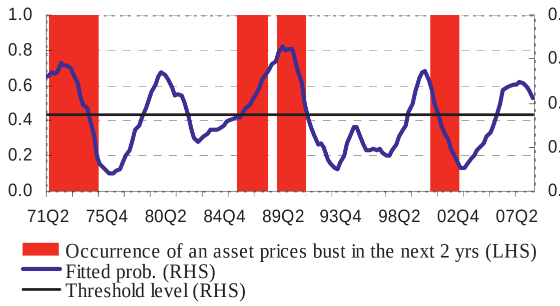
Spain



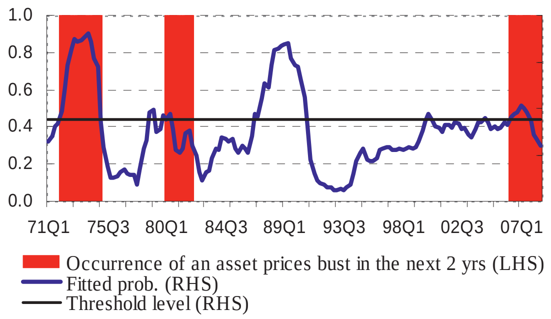
Sweden



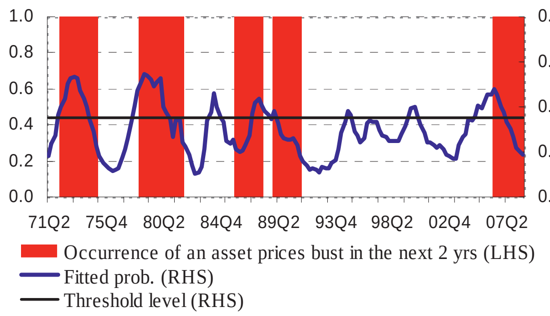
Switzerland



United Kingdom



Unites States



5 Conclusions

Large swings in asset prices, interest rates and economic activity in a variety of countries over the past several years have brought new attention on the linkages between monetary policy and asset markets. Generally speaking, it is a well established fact that distinguishing the nature of the sources of asset price movements – and, therefore, if the eventual bursting of such bubbles is likely to be destabilising for the financial system and the real economy - in real time is an extremely difficult task, as estimates of the equilibrium value of asset prices are usually surrounded by a high degree of uncertainty.

This notwithstanding, for central banks it is important to use early warning indicators to assess the possible implications of large asset price movements and the building up of financial imbalances in the economy. In this respect, several studies have shown that the analysis of monetary and credit developments may be very useful in this respect. This paper contributes to this literature for investigating whether money and credit indicators can play an important role in detecting asset price misalignments by looking at the evidence stemming from a sample of 17 OECD industrialised countries and the euro area over the period 1969 Q1 – 2008 Q3.

After providing a critical review on the current evidence in the literature on the issue, firstly it presents the construction of an asset price composite indicator which incorporates developments in both the stock price and house price markets, following the methodology commonly applied in the context of the currency crises literature. Secondly, it proposes a new criterion which can be used to select the periods characterised by asset price busts, based on a combination of the methodologies developed by Berg and Pattillo (1999) and Andreou et al. (2007). The asset price busts detected over the country sample on the basis of this criterion vary from a number of two to nine, are in parts common to almost all countries (such as in early 80s), with the maximum number of busts being recorded in the first quarter of 2008, while over the longer period made up by the first three quarters of 2008 a bust is detected in 13 countries. The length of the asset price busts also varies across the countries, lasting either two quarters or more than one year. Finally, an empirical analysis is carried out based on a pooled probit-type approach, which considers several macroeconomic variables, belonging to the monetary, financial, real economic and prices categories. According to statistical tests, credit aggregates (either in terms of annual changes or growth gap), changes in nominal long-term interest rates and the investment-to-GDP ratio jointly with developments in either house prices or stock prices turn out to be the best indicators which help to forecast asset price busts up to 8 quarters ahead.

Overall, while differing with respect to the precise quantification and identification of asset price booms and busts, the results of this paper are in line with the theoretical findings and a number of studies in the literature, and confirm that it is useful to look at monetary and credit developments as early indicators of the building up of financial imbalances. Given the promising results obtained, further extensions to the present work might be deemed useful, which include additional robustness checks and a more detailed analysis focusing on the euro area or the relationships between results at country level and euro area analysis.

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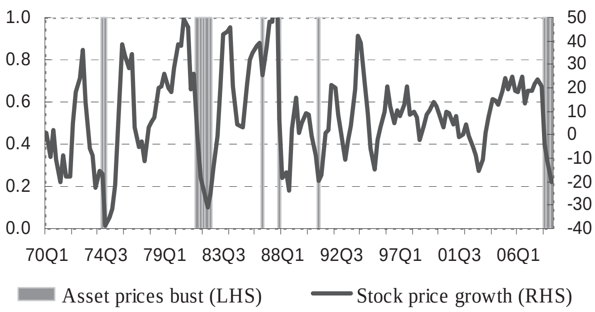
Annex 1. Developments in house prices and stock prices around the bust periods

In this Annex we provide some illustration of the developments in the house prices and stock prices markets, together with the busts periods, which can be informative of the possible sources driving busts in each country at each point in time.

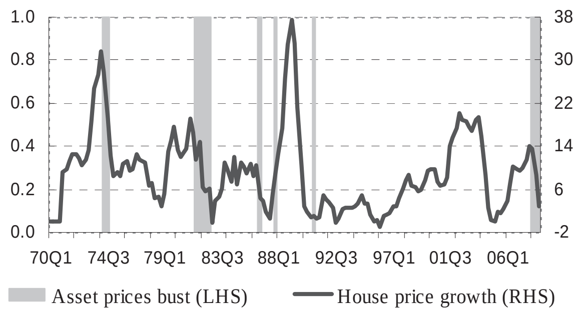
Figure 5 Developments in the stock and house prices in several OECD countries

Australia

Stock prices

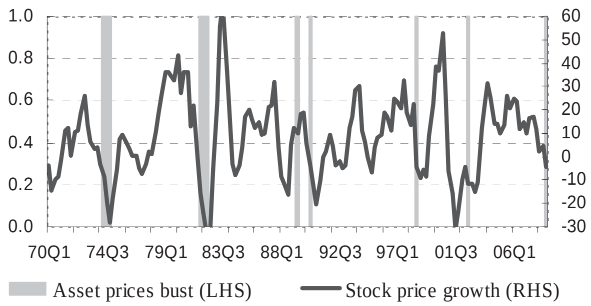


House prices

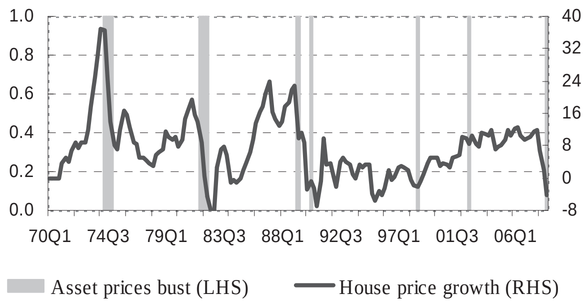


Canada

Stock prices

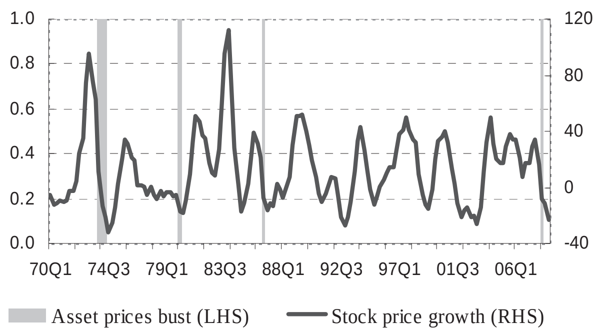


House prices

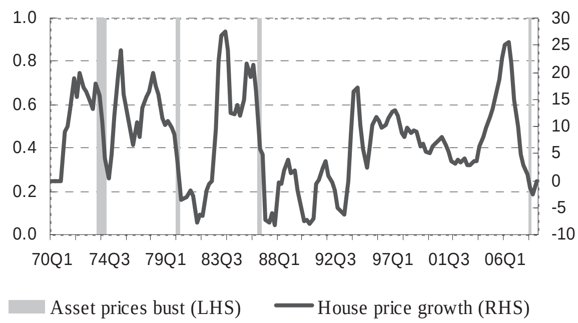


Denmark

Stock prices

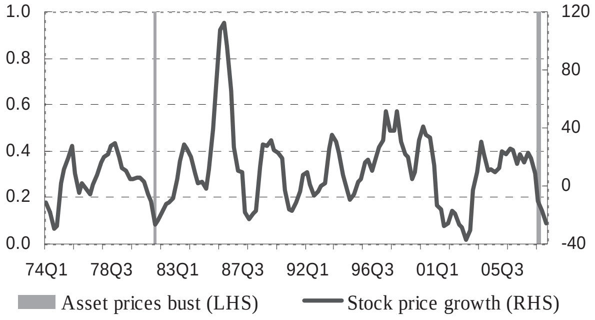


House prices

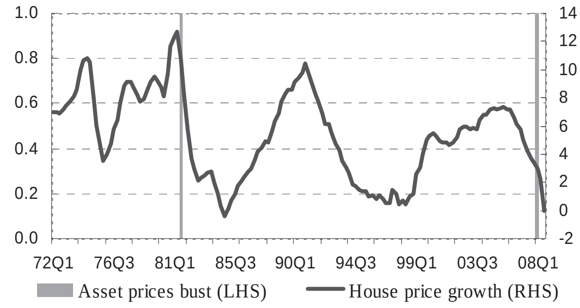


Euro area

Stock prices

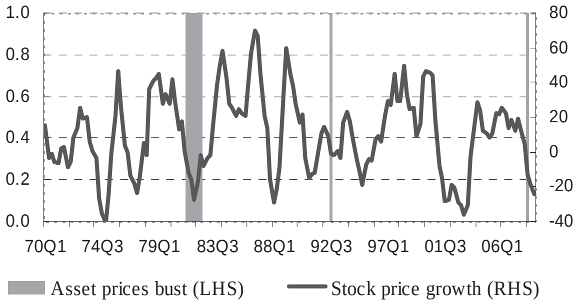


House prices

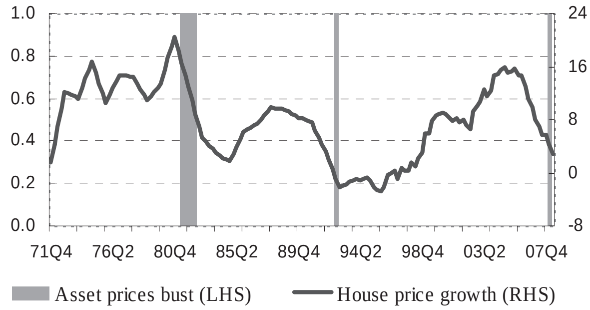


France

Stock prices

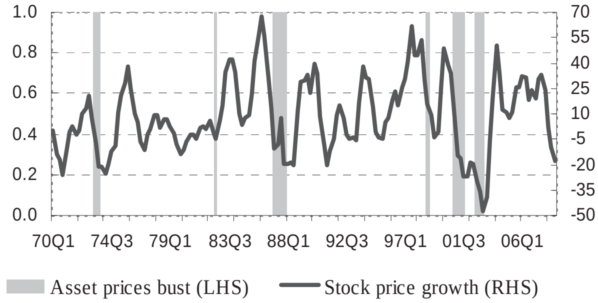


House prices

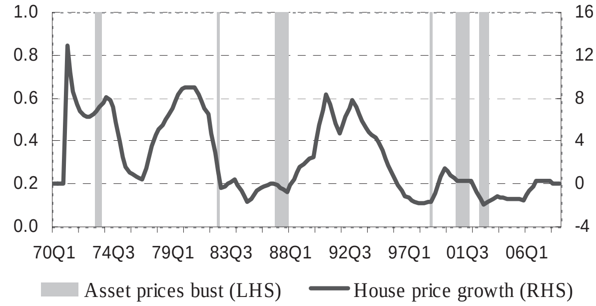


Germany

Stock prices

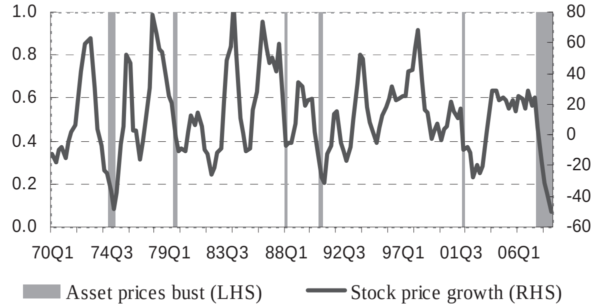


House prices

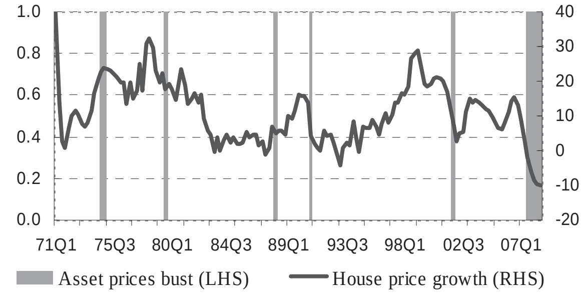


Ireland

Stock prices

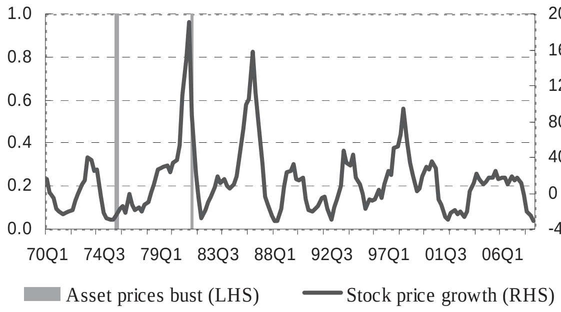


House prices

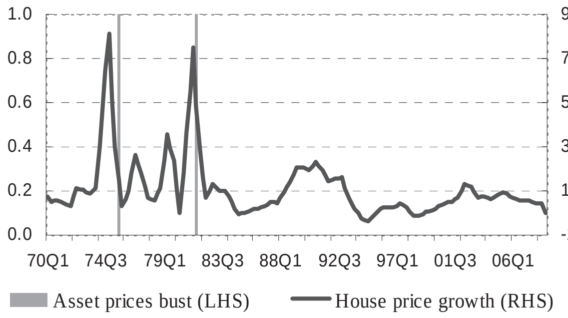


Italy

Stock prices

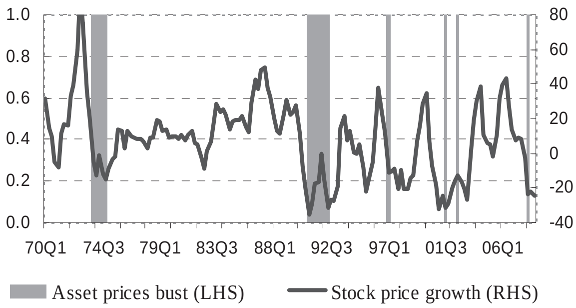


House prices

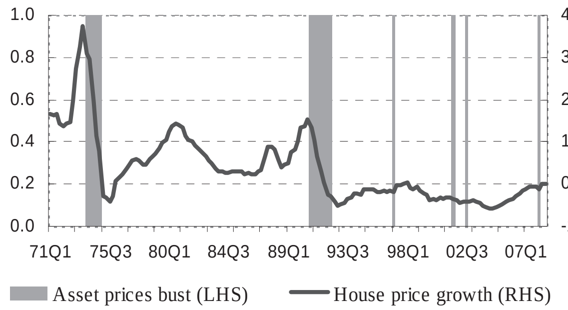


Japan

Stock prices

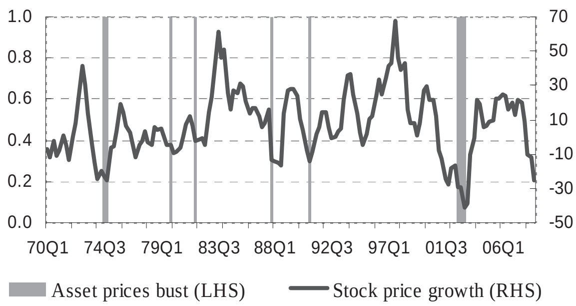


House prices

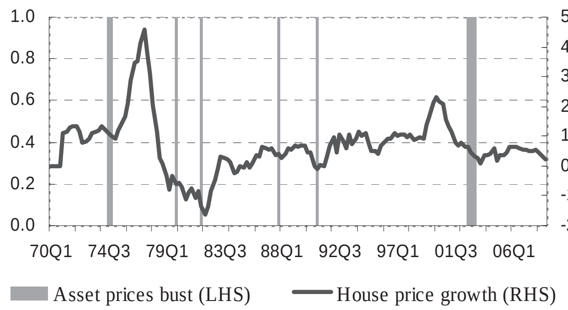


The Netherlands

Stock prices

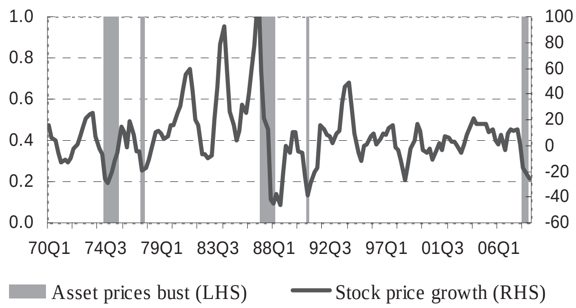


House prices

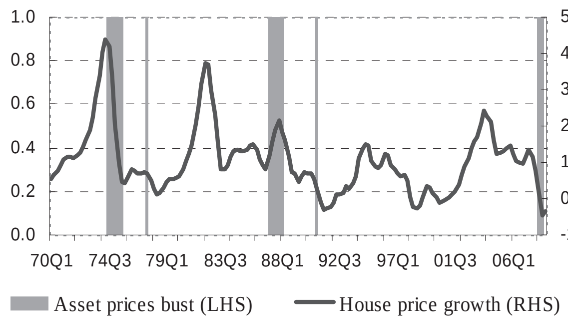


New Zealand

Stock prices

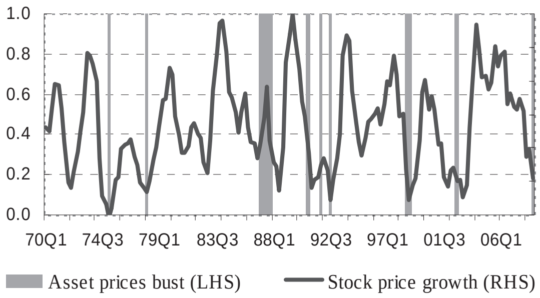


House prices

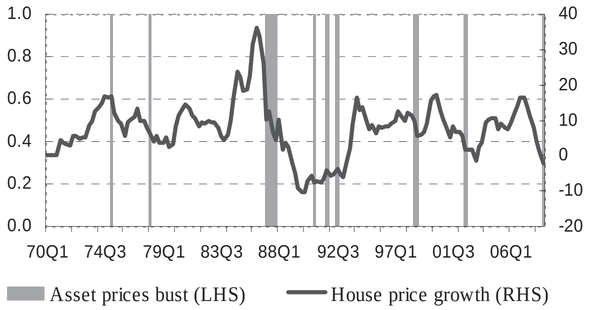


Norway

Stock prices

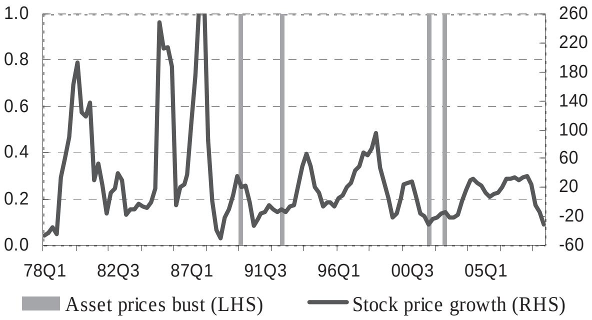


House prices

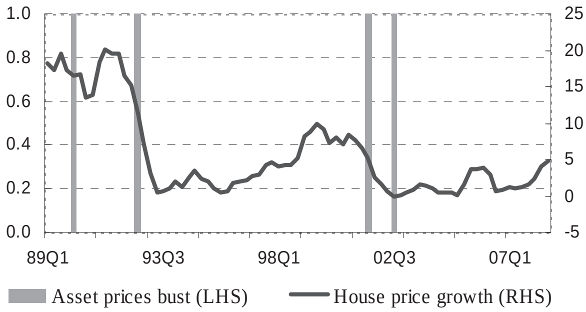


Portugal

Stock prices

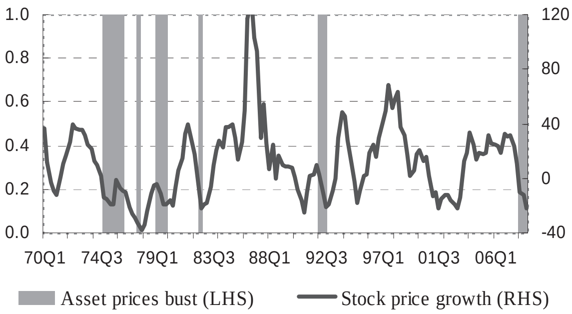


House prices

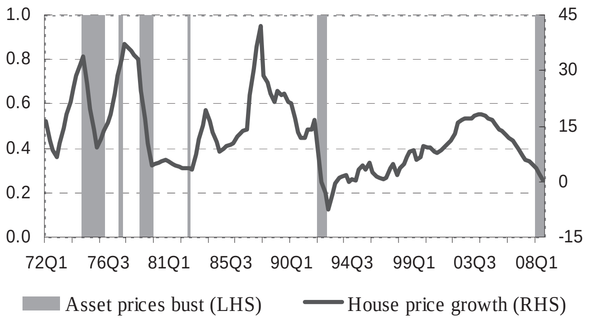


Spain

Stock prices

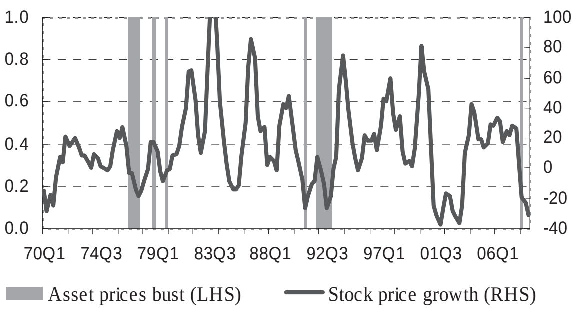


House prices

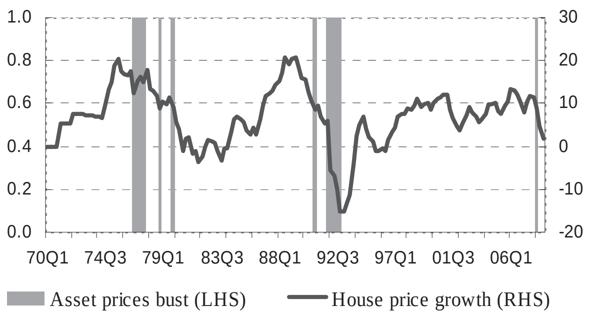


Sweden

Stock prices

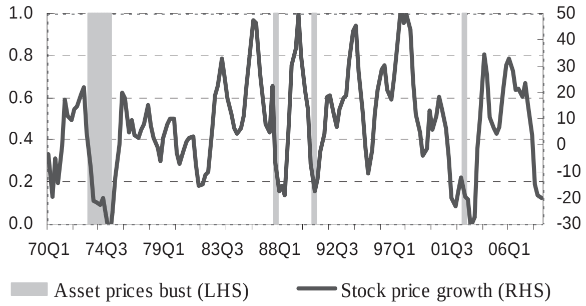


House prices

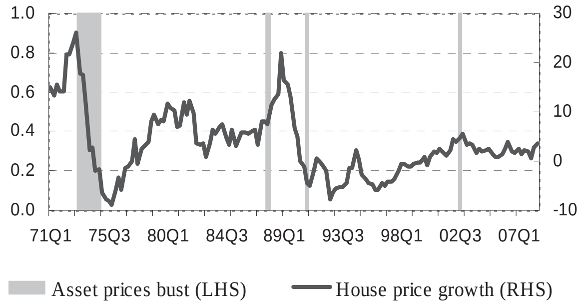


Switzerland

Stock prices

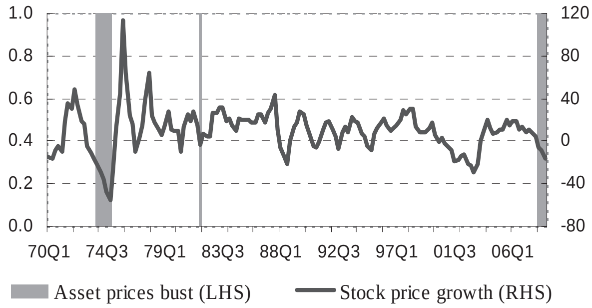


House prices

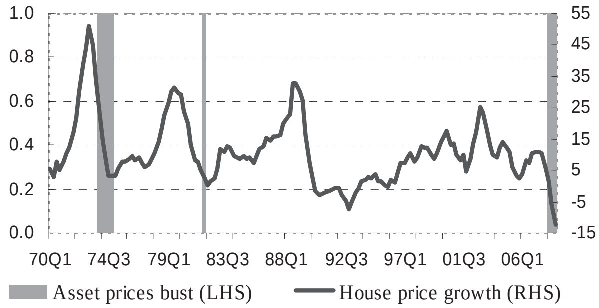


United Kingdom

Stock prices

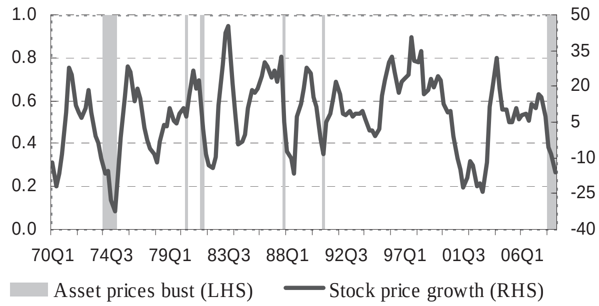


House prices

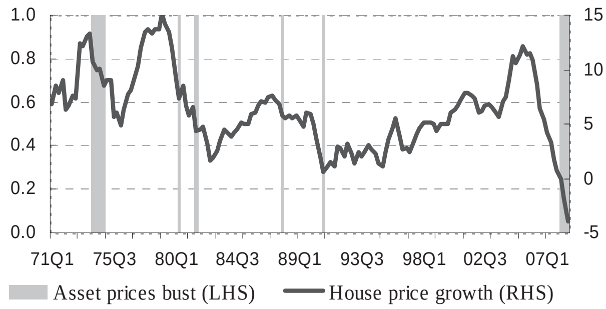


Unites States

Stock prices



House prices



Annex 2. Results from the univariate and bivariate probit models

In this Annex we report the results from probit estimations based on univariate and bivariate equations. In Table 4 we report the results for single variables including the contemporaneous variable. The table includes the t-statistics "gmm", which are based on the autocorrelation-corrected standard errors, as well the ordinary t-statistics (denoted with "ml"). For the bivariate variable models we start off with considering each of the two variables with 4 lags and, following the general-to-specific methodology, we proceed by deleting the insignificant coefficients. For matter of space, we report only the final bivariate specifications (see Table 5 below). As on the basis of the single equation approach credit aggregates turn out to be superior to monetary aggregates, the bivariate equations always include credit and in pairs the other variables taken from the different groups which performed best. Out of the results obtained with the bivariate equations, we select the best performing variables and plug them in multivariate equations (see Table 6), the best specification of which is reported in the main text in Table 2.

Table 4 Single equation probit models

Variable	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R squared	No. of obs
MONETARY VARIABLES CATEGORY						
Broad money-to-GDP ratio	+	-0.004	-1.512	-3.962	0.005	2571
Annual changes in broad money	+	0.040	3.955	7.924	0.020	2556
Money growth gap (CF filter)	+	0.057	2.323	5.790	0.011	2556
Money growth gap (HP filter)	+	0.043	2.877	4.591	0.007	2556
Credit-to-GDP ratio	+	-0.001	-0.269	-0.787	0.000	2547
Annual changes in credit	+	0.043	4.446	10.741	0.038	2539
Credit growth gap (CF filter)	+	0.095	5.117	12.882	0.056	2539
REAL VARIABLES CATEGORY						
Consumption-to-GDP ratio	+	-0.023	-2.409	-5.258	0.009	2571
Annual changes in nominal consumption	+	0.044	3.973	8.020	0.020	2537
Nominal consumption growth gap (CF filter)	+	0.140	4.594	9.022	0.026	2537
Annual changes in real consumption	+	0.037	2.075	3.899	0.005	2530
Real consumption growth gap (CF filter)	+	0.103	3.211	6.624	0.014	2530
Investment-to-GDP ratio	+	0.021	1.602	6.891	0.016	2571
Annual changes in nominal investment	+	0.022	3.744	7.063	0.016	2537
Nominal investment growth gap (CF filter)	+	0.035	3.688	6.727	0.014	2537
Annual changes in real investment	+	0.010	1.455	2.533	0.002	2526
Real investment growth gap (CF filter)	+	0.022	1.988	3.728	0.004	2526
Annual changes in nominal GDP	+	0.038	3.653	7.400	0.017	2563
Annual changes in real GDP	+	0.051	2.741	4.696	0.007	2559
PRICES CATEGORY						
Annual changes in consumer prices	+	0.036	3.202	6.205	0.012	2569
Annual changes in NEER	-	-0.004	-0.508	-0.875	0.000	2514
Annual changes in REER	-	0.000	0.007	0.004	0.000	2571
Annual changes in consumption deflator	+	0.035	3.117	6.177	0.012	2529
Annual changes in investment deflator	+	0.030	3.144	6.800	0.015	2514
Annual changes in GDP deflator	+	0.031	2.997	5.687	0.010	2559
Annual changes in nominal house prices	+	0.033	3.776	9.641	0.031	2492
Nominal house price growth gap (CF filter)	+	0.051	3.326	10.537	0.036	2492
Annual changes in real house prices	+	0.026	2.951	6.864	0.015	2492
Real house price growth gap (CF filter)	+	0.044	3.253	9.245	0.028	2492
FINANCIAL VARIABLES CATEGORY						
Dividend yields	+	-0.015	-0.564	-1.174	0.000	2359
Annual changes in dividend yields	+/-	0.002	1.209	1.971	0.001	2337
Price/earnings ratio	+	-0.007	-1.816	-3.875	0.006	2314
Annual changes in nominal stock prices	+	0.002	1.194	1.889	0.001	2563
Nominal stock price growth gap (CF filter)	+	-0.003	-0.671	-1.587	0.001	2563
Annual changes in real stock prices	+	0.001	0.385	0.621	0.000	2561
Real stock price growth gap (CF filter)	+	-0.003	-0.834	-1.948	0.001	2561
Long-term (LT) nominal interest rate	-	0.012	0.769	1.736	0.001	2571
Annual changes in nominal LT	+/-	0.157	4.857	8.196	0.022	2567
Real LT	-	-0.056	-3.252	-6.625	0.014	2569
Annual changes in real LT	+/-	-0.034	-2.398	-2.885	0.003	2501
Short-term (ST) nominal interest rate	-	0.029	2.122	4.994	0.008	2571
Annual changes in nominal ST	+/-	0.109	6.494	10.142	0.034	2566
Real ST	-	-0.011	-0.629	-1.370	0.001	2569
Annual changes in real ST	+/-	0.029	2.507	3.071	0.003	2501
Spread (LT-ST)	+	-0.085	-3.155	-7.225	0.016	2571

Table 5 Bivariate equations probit models

Credit aggregate and money aggregates

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in nominal credit	+	0.027	2.406	4.184	0.047	0.397	0.58
Annual changes in nominal credit (-4)	+	0.023	2.367	3.834			
Annual changes in nominal money (-1)	+	0.010	0.650	0.692			
Annual changes in nominal money (-2)	+	-0.004	-0.284	-0.282			
c	?	-1.036	-6.304	-17.217			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in nominal credit	+	0.030	2.816	5.235	0.056	0.405	0.59
Annual changes in nominal credit (-4)	+	0.025	2.667	4.333			
Money-to-GDP ratio (-3)	+	-0.006	-2.113	-5.562			
c	?	-0.721	-3.619	-9.481			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.791	-3.055	-6.244	0.092	0.388	0.57
Nominal credit growth gap (-1)	+	3.419	3.018	6.091			
Nominal credit growth gap (-2)	+	-1.591	-2.770	-5.577			
Annual changes in nominal money (-1)	+	0.031	2.822	5.766			
c	?	-0.793	-5.776	-13.951			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap (-1)	+	0.095	4.870	12.341	0.074	0.396	0.58
Annual changes in nominal money (-1)	+	0.028	2.431	5.192			
c	?	-0.758	-5.393	-13.601			

Credit aggregate and financial variables[46]

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in nominal credit	+	0.023	2.162	3.831	0.052	0.408	0.59
Annual changes in nominal credit (-4)	+	0.028	2.977	4.688			
Annual changes in nominal stock prices (-1)	+	0.003	1.818	2.280			
Annual changes in nominal stock prices (-4)	+	0.004	2.392	2.872			
c	?	-1.055	-6.613	-18.565			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in nominal credit (-1)	+	0.025	1.938	3.256	0.042	0.400	0.58
Annual changes in nominal credit (-4)	+	0.024	2.002	3.101			
Price-earnings ratio	+	-0.003	-0.742	-1.531			
c	?	-0.933	-6.034	-12.797			

46 The number of observations for the equation including the price-earnings ratio is smaller due to data availability.

Credit aggregate and prices

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in nominal credit	+	0.023	2.122	3.290	0.053	0.401	0.59
Annual changes in nominal credit (-4)	+	0.015	1.361	2.236			
Annual changes in nominal house prices (-1)	+	0.019	1.765	4.522			
c	?	-1.009	-6.517	-18.421			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.821	-2.987	-6.192	0.106	0.371	0.55
Nominal credit growth gap (-1)	+	3.513	3.001	6.124			
Nominal credit growth gap (-2)	+	-1.673	-2.828	-5.744			
Nominal house prices gap	+	-0.135	-1.780	-4.541			
Nominal house prices gap (-1)	+	0.172	2.230	5.773			
c	?	-0.526	-6.890	-18.699			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal house prices gap (-1)	+	0.045	2.846	8.740	0.064	0.395	0.58
Annual changes in nominal credit	+	0.034	3.223	7.936			
c	?	-0.847	-5.934	-16.062			

Credit aggregates and real variables

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.022	2.047	3.683	0.062	0.401	0.58
Annual changes in credit (-4)	+	0.021	2.232	3.589			
Investment-to-GDP ratio	+	0.078	2.446	4.701			
Investment-to-GDP ratio (-4)	+	-0.050	-2.075	-3.432			
c	?	-1.563	-4.737	-15.186			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.029	2.422	4.689	0.046	0.411	0.60
Annual changes in credit (-4)	+	0.023	2.298	3.839			
Annual changes in nominal consumption (-1)	+	0.002	0.116	0.271			
c	?	-1.019	-6.300	-17.349			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-5.451	-1.770	-4.123	0.084	0.392	0.57
Nominal credit growth gap (-1)	+	14.428	1.623	3.733			
Nominal credit growth gap (-2)	+	-12.797	-1.458	-3.317			
Nominal credit growth gap (-3)	+	3.866	1.303	2.942			
Nominal consumption growth gap (-2)	+	0.042	1.028	2.445			
c	?	-0.507	-6.817	-18.373			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.848	-3.028	-6.369	0.101	0.380	0.56
Nominal credit growth gap (-1)	+	3.551	3.019	6.250			
Nominal credit growth gap (-2)	+	-1.660	-2.797	-5.750			
Investment-to-GDP ratio	+	0.027	2.230	7.302			
c	?	-1.151	-3.924	-12.520			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap (-1)	+	0.091	4.669	11.648	0.071	0.398	0.58
Annual changes in real GDP (-3)	+	0.059	2.398	4.904			
c	?	-0.669	-6.915	-15.213			

Credit aggregates and interest rates

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in nominal credit	+	0.024	2.268	4.173	0.060	0.403	0.59
Annual changes in nominal credit (-4)	+	0.020	2.006	3.374			
Annual changes in nominal LT	+/-	0.119	3.845	5.905			
Real LT (-1)	-	-0.020	-0.924	-2.210			
c	?	-0.858	-4.722	-12.328			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in nominal credit	+	0.024	2.230	4.162	0.065	0.401	0.58
Annual changes in nominal credit (-4)	+	0.018	1.959	3.103			
Annual changes in nominal LT	+/-	0.117	3.607	5.828			
Spread	+	-0.056	-1.967	-4.310			
c	?	-0.879	-5.496	-14.998			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.646	-2.773	-5.720	0.095	0.386	0.56
Nominal credit growth gap (-1)	+	3.172	2.768	5.633			
Nominal credit growth gap (-2)	+	-1.479	-2.553	-5.173			
Annual changes in nominal LT	+/-	0.125	4.014	6.187			
c	?	-0.503	-6.783	-18.285			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.639	-2.773	-5.705	0.091	0.389	0.57
Nominal credit growth gap (-1)	+	3.184	2.797	5.661			
Nominal credit growth gap (-2)	+	-1.496	-2.604	-5.233			
Spread	+	-0.069	-2.337	-5.301			
c	?	-0.481	-6.332	-17.190			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.604	-2.707	-5.543	0.101	0.383	0.56
Nominal credit growth gap (-1)	+	3.124	2.736	5.518			
Nominal credit growth gap (-2)	+	-1.475	-2.559	-5.129			
Spread	+	-0.060	-2.063	-4.596			
Annual changes in nominal LT	+/-	0.114	3.663	5.610			
c	?	-0.478	-6.229	-16.991			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap (-1)	+	0.100	5.141	13.337	0.073	0.397	0.58
Annual changes in nominal LT (-1)	+/-	0.094	3.098	4.767			
c	?	-0.504	-6.781	-18.596			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap (-1)	+	0.101	5.195	13.382	0.078	0.395	0.57
Spread	+	-0.079	-2.756	-6.230			
c	?	-0.476	-6.258	-17.226			

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap (-1)	+	0.097	4.888	12.711	0.089	0.388	0.57
Spread	+	-0.069	-2.408	-5.374			
Annual changes in nominal LT	+/-	0.119	3.725	5.885			
c	?	-0.475	-6.164	-17.079			

Table 6 Multivariate equations probit models

Credit, investment, long-term interest rates, spread and house prices

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.014	1.205	2.153	0.077	0.391	0.57
Annual changes in credit (-4)	+	0.016	1.415	2.523			
Investment-to-GDP ratio	+	0.053	1.785	3.076			
Investment-to-GDP ratio (-4)	+	-0.033	-1.343	-2.134			
Annual changes in nominal LT	+/-	0.099	3.043	4.776			
Real LT (-1)	-	-0.003	-0.124	-0.296			
Spread	+	-0.043	-1.517	-3.215			
Annual change in nominal house prices (-1)	+	0.012	1.060	2.672			
c	?	-1.289	-3.854	-9.958			

Credit, investment, long-term interest rates, spread and house prices

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.014	1.202	2.149	0.077	0.391	0.57
Annual changes in credit (-4)	+	0.016	1.448	2.556			
Investment-to-GDP ratio	+	0.052	1.777	3.062			
Investment-to-GDP ratio (-4)	+	-0.032	-1.349	-2.114			
Annual changes in nominal LT	+/-	0.099	2.978	4.830			
Spread	+	-0.043	-1.531	-3.226			
Annual changes in nominal house prices (-1)	+	0.012	1.110	2.765			
c	?	-1.310	-4.439	-12.076			

Credit, investment, long-term interest rates and spread

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.019	1.666	3.045	0.075	0.392	0.57
Annual changes in credit (-4)	+	0.018	1.943	3.034			
Investment-to-GDP ratio	+	0.069	2.322	4.174			
Investment-to-GDP ratio (-4)	+	-0.046	-1.958	-3.184			
Annual changes in nominal LT	+/-	0.108	3.310	5.308			
Spread	+	-0.043	-1.529	-3.234			
c	?	-1.344	-4.466	-12.417			

Credit, investment, long-term interest rates and spread

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.021	1.801	3.365	0.079	0.390	0.57
Annual changes in credit (-4)	+	0.023	2.323	3.658			
Investment-to-GDP ratio	+	0.060	2.017	3.566			
Investment-to-GDP ratio (-4)	+	-0.040	-1.677	-2.709			
Annual changes in nominal LT	+/-	0.122	3.202	5.809			
Spread	+	-0.044	-1.512	-3.305			
Nominal LT	-	-0.026	-1.396	-3.201			
c	?	-1.132	-3.437	-8.974			

Credit, investment, stock prices, long-term interest rates and spread

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.017	1.450	2.715	0.083	0.386	0.57
Annual changes in credit (-4)	+	0.027	2.713	4.289			
Investment-to-GDP ratio	+	0.017	1.560	4.206			
Annual changes in nominal stock prices (-1)	+	0.006	3.432	4.721			
Annual changes in nominal LT	+/-	0.138	3.642	6.555			
Spread	+	-0.046	-1.552	-3.448			
Nominal LT	-	-0.031	-1.615	-3.764			
c	?	-1.098	-3.557	-9.039			

Credit, investment, stock prices and long-term interest rates

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Annual changes in credit	+	0.016	1.403	2.540	0.075	0.391	0.578
Annual changes in credit (-4)	+	0.024	2.434	3.907			
Investment-to-GDP ratio	+	0.023	1.846	5.650			
Annual changes in nominal stock prices (-1)	+	0.006	3.268	4.442			
Annual changes in nominal LT	+/-	0.126	4.029	6.247			
c	?	-1.444	-5.143	-14.378			

Credit, investment, house prices, money and long-term interest rates

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.823	-2.927	-5.751	0.132	0.358	0.53
Nominal credit growth gap (-1)	+	3.514	2.922	5.695			
Nominal credit growth gap (-2)	+	-1.678	-2.757	-5.362			
Nominal house prices gap	+	-0.384	-0.875	-1.714			
Nominal house prices gap (-1)	+	0.669	0.775	1.528			
Nominal house prices gap (-2)	+	-0.265	-0.597	-1.189			
Annual changes in nominal money	+	0.007	0.422	0.451			
Annual changes in nominal money (-1)	+	0.012	0.796	0.742			
Annual changes in nominal LT	+/-	0.082	2.414	3.878			
Investment-to-GDP ratio	+	0.022	2.638	5.622			
c	?	-1.207	-5.087	-11.732			

Credit, investment, house prices, money and long-term interest rates

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-1.949	-3.180	-6.474	0.132	0.358	0.53
Nominal credit growth gap (-1)	+	3.760	3.186	6.407			
Nominal credit growth gap (-2)	+	-1.804	-3.025	-6.057			
Nominal house prices gap	+	-0.120	-1.598	-3.995			
Nominal house prices gap (-1)	+	0.150	1.960	5.004			
Annual changes in nominal money (-1)	+	0.019	1.534	3.231			
Annual changes in nominal LT	+/-	0.084	2.510	3.965			
Investment-to-GDP ratio	+	0.022	2.567	5.680			
c	?	-1.208	-4.977	-11.770			

Credit, investment and long-term interest rates

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	-0.207	-2.330	-5.117	0.111	0.367	0.54
Nominal credit growth gap (-1)	+	0.283	3.219	7.013			
Nominal house prices gap (-1)	+	0.031	1.987	5.397			
Annual changes in nominal LT	+/-	0.107	3.191	5.158			
Investment-to-GDP ratio	+	0.020	2.078	5.713			
c	?	-0.982	-4.081	-11.266			

Credit, investment and long-term interest rates

Variables	Expected sign	Estimated coefficient	t-statistic gmm	t-statistic ml	McFadden R-squared	qps	lps
Nominal credit growth gap	+	0.071	3.428	8.376	0.096	0.378	0.56
Nominal house prices gap (-1)	+	0.029	1.844	5.176			
Annual changes in nominal LT	+/-	0.125	3.551	6.108			
Investment-to-GDP ratio	+	0.020	1.878	5.777			
c	?	-0.978	-3.724	-11.285			

Annex 3. Description of the data series

This appendix contains some detailed information about the series which are used in the present study. In order to save space, we present them in a table format. Generally speaking, the main sources of the series were the following: BIS, DataStream, Euro area wide model (AWM), European Central Bank (both official and internal databases), Eurostat, Global Financial Data, IMF International Financial Statistics, the respective National Central Banks for each country, OECD Main Economic Indicators and Reuters. All data are seasonally adjusted (with the exception of the interest rates, exchange rates, the stock market index, the dividend yields and the price-earnings ratios) either from the original sources (whenever available, also working day adjusted) or via the multiplicative (ratio to moving average) method. Sources are reported next to each series to which they refer to. Monthly data are calculated as averages of daily data whenever possible. Quarterly data are averages of monthly data. Back data of the official series which start later than January 1969 are reconstructed by using monthly (or quarterly) changes of the series which are as close as possible to the official one.[47] Data for the euro area refers to euro 11 up to December 2000, euro12 from January 2001, euro13 from January 2007 and euro15 from January 2008.

Some sources are abbreviated as follows

AWM = Euro area wide model;

BIS = Bank for International Settlements;

BIS QR04 = source of the house price series refers to the article "What drives housing price dynamics: cross-country evidence", by K. Tsatsaronis and H. Zhu, BIS Quarterly Review, March 2004, pp. 65-78;

ECB = European Central Bank;

GFD = Global Financial Data;

IMF = International Monetary Fund - International Financial Statistics;

MEI = Organisation for Economic Cooperation and Development Main Economic Indicators;

OEO = Organisation for Economic Cooperation and Development Economic Outlook.

47 In case of quarterly data, they are obtained using quarterly changes. When quarterly series derived using the interpolation method from annual data, annual changes are instead applied to compile backward series.

PRICES

Consumer Prices Index
Abbreviation: CPI

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	September 1969	Consumer Prices, All items, interpolated from quarterly data using the linear method.	*Reserve Bank of Australia*.
Canada	January 1969	Consumer Prices, All items.	*BIS*.
Denmark	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1987 Consumer Price Index and before January 1975 Consumer Price Index for 70 localities.	*BIS, ECB, ECB calculations, IMF*.
Euro area	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1992 national Consumer Price Indices (CPIs, excluding owner occupied housing, except for Spain).	*ECB, ECB calculations, Eurostat*.
France	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1990 Consumer Price Index.	*BIS, ECB, ECB calculations*.
Germany	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1980 Consumer Price Index.	*BIS, ECB, ECB calculations*.
Ireland	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1988 Consumer Price Index.	*BIS, ECB, ECB calculations, GFD*.
Italy	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1987 Consumer Price Index.	*BIS, ECB, ECB calculations*.
Japan	January 1969	Consumer Price Index, all items (whole country).	*BIS, MEI*.
Netherlands	January 1969	Harmonised Index of Consumer Prices – overall index. Before October 1987 Consumer Price Index.	*BIS, ECB, ECB calculations*.
New Zealand	January 1969	Consumer Prices, All items, interpolated from quarterly data using the linear method.	*Reserve Bank of New Zealand*.
Norway	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1995 Consumer Price Index.	*BIS, ECB*.
Portugal	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1987 Consumer Price Index.	*BIS, ECB, ECB calculations, GFD*.

Spain	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1992 Consumer Price Index.	*BIS, ECB, ECB calculations.*
Sweden	January 1969	Harmonised Index of Consumer Prices – overall index. Before January 1987 Consumer Price Index.	*BIS, ECB, ECB calculations.*
Switzerland	January 1969	Consumer Prices, All items.	*MEI.*
United Kingdom	January 1969	Consumer Prices, All items.	*UK Office for National Statistics.*
United States	January 1969	Consumer Price Index, all items (all urban consumers).	*BIS.*

House prices
Abbreviation: HP

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	1970 Q1	Residential property prices, Existing dwellings; Residential property in good & poor condition; Large cities.	*Australian bureau of statistics, BIS QR04.*
Canada	1970 Q1	Residential property prices, Existing dwellings; Residential property in good & poor condition; whole country.	*BIS QR04, Canadian real estate association.*
Denmark	1970 Q1	Residential property prices, New and existing dwellings; Residential property in good & poor condition; whole country.	*BIS QR04, Statistik Denmark.*
Euro area	1971 Q1	Residential property prices, based on aggregating euro area country residential property prices, using GDP weights at PPP exchange rates.	*ECB calculations.*
France	1970 Q4	Residential property prices, Existing dwellings; Residential property in good & poor condition; Whole country. Before 1985 Q1 interpolated from annual data using the linear method and seasonally adjusted.	*BIS, Insee, Ministry of Equipment/ECLN.*
Germany	1970 Q1	Residential property prices, New and existing dwellings; Residential property in good & poor condition; Whole country. Before 1995 Q1 Residential property prices, Existing dwellings; Residential property in good & poor condition; West Germany. Interpolated from annual data using the linear method.	*BIS, Deutsche Bundesbank, ECB.*
Ireland	1976 Q1	Residential property prices, New and existing dwellings; Residential property in good & poor condition; Whole country.	*BIS, BIS QR04, Permanent TSB.*
Italy	1969 Q1	Residential property prices, New and existing dwellings; Residential property	*ECB.*

		in good & poor condition; whole country. Interpolated from semi-annual data using the linear method.	
Japan	1969 Q1	House prices, residential; Whole country. Interpolated from semi-annual data using the linear method and seasonally adjusted.	*BIS, BIS QR04.*
Netherlands	1970 Q1	Residential property prices, Existing dwellings; Residential property in good & poor condition; whole country.	*BIS QR04, De Nederlandsche Bank.*
New Zealand	1969 Q1	Residential property prices, All dwellings, whole country. Before 1980 Q1 Residential property prices, all houses; whole country.	*BIS.*
Norway	1970 Q1	Residential property prices, Existing dwellings; Residential property in good & poor condition; whole country.	*BIS QR04, Statistics Norway.*
Portugal	1988 Q1	Residential property prices, New and existing dwellings; Residential property in good & poor condition; whole country.	*Confidencial imobiliario.*
Spain	1971 Q4	Residential property prices, New and existing dwellings; Residential property in good & poor condition; whole country. Before 1987 Q1 interpolated from annual data using the linear method and seasonally adjusted.	*BIS, Banco de España.*
Sweden	1970 Q1	Residential property prices, Existing dwellings; Residential property in good & poor condition; whole country.	*BIS, BIS QR04, Statistics Sweden.*
Switzerland	1970 Q1	Residential property prices, New and existing houses; Residential property in good & poor condition; whole country.	*Swiss National Bank.*
United Kingdom	1969 Q1	Residential property prices, New and existing dwellings; Residential property in good & poor condition; whole country.	*Government agency other than NSI/NCB.*
United States	1970 Q1	Residential property prices, Existing houses; Residential property in good & poor condition; whole country.	*BIS QR04, Office of federal housing enterprise oversight (OFHEO).*

EXCHANGE RATES

Nominal Effective Exchange Rate
Abbreviation: NEER

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	January 1975	Nominal effective exchange rate of the Australian dollar.	*BIS*.
Canada	January 1969	Nominal effective exchange rate of the Canadian dollar (vis-à-vis 10 currencies).	*Bank of England*, *BIS*, *IMF*.
Denmark	January 1969	Nominal effective exchange rate of the Danish Kroner.	*Bank of England*, *BIS*, *IMF*.
Euro area	January 1969	Nominal effective exchange rate of the euro, broad index.	*Bank of England*, *BIS*, *IMF*.
France	January 1969	Nominal effective exchange rate of the French Franc.	*Bank of England*, *BIS*, *IMF*.
Germany	January 1969	Nominal effective exchange rate of the Deutsche Mark vis-à-vis 14 currencies.	*Bank of England*, *BIS*, *IMF*.
Ireland	January 1969	Nominal effective exchange rate of the Irish pound.	*Bank of England*, *BIS*, *IMF*.
Italy	January 1969	Nominal effective exchange rate of the Italian lira (vis-à-vis 24 currencies).	*BIS*, *IMF*.
Japan	January 1969	Nominal effective exchange rate of the Japanese Yen.	*BIS*, *IMF*.
Netherlands	January 1969	Nominal effective exchange rate of the Dutch Guilder.	*BIS*, *IMF*.
New Zealand	January 1975	Nominal effective exchange rate of the New Zealand dollar.	*BIS*.
Norway	January 1969	Nominal effective exchange rate of the Norvegian Kroner.	*Bank of England*, *BIS*, *IMF*.
Portugal	January 1975	Nominal effective exchange rate of the Portuguese Escudo.	*Bank of England*, *BIS*, *IMF*.
Spain	January 1969	Nominal effective exchange rate of the Peseta.	*Bank of England*, *BIS*, *IMF*.
Sweden	January 1969	Nominal effective exchange rate of the Swedish Kroner.	*Bank of England*, *BIS*, *IMF*.
Switzerland	January 1969	Nominal effective exchange rate of the Swiss Franc.	*Bank of England*, *BIS*, *IMF*.
United Kingdom	January 1969	Nominal effective exchange rate of the British Pound, broad coverage.	*BIS*, *IMF*.
United States	January 1969	Nominal effective exchange rate of the US dollar, broad coverage.	*Bank of England*, *BIS*, *IMF*.

Real Effective Exchange Rate
Abbreviation: REER

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	January 1969	Real effective exchange rate of the Australian dollar, broad index (52 countries). Before January 1994 narrow index (27 countries)).	*BIS*.
Canada	January 1969	Real effective exchange rate of the Canadian dollar, broad index (52 countries). Before January 1994 narrow index (27 countries)).	*BIS*.
Denmark	January 1969	Real effective exchange rate of the Danish Kroner, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Euro area	January 1969	Real effective exchange rate of the euro, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
France	January 1969	Real effective exchange rate of the French Franc, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Germany	January 1969	Real effective exchange rate of the Deutsche Mark, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Ireland	January 1969	Real effective exchange rate of the Irish Pound, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Italy	January 1969	Real effective exchange rate of the Italian Lira, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Japan	January 1969	Real effective exchange rate of the Japanese yen, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Netherlands	January 1969	Real effective exchange rate of the Dutch Guilder, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
New Zealand	January 1969	Real effective exchange rate of the New Zealand dollar, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Norway	January 1969	Real effective exchange rate of the Norvegian Kroner, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Portugal	January 1969	Real effective exchange rate of the Portuguese Escudo, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Spain	January 1969	Real effective exchange rate of the Peseta, broad index (52	*BIS*.

		countries). Before January 1994 narrow index (27 countries).	
Sweden	January 1969	Real effective exchange rate of the Swedish Kroner, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
Switzerland	January 1969	Real effective exchange rate of the Swiss Franc, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
United Kingdom	January 1969	Real effective exchange rate of the British Pound, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.
United States	January 1969	Real effective exchange rate of the US dollar, broad index (52 countries). Before January 1994 narrow index (27 countries).	*BIS*.

MONEY AND CREDIT AGGREGATES

Broad Monetary Aggregate
Abbreviation: M

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	January 1969	Money stock M3	*Reserve Bank of Australia*.	Billions of Australian dollars
Canada	January 1969	M2 plus.	*BIS*.	Millions of Canadian dollars
Denmark	January 1969	Harmonised broad monetary aggregate M3.	*BIS*, *IMF*.	Billions of Danish Kroner
Euro area	January 1970	Harmonised broad monetary aggregate “adjusted” stock of M3, based on aggregating euro area country harmonised M3 series using the irrevocable fixed exchange rates. Adjusted after October 1997 for the effect of reclassifications, other revaluations, exchange rate variations and the euro area enlargements.	*ECB*, *ECB calculations*.	Millions of euro
France	December 1969	Harmonised broad monetary aggregate M3.	*BIS, ECB, ECB calculations*.	Millions of euro
Germany	January 1969	Harmonised broad monetary aggregate M3.	*BIS, ECB, ECB calculations*.	Millions of euro
Ireland	January 1970	Harmonised broad monetary aggregate M3.	*ECB*, *ECB calculations*.	Millions of euro
Italy	January 1969	Harmonised broad monetary aggregate M3.	*BIS, ECB, ECB calculations*.	Millions of euro
Japan	January 1969	Money stock M2+CD.	*BIS*.	Billions of yen
Netherlands	January 1970	Harmonised broad monetary aggregate M3.	*ECB*, *ECB calculations*.	Millions of euro
New Zealand	March 1969	Broad monetary aggregate M3. Before April 1977 interpolated from quarterly data using the linear method.	*OECD, Reserve Bank of New Zealand*.	Millions of New Zealand dollars
Norway	January 1969	Broad monetary aggregate M2.	*OECD*.	Millions of

				Norvegian Kroner
Portugal	January 1970	Harmonised broad monetary aggregate M3.	*ECB*, *ECB calculations*.	Millions of euro
Spain	January 1969	Harmonised broad monetary aggregate M3.	*BIS*, *ECB*, *ECB calculations*.	Millions of euro
Sweden	January 1969	Money stock M3, resident concept.	*BIS*, *OECD*.	Millions of Swedish Kroner
Switzerland	January 1969	Money stock M3 (M2 plus time deposits).	*BIS*, *IMF*, *OECD*..	Millions of Swiss Francs
United Kingdom	March 1969	Broad monetary aggregate M4. Before December 1979 interpolated from quarterly data using the linear method.	*OECD*.	Millions of British pounds
United States	January 1969	M2 (M1 plus small time & savings deposits & money market mutual funds).	*BIS*.	Billions of US dollars

Credit/Loans to the private sector
Abbreviation: C

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	January 1969	Credit to the private non-financial sector. It includes also 'narrow credit', securitised loans and other housing loans provided by non-AFIs (i.e. refers to banks, credit unions, building societies, SCCIs, RFCs and the RBA).	*IMF*, *OECD*, *Reserve Bank of Australia*.	Billions of Australian dollars
Canada	January 1969	Credit to the private sector.	*IMF*, *OECD*.	Millions of Canadian dollars
Denmark	January 1969	Credit to economy: domestic lending.	*IMF*, *OECD*.	Millions of Danish Kroner
Euro area	January 1969	Loans to the private sector (adjusted after October 1997 for the effect of reclassifications, other revaluations and exchange rate variations and the euro area enlargements), total maturity, all currencies combined. Based on aggregating euro area country harmonised M3 series using the irrevocable fixed	*ECB*, *ECB calculations*.	Millions of euro

		exchange rates.		
France	January 1969	Loans to the private sector, total maturity, euro area (changing composition) counterpart, non-MFIs excluding general government sector. Before January 1980 bank credit to the domestic economy (counterpart of M3). From January 1999 loans to the private sector.	*BIS*, *ECB*, *ECB calculations*, *IMF*.	Millions of euro
Germany	January 1969	Loans to the private sector, total maturity, euro area (changing composition) counterpart, non-MFIs excluding general government sector. Before January 1980 credit to domestic enterprises and individuals of the banking system.	*BIS*, *ECB*, *ECB calculations*.	Millions of euro
Ireland	1970 Q1	Credit to the private sector. Loans to the private sector, total maturity, euro area (changing composition) counterpart, non-MFIs excluding general government sector.	*ECB*, *ECB calculation*, *IMF*.	Millions of euro
Italy	December 1973	Loans to the private sector, total maturity, euro area (changing composition) counterpart, non-MFIs excluding general government sector. Before January 1983 credit to the private sector.	*BIS*, *ECB*, *ECB calculations*.	Millions of euro
Japan	January 1969	Loans and discounts of domestically licensed banks (banking and trust accounts).	*BIS*, *OECD*.	Billions of yen
Netherlands	January 1969	Loans to the private sector, total maturity, euro area (changing composition) counterpart, non-MFIs excluding general government sector. Before December 1982 credit to the private sector of monetary institutions.	*BIS*, *ECB*, *ECB calculations*.	Millions of euro
New Zealand	January 1969	Private sector credit.	*BIS*, *IMF*, *OECD*.	Millions of New Zealand dollars
Norway	January 1969	Credit extended by private banks.	*OECD*, *Statistics Norway*.	Millions of Norvegian Kroner
Portugal	December 1976	Loans to the private sector, total maturity, euro area (changing composition) counterpart, non-MFIs excluding general government sector. Before January 1980 credit to enterprises and individuals.	*ECB*, *ECB calculations*, *IMF*.	Millions of euro
Spain	January 1969	Loans to the private sector, total maturity, euro area (changing	*BIS*, *ECB*, *ECB*	Millions of euro

		composition) counterpart, non-MFIs excluding general government sector. Before January 1980 total credit to the private sector.	*calculations, IMF*.	
Sweden	January 1969	Bank credit to the private sector.	*BIS, IMF, ECB, ECB calculations, Statistics Sweden*.	Millions of Swedish Kroner
Switzerland	January 1969	Domestic credit to the private sector.	*IMF, OECD, Swiss National Bank*.	Billions of Swiss Francs
United Kingdom	August 1971	Bank and building societies kending to the private sector (counterpart of M4).	*BIS*.	Millions of British Pounds
United States	January 1969	Commercial banks' credit (loans excluding interbank loans).	*OECD, St. Louis Federal Bank*.	Billions of US dollars

INTEREST RATES

Short-term Interest Rate
Abbreviation: ST

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	June 1969	3-month money market bankers' acceptances. Before April 1976 money market, 90 days bank accepted bills.	*BIS*, *Reserve Bank of Australia*.
Canada	January 1969	3-month money market, Treasury Bills, market yield.	*BIS*.
Denmark	January 1969	3-month money market short-term interest rate. Before January 1982 3-month Treasury Bill Yield and before January 1976 call money rate and discount rate.	*BIS*, *ECB calculations*, *GFD*, *IMF*.
Euro area	January 1969	3-month money market short-term interest rate, based on aggregating euro area country 3-month interest rates using GDP weights at PPP exchange rates.	*BIS*, *ECB calculations*.
France	January 1969	3-month money market short-term interest rate (Treasury Bills). Before January 1970 3-month Treasury Bill Yield.	*BIS*, *ECB calculations*, *GFD*.
Germany	January 1969	3-month money market short-term interest rate.	*BIS*, *ECB calculations*.
Ireland	January 1969	3-month money market short-term interest rate. Before January 1971 STF rate.	*BIS*, *ECB calculations*, *IMF*.
Italy	January 1969	3-month money market short-term interest rate. Before March 1976 3-month Treasury Bill Yield.	*BIS*, *ECB calculations*, *GFD*.
Japan	January 1969	3-month money market short-term interest rate. Before February 1979 3-month repo's on bonds (Gensaki). From April 2006 call money (uncollateralized), 3 months.	*BIS*.
Netherlands	January 1969	3-month money market short-term interest rate. Before October 1972 3-month Treasury Bill Yield.	*BIS*, *ECB calculations*, *GFD*.
New Zealand	January 1969	3-month money market bank bills. Before September 1984 3-month (or 90-day) rates and yields/Bank bills and before December 1973 discount rate.	*BIS*, *IMF*, *MEI*.
Norway	January 1969	3-month money market NIBOR. Before August 1978 call money rate and discount rate.	*BIS*, *IMF*.
Portugal	March 1977/1970	3-month money market short-term interest rate. Before February	*BIS*, *ECB calculations*, *IMF*, *OEO*.

	Q1	1989 3-month Treasury Bill rate. Before August 1985 3-month LISBOR, before January 1983 discount rate.	
Spain	January 1969	3-month money market short-term interest rate. Before January 1977 call money rate and Bank of Spain rate.	*BIS*, *ECB calculations*, *IMF*.
Sweden	January 1969	3-month money market short-term interest rate. Before February 1987 3-month (or 90-day) rates and yields/Treasury securities and before January 1982 3-month Treasury Bill Yield.	*BIS*, *ECB calculations*, *GFD*, *MEI*.
Switzerland	January 1969	3-month or 90-day rates and yields/interbank rates. Before January 1974 discount rate.	*IMF*, *MEI*.
United Kingdom	January 1969	3-month money market short-term interest rate. Before July 1977 3-month Treasury Bill Yield.	*BIS*, *ECB calculations*, *GFD*.
United States	January 1969	3-month money market Treasury Bills, market yield.	*BIS*.

Long-term Interest Rate
Abbreviation: LT

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	January 1969	10-year Treasury bonds yield, secondary market.	*BIS*, *IMF*, *Reuters*.
Canada	January 1969	10-year government bond yield (benchmark), secondary market.	*BIS*, *IMF*.
Denmark	January 1969	10-year (or equivalent) government bond yield (capital market interest rate).	*ECB calculations*, *IMF*, *Reuters*.
Euro area	January 1970	10-year government bond yield, based on aggregating euro area country 10-year government bond yields (or their closest substitutes) using GDP weights at PPP exchange rates.	*BIS*, *ECB calculations*, *IMF*.
France	January 1969	10-year government bond yield (benchmark), secondary market.	*BIS*, *ECB calculations*, *IMF*.
Germany	January 1969	9-10 year government bond yield, secondary market.	*BIS*, *ECB calculations*.
Ireland	January 1969	10-year government bond yield (benchmark), secondary market.	*BIS*, *ECB calculations*, *IMF*.
Italy	January 1969	10-year government bond yield (benchmark), secondary market.	*BIS*, *ECB calculations*.
Japan	January 1969	10-year government bond yield (benchmark), secondary market.	*BIS*, *IMF*, *Reuters*.
Netherlands	January 1969	10-year (or equivalent) government bond yield (capital market interest rate)	*ECB calculations*, *IMF*, *Reuters*.

New Zealand	January 1969	10-year government bond yield (benchmark), secondary market.	*BIS*, *IMF*.
Norway	January 1969	10 year government bond yield, secondary market.	*BIS*, *IMF*.
Portugal	January 1969	10 year government bond yield, secondary market.	*BIS*, *ECB calculations*, *IMF*.
Spain	January 1969	10 year government bond yield, secondary market.	*BIS*, *ECB calculations*, *GFD*.
Sweden	January 1969	9-10 year government bond yield, secondary market.	*BIS*, *IMF*, *Reuters*.
Switzerland	January 1969	7-10 year government bond yield, secondary market.	*BIS*, *IMF*.
United Kingdom	January 1969	10-year government bond yield (benchmark), secondary market.	*BIS*, *ECB calculations*, *IMF*.
United States	January 1969	10-year Treasury notes and bonds yield, secondary market.	*BIS*, *Reuters*.

ASSET MARKET VARIABLES

Stock Prices Index
Abbreviation: SP

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	January 1969	Stock exchange prices, shares, overall index.	*BIS, GFD.*
Canada	January 1969	S&P/TSX composite stock price index.	*Reuters.*
Denmark	January 1969	Stock exchange prices, shares, overall index.	*BIS.*
Euro area	January 1973	DJ Euto Stoxx price index and, before 1987, share index covering a set of stocks representing 75%-80% of the total market capitalisation.	*Datastream, Reuters.*
France	January 1969	Stock exchange prices, shares, CAC 40 index. Before January 1988 share prices overall index and before January 1973 SBF-250 Index.	*BIS, GFD, Reuters.*
Germany	January 1969	Stock exchange prices, shares, DAX index.	*BIS.*
Ireland	January 1969	Stock exchange prices, shares, ISEQ total index.	*BIS, MEI.*
Italy	January 1969	Stock exchange prices, shares, overall index (MIB).	*BIS, MEI.*
Japan	January 1969	Stock exchange prices, stocks, Nikkei (TSE 225).	*BIS.*
Netherlands	January 1969	Stock exchange prices, shares, AEX all shares.	*MEI.*
New Zealand	January 1969	Share prices: NZSE All shares Capital index.	*MEI.*
Norway	December 1969	Share prices: index Oslo SE (OSE), total.	*BIS, MEI.*
Portugal	January 1969	Stock exchange prices, shares, overall index. Before January 1988 Oporto PSI-20 Index.	*BIS, GFD.*
Spain	January 1969	Stock exchange prices, shares, overall index. Before January 1985 Madrid SE General Index	*BIS, GFD.*
Sweden	January 1969	Stock exchange prices, shares, overall index (SAX). Before December 1995 share prices AFGX index.	*BIS, MEI.*
Switzerland	January 1969	Swiss DS Market, price index. Before January 1973 USB 100 index.	*MEI, Reuters.*
United Kingdom	January 1969	FTSE 100 share price index.	*MEI, Reuters.*
United States	January 1969	S&P 500 composite –share price index.	*Reuters.*

Dividend yield
Abbreviation: DIV_Y

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	January 1969	Dividend yield, overall index.	*BIS*, *GFD*.
Canada	January 1969	S&P/TSX-300 stock exchange Dividend yield.	*GFD*.
Denmark	July 1969	Copenhagen stock exchange Dividend yield.	*GFD*.
Euro area	January 1973	Dividend yield related to the share index covering a set of stocks representing 75%-80% of the total market capitalisation.	*Datastream*.
France	January 1969	Dividend yield.	*GFD*.
Germany	January 1969	Dividend yield.	*GFD*.
Ireland	May 1990	Dividend yield.	*GFD*.
Italy	January 1969	Dividend yield.	*BIS*, *GFD*.
Japan	January 1969	Dividend yield, shares, Tokyo stock exchange (1^{st} sector).	*BIS*.
Netherlands	July 1969	CBS All x/Royal Dutch Dividend Yield.	*GFD*.
New Zealand	January 1988	Dividend yield.	*GFD*.
Norway	July 1969	Oslo stock exchange Dividend yield.	*GFD*, *OECD*.
Portugal	January 1988	Dividend yield.	*GFD*.
Spain	February 1981	Madrid stock exchange Dividend yield.	*GFD*.
Sweden	January 1969	Stockholm stock exchange Dividend yield.	*GFD*.
Switzerland	January 1969	Dividend yield.	*GFD*.
United Kingdom	January 1969	Dividend yield (all ordinary shares, FTSE).	*BIS*, *GFD*.
United States	January 1969	Dividend yield Standard & Poor's composite (500).	*BIS*.

Price/earnings ratio
Abbreviation: P/E

COUNTRY	START DATE	DESCRIPTION	SOURCES
Australia	January 1969	Price/earnings ratio.	*BIS*, *GFD*.
Canada	January 1969	S&P/TSX-300 stock exchange Price/earnings ratio.	*BIS*, *GFD*.
Denmark	July 1969	Copenhagen stock exchange Price/earnings ratio.	*GFD*.

Euro area	January 1973	Price/earnings ratio related to the share index covering a set of stocks representing 75%-80% of the total market capitalisation.	*Datastream*.
France	September 1971	Price/earnings ratio.	*GFD*.
Germany	July 1969	Price/earnings ratio.	*GFD*.
Ireland	May 1990	Price/earnings ratio.	*GFD*.
Italy	January 1981	Price/earnings ratio.	*GFD*.
Japan	January 1969	Tokyo SE Price/Earnings Ratio, equivalent to the Japan Nikkei 225 Price/earnings ratio.	*GFD*.
Netherlands	July 1969	Price/earnings ratio.	*GFD*.
New Zealand	January 1988	Price/earnings ratio.	*GFD*.
Norway	July 1969	Oslo stock exchange Price/earnings ratio.	*GFD*.
Portugal	January 1988	Price/earnings ratio.	*GFD*.
Spain	December 1979	Madrid stock exchange Price/earnings ratio.	*GFD*.
Sweden	July 1969	Stockholm stock exchange Price/earnings ratio.	*BIS*, *GFD*.
Switzerland	July 1969	Price/earnings ratio.	*GFD*.
United Kingdom	January 1969	FT-Actuaries Price/earnings ratio.	*GFD*.
United States	January 1969	Price/earnings ratio, Standard & Poor's composite (500).	*BIS*.

NATIONAL ACCOUNTS

Nominal Gross Domestic Product
Abbreviation: NGDP

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	1969 Q1	Gross domestic product at market price, current prices.	*Reserve Bank of Australia*.	Millions of Australian dollars
Canada	1969 Q1	Gross domestic product at market price (including 2007 revisions), current prices.	*BIS*.	Millions of Canadian dollars
Denmark	1969 Q1	Gross domestic product at market price (SNA 93), current prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*, *GFD*.	Millions of Danish Kroner
Euro area	1970 Q1	Gross domestic product at market price (ESA 95), current prices. Based on aggregating euro area country nominal GDP using the irrevocable fixed exchange rates.	*AWM*, *Eurostat*.	Millions of euro
France	1969 Q1	Gross domestic product at market price (ESA 95), current prices.	*Eurostat*, *IMF*.	Millions of euro
Germany	1969 Q1	Gross domestic product at market price (ESA 95), current prices.	*Eurostat*, *IMF*.	Millions of euro
Ireland	1969 Q1	Gross domestic product at market price (ESA 95), current prices. Before 1980 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *GFD*.	Millions of euro
Italy	1969 Q1	Gross domestic product at market price (ESA 95), current prices.	*Eurostat*, *IMF*.	Millions of euro
Japan	1969 Q1	Gross domestic product at market price (SNA 93), current prices.	*BIS*, *IMF*.	Billions of yen
Netherlands	1969 Q1	Gross domestic product at market price (ESA 95), current prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *GFD*, *IMF*.	Millions of euro
New Zealand	1969 Q1	Gross domestic product at market price (SNA 93), current prices. Before 1982 Q2 interpolated from annual data using the cubic-spline method.	*BIS*, *GFD*, *IMF*.	Millions of New Zealand dollars

Norway	1969 Q1	Gross domestic product at market price (ESA 95), current prices.	*BIS*, *IMF*, *OEO*.	Millions of Norvegian Kroner
Portugal	1969 Q1	Gross domestic product at market price (SNA 93), current prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *GFD*, *IMF*.	Millions of euro
Spain	1970 Q1	Gross domestic product at market price (ESA 95), current prices.	*Eurostat*, *IMF*.	Millions of euro
Sweden	1969 Q1	Gross domestic product at market price (ESA 95), current prices. Before 1980 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *GFD*, *OEO*.	Millions of Swedish Kroner
Switzerland	1970 Q1	Gross domestic product at market price (ESA 95), current prices.	*BIS*, *IMF*.	Millions of Swiss Francs
United Kingdom	1969 Q1	Gross domestic product at market price (ESA 95), current prices.	*Eurostat*.	Millions of British pounds
United States	1969 Q1	Gross domestic product at market price (including 1999 revisions), current prices.	*BIS*.	Billions of US dollars

Real Gross Domestic Product
Abbreviation: RGDP

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	1969 Q1	Gross domestic product at market price, constant prices (chained volume measures referenced to 2005/06 values).	*Reserve Bank of Australia*.	Millions of Australian dollars
Canada	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (chained 2000 Canadian dollars).	*BIS*.	Millions of chained 2000 Canadian dollars
Denmark	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995). Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*, *GDF*.	Millions of Danish Kroner
Euro area	1970 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995). Based on aggregating euro	*AWM*, *Eurostat*.	Millions of euro

		area country nominal GDP using the irrevocable fixed exchange rates.		
France	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995).	*BIS*, *Eurostat*.	Millions of euro
Germany	1970 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995).	*BIS*, *Eurostat*.	Millions of euro
Ireland	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995). Before 1980 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *GFD*, *OECD*.	Millions of euro
Italy	1969 Q1	Gross domestic product at market price (ESA 95, before 1980 Q1 ESA 79), constant prices (unit price base = 1995).	*BIS*, *Eurostat*.	Millions of euro
Japan	1969 Q1	Gross domestic product at market price (SNA 93), constant prices (chained 2000 yen).	*BIS*, *IMF*, *OECD*.	Billions of chained 2000 yen
Netherlands	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995). Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *GFD*.	Millions of euro
New Zealand	1969 Q1	Gross domestic product at market price (SNA 93), constant prices. Before 1977 Q2 interpolated from annual data using the cubic-spline method.	*BIS*, *GFD*.	Millions of chained 1995/96 NZ dollars
Norway	1969 Q1	Gross domestic product at market price (ESA 95), constant prices - Constant prices (chained 2005 Norvegian Kroner).	*BIS*, *GFD*, *OECD*.	Millions of chained 2005 Norvegian Kroner
Portugal	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995). Before 1980 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *GDF*.	Millions of euro
Spain	1970 Q1	Gross domestic product at market price (ESA 95, before 1980 Q1 ESA 79), constant prices (unit price base = 1995).	*BIS*, *Eurostat*.	Millions of euro
Sweden	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995). Before 1980 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*, *GDF*, *OECD*.	Millions of Swedish Kroner
Switzerland	1970 Q1	Gross domestic product at market price (ESA 95), constant prices (chained 2000 Swiss Francs).	*BIS*, *IMF*.	Millions of chained 2000 Swiss Francs

United Kingdom	1969 Q1	Gross domestic product at market price (ESA 95), constant prices (unit price base = 1995).	*Eurostat*.	Millions of British pounds
United States	1969 Q1	Gross domestic product at market price (ESA 95), constant prices.	*BIS*	Billions of chained 2000 US dollars

Gross Domestic Product Deflator
Abbreviation: GDPD

The GDP deflator has been calculated by dividing the nominal GDP by the real GDP.

Nominal investment
Abbreviation: N_INV

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	1969 Q1	Gross fixed capital formation (SNA 93), current prices.	*BIS*.	Millions of Australian dollars
Canada	1969 Q1	Gross fixed capital formation (including 2007 revisions), current prices.	*BIS*.	Millions of Canadian dollars
Denmark	1971 Q4	Gross fixed capital formation (ESA 95), current prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*.	Millions of Danish Kroner
Euro area	1970 Q1	Gross fixed capital formation (ESA 95), current prices.	*AWM*, *Eurostat*.	Millions of euro
France	1970 Q1	Gross fixed capital formation (ESA 95), current prices.	*BIS*, *Eurostat*.	Millions of euro
Germany	1969 Q1	Gross fixed capital formation (ESA 95), current prices. Before 1991 Q1 gross fixed capital formation of West Germany.	*BIS*, *Eurostat*.	Millions of euro
Ireland	1990 Q4	Gross fixed capital formation (ESA 95), current prices. Before 1997 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*.	Millions of euro
Italy	1970 Q1	Gross fixed capital formation (ESA 95), current prices. Before 1980 Q1 gross fixed capital formation (ESA 79).	*BIS*, *Eurostat*.	Millions of euro
Japan	1969 Q1	Gross fixed capital formation (SNA 93), current prices.	*BIS*, *IMF*.	Billions of Japanese yen
Netherlands	1969 Q1	Gross fixed capital formation (ESA 95), current prices. Before 1977 Q1 gross fixed capital formation (ESA 79).	*BIS*, *Eurostat*.	Millions of euro
New Zealand	1970 Q1	Gross fixed capital formation (SNA 93), current prices. Before 1995 Q1 gross fixed capital formation (SNA 68).	*BIS*, *OEO*.	Millions of New Zealand dollars
Norway	1969 Q1	Gross fixed capital formation (ESA 95), current prices.	*BIS*, *IMF*.	Millions of Norvegian Kroner
Portugal	1970 Q1	Gross fixed capital formation (ESA 95), current prices.	*Eurostat*, *IMF*, *OEO*.	Millions of euro
Spain	1970 Q1	Gross fixed capital formation (ESA 95), current prices. Before 1980 Q1 gross fixed capital formation (ESA 79).	*BIS*, *Eurostat*.	Millions of euro

Sweden	1970 Q1	Gross fixed capital formation (ESA 95), current prices.	*BIS*, *Eurostat*.	Millions of Swedish Kroner
Switzerland	1970 Q1	Gross fixed capital formation (ESA 95), current prices.	*BIS*, *IMF*.	Millions of Swiss Francs
United Kingdom	1969 Q1	Gross fixed capital formation (ESA 95), current prices.	*BIS*, *Eurostat*.	Millions of British pounds
United States	1969 Q1	Gross fixed capital formation, current prices.	*BIS*.	Billions of US dollars

Real investment
Abbreviation: R_INV

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	1969 Q1	Gross domestic fixed capital formation (SNA 93), constant prices.	*BIS*.	Millions of chained 2005/06 Australian dollars
Canada	1969 Q1	Gross domestic fixed capital formation (including 2007 revisions), constant prices.	*BIS*.	Millions of chained 2002 Canadian dollars
Denmark	1969 Q4	Gross fixed capital formation, constant prices (ESA 95). Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*.	Millions of Danish Kroner
Euro area	1970 Q1	Gross fixed capital formation, constant prices (ESA 95).	*AWM*, *Eurostat*.	Millions of euro
France	1970 Q1	Gross fixed capital formation, constant prices (ESA 95).	*BIS*, *Eurostat*.	Millions of euro
Germany	1969 Q1	Gross fixed capital formation, constant prices (ESA 95).	*BIS*, *Eurostat*.	Millions of euro
Ireland	1970 Q1	Gross fixed capital formation, constant prices (ESA 95). Before 1997 Q1 and up to 1990 Q4 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*, *OEO*.	Millions of euro
Italy	1969 Q1	Gross fixed capital formation, constant prices (ESA 95). Before 1980 Q1 gross fixed capital formation (ESA 79).	*BIS*, *Eurostat*.	Millions of euro
Japan	1969 Q1	Gross domestic fixed capital formation (SNA 93), constant	*BIS*.	Billions of

		prices. Before 1980 Q1 gross fixed capital formation (SNA 689).		chained 2000 Japanese yen
Netherlands	1969 Q1	Gross fixed capital formation, constant prices (ESA 95). Before 1977 Q1 gross fixed capital formation (excl. used cap. sales).	*BIS*, *Eurostat*.	Millions of euro
New Zealand	1970 Q1	Gross domestic fixed capital formation (SNA 93), constant prices. Before 1995 Q1 gross fixed capital formation (SNA 68).	*BIS*.	Millions of chained 1995/96 New Zealand dollars
Norway	1970 Q1	Gross fixed capital formation (ESA 95), constant prices.	*BIS*, *OEO*.	Millions of chained 2005 Norvegian Kroner
Portugal	1988 Q4	Gross fixed capital formation, constant prices (ESA 95). Before 1995 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*.	Millions of euro
Spain	1970 Q1	Gross fixed capital formation, constant prices. Before 1980 Q1 gross fixed capital formation (ESA 79).	*BIS*, *Eurostat*.	Millions of euro
Sweden	1970 Q1	Gross fixed capital formation (ESA 95), constant prices.	*BIS*, *Eurostat*, *OEO*.	Millions of Swedish Kroner
Switzerland	1969 Q1	Gross fixed capital formation (ESA 95), constant prices.	*BIS*.	Millions of chained 2000 Swiss Francs
United Kingdom	1969 Q1	Gross fixed capital formation, constant prices.	*Eurostat*.	Millions of British pounds
United States	1969 Q1	Gross fixed capital formation (ESA 95), constant prices.	*BIS*.	Billions of chained 2000 US dollars

Investment Deflator
Abbreviation: INVD

The investment deflator has been calculated by dividing nominal investment by real investment.

Nominal Consumption
Abbreviation: N_CONS

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	1969 Q1	Final private consumption expenditure (SNA 93), current prices.	*BIS*.	Millions of Australian dollars
Canada	1969 Q1	Consumption on consumer goods and services (including 2007 revisions), current prices.	*BIS*.	Millions of Canadian dollars
Denmark	1971 Q4	Final private consumption expenditure (ESA 95), current prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*.	Millions of Danish Kroner
Euro area	1970 Q1	Final private consumption expenditure (ESA 95), current prices.	*AWM*, *Eurostat*.	Millions of euro
France	1970 Q1	Final private consumption expenditure, current prices (ESA 95).	*Eurostat*, *IMF*.	Millions of euro
Germany	1969 Q1	Final private consumption expenditure, current prices (ESA 95). Before 1991 Q1 final private consumption expenditure of West Germany.	*BIS*, *Eurostat*.	Millions of euro
Ireland	1970 Q1	Final private consumption expenditure (ESA 95), current prices. Before 1997 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*, *OEO*.	Millions of euro
Italy	1970 Q1	Final private consumption expenditure, current prices (ESA 95). Before 1980 Q1 final private consumption expenditure (ESA 79).	*BIS*, *Eurostat*.	Millions of euro
Japan	1969 Q1	Final private consumption expenditure (SNA 93), current prices. Before 1980 Q1 final private consumption expenditure (SNA 68).	*BIS*.	Billions of Japanese yen
Netherlands	1971 Q4	Final private consumption expenditure (ESA 95), current prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*.	Millions of euro
New Zealand	1970 Q1	Private consumption expenditure (SNA 93), current prices. Before 1995 Q1 private consumption expenditure (SNA 68).	*BIS*, *OEO*.	Millions of New Zealand dollars

Norway	1969 Q1	Consumption expenditure, households and non-profit institutions (ESA 95), current prices.	*BIS*, *IMF*.	Millions of Norvegian Kroner
Portugal	1970 Q1	Final private consumption expenditure (ESA 95), current prices.	*Eurostat*, *IMF*.	Millions of euro
Spain	1970 Q1	Final private consumption expenditure, current prices (ESA 95). Before 1980 Q1 final private consumption expenditure (ESA 79).	*BIS*, *Eurostat*.	Millions of euro
Sweden	1970 Q1	Final private consumption expenditure (ESA 95), current prices.	*BIS*, *Eurostat*.	Millions of Swedish Kroner
Switzerland	1969 Q1	Private consumption expenditure of goods and services (ESA 95), current prices. Before 1980 Q1 Private consumption expenditure of goods and services (OEEC 63).	*BIS*.	Millions of Swiss Francs
United Kingdom	1969 Q1	Final private consumption expenditure (ESA 95), current prices.	*BIS*, *Eurostat*.	Millions of British pounds
United States	1969 Q1	Final personal consumption expenditure, current prices.	*BIS*.	Billions of US dollars

Real Consumption
Abbreviation: R_CONS

COUNTRY	START DATE	DESCRIPTION	SOURCES	UNIT
Australia	1969 Q1	Private consumption (SNA 93), constant prices.	*BIS*.	Millions of chained 2005/06 Australian dollars
Canada	1969 Q1	Consumption of consumer goods and services (ESA 95), constant prices.	*BIS*.	Millions of chained 2002 Canadian dollars
Denmark	1969 Q4	Final private consumption expenditure, constant prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*BIS*, *Eurostat*.	Millions of Danish Kroner
Euro area	1970 Q1	Final private consumption expenditure (ESA 95), constant	*AWM*, *Eurostat*.	Millions of euro

		prices.		
France	1969 Q4	Final private consumption expenditure (ESA 95), constant prices. Before 1978 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*.	Millions of euro
Germany	1970 Q1	Final private consumption expenditure (ESA 95), constant prices. Before 1991 Q1 final private consumption expenditure of West Germany.	*BIS*, *Eurostat*.	Millions of euro
Ireland	1970 Q1	Final private consumption expenditure (ESA 95), constant prices. Before 1997 Q1 and up to 1990 Q4 interpolated from annual data using the cubic-spline method.	*Eurostat*, *OEO*.	Millions of euro
Italy	1970 Q1	Final private consumption expenditure (ESA 95), constant prices. Before 1980 Q1 domestic consumption of households (ESA 95).	*BIS*, *Eurostat*, *OECD*.	Millions of euro
Japan	1969 Q1	Private consumption (SNA 93), constant prices. Before 1994 Q1 private consumption (SNA 68).	*BIS*.	Billions of chained 2000 Japanese yen
Netherlands	1969 Q4	Final private consumption expenditure (ESA 95), constant prices. Before 1977 Q1 interpolated from annual data using the cubic-spline method.	*Eurostat*.	Millions of euro
New Zealand	1970 Q1	Private consumption expenditure, (SNA 93), constant prices. Before 1995 Q1 private consumption (SNA 68).	*BIS*, *OEO*.	Millions of chained 1995/96 New Zealand dollars
Norway	1970 Q1	Private consumption expenditure (ESA 95), constant prices.	*BIS*, *OEO*.	Millions of chained 2005 Norvegian Kroner
Portugal	1970 Q1	Private consumption expenditure (ESA 95), constant prices. Before 1995 Q1 and up to 1988 Q4 interpolated from annual data using the cubic-spline method.	*Eurostat*, *OEO*.	Millions of euro
Spain	1970 Q1	Final private consumption expenditure (ESA 95), constant prices. Before 1980 Q1 private consumption (ESA 79).	*BIS*, *Eurostat*.	Millions of euro
Sweden	1980 Q1	Final private consumption expenditure (ESA 95), constant prices.	*BIS*, *OECD*.	Millions of Swedish Kroner

Switzerland	1969 Q1	Private consumption of consumer goods and services (ESA 95), constant prices. Before 1980 Q1 private consumption of consumer goods and services (OEEC 63)-	*BIS*, *OECD*.	Millions of chained 2000 Swiss Francs
United Kingdom	1969 Q1	Final private consumption expenditure (ESA 95), constant prices.	*Eurostat*.	Millions of British pounds
United States	1969 Q1	Personal consumption, constant prices.	*BIS*.	Billions of chained 2000 US dollars

Private consumption Deflator
Abbreviation: CONSD

The private consumption deflator has been calculated by dividing nominal private consumption by real private consumption.

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