ARTICLES

ASSET PRICE BUBBLES AND MONETARY POLICY REVISITED

In the light of the recent financial crisis, this article reconsiders the role of asset prices in the conduct of monetary policy, with a focus on the desirability and feasibility of conducting monetary policy in a manner that "leans against the wind" of asset price bubbles.

Boom/bust cycles in asset prices are potentially very costly in terms of output and price stability. Central banks have an interest in reducing the risks to price stability that arise from such developments. Against this background, this article argues that both the experience of the recent financial crisis and the results of economic research have strengthened the case for central banks "leaning against the wind" of asset price bubbles. While the identification of such bubbles is not an easy task, recent research suggests that money and credit indicators can help to predict boom/bust cycles in asset prices. This makes it all the more important that central banks monitor such variables closely on a regular basis.

The ECB's stability-oriented monetary policy strategy contains elements of a "leaning against the wind" approach. In particular, the prominent role assigned to monetary analysis within the strategy ensures that money, credit and liquidity conditions, which are empirically associated with the evolution of asset prices, are duly factored into the conduct of monetary policy. Monetary analysis provides a valuable framework within which to analyse longer-term risks to price stability, such as those derived from boom/bust cycles in asset prices.

1 INTRODUCTION

The recent financial crisis has again demonstrated that boom/bust cycles in asset prices can have dramatic effects on macroeconomic stability. In pursuing their mandate to maintain price stability, central banks need to consider whether, and how, to incorporate an analysis of such asset price developments in their monetary policy decisions. Against this background, this article revisits the relationship between asset price bubbles and monetary policy, drawing lessons both from recent experience and from advances in economic literature.

In the past the ECB has argued that consideration should be given to "leaning against the wind" of asset price bubbles when taking interest rate decisions.[1] Such an approach does not entail the targeting of any particular asset price or index. Rather, it aims to ensure that the overall assessment supporting monetary policy decisions incorporates an analysis of the medium to long-term risks to price stability that stem from asset price developments.

Indeed, there are a variety of mechanisms through which asset prices can affect consumer prices. For example, asset prices can affect consumer prices through a wealth effect on the side of consumers and a "Q effect" on the side of firms.[2] If Q – i.e. the ratio of the stock market value of a firm to the replacement cost of its capital – rises as a result of an increase in equity prices, the firm can raise more capital through the equity it issues. This makes it more attractive for firms to raise new capital, thus increasing investment demand, which may in turn lead to higher prices for goods and services. Additional effects can stem from residential property prices, which, via higher wages demanded by workers, may lead to increases in both the prices of goods and services and, therefore, consumer prices. Finally, a further potential channel may be the impact of asset prices on investor and consumer confidence.

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1 "Asset price bubbles and monetary policy", *Monthly Bulletin*, ECB, Frankfurt am Main, April 2005.
2 See Tobin, J., "A general equilibrium approach to monetary theory", *Journal of Money, Credit and Banking*, 1, 1969, pp. 15-29. Tobin's Q is defined as the market value of capital relative to the replacement cost of capital.

Research conducted over the past decade also offers evidence of a link between money and credit developments on the one hand and asset prices on the other.[3] As a result, the ECB's two-pillar monetary policy strategy – with a prominent role played by monetary analysis – has been seen as a framework supporting the analysis of the relationships between money, credit and asset prices with a view to assessing risks to price stability.

This article shows that both recent economic developments and the results of economic research have strengthened the case for central banks "leaning against the wind" of incipient asset price imbalances. By looking at asset price dynamics through the lens of monetary developments, the ECB's monetary policy strategy integrates them into the general analytical framework designed to maintain price stability in the euro area.

The structure of the article is as follows. Section 2 presents the "leaning against the wind" approach to the conduct of monetary policy and outlines the main traditional arguments against it, as well as discussing recent developments relevant to its possible implementation. Section 3 illustrates the results of recent research regarding methods for identifying boom/bust cycles in asset prices, while Section 4 discusses the role of money and credit as early warning indicators signalling boom/bust cycles in asset prices. In this respect, this article moves away from the discussion of the traditional leading indicator properties of money/credit for consumer prices, which are instead tackled in the companion article in this issue of the Monthly Bulletin.[4] Section 5 presents some conclusions.

2 THE CASE FOR "LEANING AGAINST THE WIND"

Before the emergence of the financial crisis in August 2007, an influential view emphasised that central banks should not "lean against" asset price surges in their conduct of monetary policy. While containing short to medium-term inflationary pressures stemming from positive wealth effects on spending decisions was considered justified during the boom phase, it was widely believed that central banks should let asset price bubbles burst naturally, rather than acting to contain them. The appropriate approach was to support the economy with accommodative monetary policy during the bust, but not to attempt to dampen the initial boom.

Recent events have challenged this view. It is now apparent that in the years prior to the onset of the financial crisis, subdued inflationary pressures coexisted with rampant asset price growth and the slow accumulation of financial imbalances. In this context, inflation forecasts, with their focus on shorter-run horizons, may not be an accurate indicator of imbalances building up in the economy that pose risks to price stability over the longer term. In such times, leaning against the wind of asset price misalignments may be a more desirable policy option.[5]

Leaning against the wind does not imply asset price targeting. It can instead be defined as a strategy whereby the central bank adopts a somewhat tighter policy stance in the face of an inflating asset price bubble than it would have done if confronted with a similar macroeconomic outlook under more normal asset market conditions. In this way, the central bank – at an early stage in the market dynamics – errs on the side of caution by trying to avoid feeding the bubble with an overly accommodative policy.

3   Borio, C. and Lowe, P., "Securing sustainable price stability: should credit come back from the wilderness?", *BIS Working Papers*, No 157, BIS, Basel, 2004. See also the references quoted in Box 3 of the article cited in footnote 1.
4   See the article entitled "Enhancing monetary analysis" in this issue of the Monthly Bulletin.
5   A closely related concept in the literature is "leaning against financial fragility". This concept was put forward in Diamond, D.W. and Rajan, R.G., "Illiquidity and interest rate policy", *NBER Working Papers*, No 15197, Cambridge, Massachusetts, 2009, and Giavazzi, F. and Giovannini, A., "Central banks and the financial system", *CEPR Discussion Papers*, No DP7944, London, 2010. The authors advocate that central banks deal with the inherent fragility of the financial system – which stems from banks' liquidity transformation (i.e. the tendency to borrow too much at too short a maturity and then invest in excessively illiquid assets) – by "putting a premium" on policy rates, thus having rates higher than the "natural" rate during normal times.

Consistent with a mandate to maintain price stability on a lasting basis, the central bank may thus potentially tolerate some greater short-term volatility in price developments in exchange for better prospects for preserving price stability over the longer term.

Traditional scepticism about leaning against the wind has rested on three legitimate concerns.[6] First, in times of market euphoria, the effectiveness of monetary policy in containing asset price surges may be open to doubt. Policy rates might have to be raised significantly in order to have a measurable effect on booming asset prices. Second, monetary policy has been seen as a very blunt tool for containing asset price bubbles. Raising policy interest rates will, under normal circumstances, depress the prices of many assets (including those which are not booming), as well as dampening the real economy and consumer prices. Consequently, the collateral damage created by a monetary policy that leans against asset price bubbles could be considerable. Third, some concerns surround central banks' ability to identify asset price bubbles in real time. In particular, if asset price surges were driven and justified by changes in economic fundamentals (rather than constituting a bubble), a policy response to such a surge could destabilise the economy unnecessarily.

However, experience acquired during the financial crisis and the findings of recent empirical and theoretical research have shed more light on the issue. Overall, they temper the concerns expressed above and thus lend support to leaning against asset price bubbles as a sound approach to monetary policy-making.[7]

First, in respect of the scepticism regarding the effectiveness and efficiency of monetary policy in containing asset price bubbles, recent research has pointed to additional monetary policy transmission channels, each of which can reasonably be expected to increase the impact of monetary policy during financial boom periods. For example, the "risk-taking" channel suggests

that banks' attitude towards risk is strongly correlated with the monetary policy stance. In the presence of very considerable intra-financial sector leverage, even relatively modest increases in policy rates can lead to significant changes in credit conditions and market dynamics, to the extent that they alter financial institutions' risk tolerance.

Similarly, mechanisms that operate through the signalling effects of monetary policy or the role potentially played by central banks in discouraging herding behaviour by investors can result in policy rate changes exerting more pronounced effects on asset prices than was typically thought to be the case in the past.[8] To illustrate such a signalling transmission channel, it has been argued that monetary policy actions convey the central bank's assessment of the state of the economy in a more credible way than any speech or statement. This, in turn, enables more efficient investment and enhanced decision-making by investors. As regards the issue

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6 See, for instance, Kohn, D., "Monetary policy and asset prices", speech given at the colloquium (entitled "Monetary policy: a journey from theory to practice") held in honour of Otmar Issing, Frankfurt am Main, 16 March 2006, and Assenmacher-Wesche, K. and Gerlach, S., "Monetary policy and financial imbalances: facts and fiction", *Economic Policy*, Vol. 25, No 63, 2010, pp. 437-482.

7 It should be noted that the ECB was discussing this issue at a relatively early stage and has shown some sympathy and openness with regard to the principle of leaning against the wind, while stressing the implicit link with the monetary analysis element of the ECB's monetary policy strategy. See, for instance: Issing, O., "Monetary and financial stability: is there a trade-off?", speech at BIS conference on "Monetary stability, financial stability and the business cycle", Basel, 28-29 March 2003; Trichet, J.-C., "Asset price bubbles and monetary policy", MAS lecture, Singapore, 8 June 2005; and, more recently, Papademos, L., "Financial market excesses and corrections: a central banker's perspective", speech at the International Research Forum on Monetary Policy, Frankfurt am Main, 26 June 2008; González-Páramo, J.M., "Financial market failures and public policies: a central banker's perspective on the global financial crisis", closing remarks at XVI Meeting of Public Economics, Granada, 6 February 2009; Stark, J., "Monetary policy before, during and after the financial crisis", speech delivered at the University of Tübingen, Tübingen, 9 November 2009; and Trichet, J.-C., "Credible alertness revisited", intervention at the Federal Reserve symposium on "Financial Stability and Macroeconomic Policy", Jackson Hole, 22 August 2009.

8 See Hoerova, M., Monet, C. and Temzelides, T., "Money talks", *Working Paper Series*, No 1091, ECB, Frankfurt am Main, 2009.

of herding behaviour, whereby investors pay attention to the decisions of other market participants, the more strongly markets follow a given trend, the more likely investors are to fuel a bubble. It is found that raising policy rates may be effective in stopping herding behaviour and instead persuading investors to base decisions on their own information set as regards the expected profitability of investment projects.[9]

Second, with regard to the welfare implications of leaning against the wind, analysis of the costs of boom/bust cycles in asset prices in developed economies has been deepened and refined.[10] Theory-based approaches to the calculation of the costs of bubbles give ambiguous results[11] or even justify bubbles as being consistent with individual optimising behaviour in general equilibrium.[12] But existing theoretical models use fairly specific assumptions to allow for bubbles in general equilibrium[13] and, with regard to welfare analysis, tend to neglect important aspects which make bubbles costly in the real world. For example, the fiscal burden for future generations, the loss of trust in the market economy, and the incentives provided for future risk-taking owing to various types of public intervention and rescue packages – i.e. the "moral hazard" problem – are not usually included in calculations of the welfare cost of bursting asset price bubbles. Admittedly, not all boom/bust cycles are detrimental and have significant real effects. This is also one of the reasons why mechanical asset price targeting is not a sensible option for monetary policy. However, the experience of the recent financial crisis, which has been accompanied by sharp declines in global economic activity, increasing unemployment and significant financial instability in a number of countries and markets, is a reminder that there are boom/bust cycles which have the potential to trigger systemic crises and thus constitute a serious threat to world economic growth.

Third, with regard to the ability to identify bubbles in real time, recent research has emphasised that uncertainties surrounding the assessment of whether an asset price boom is indeed a bubble or merely a reflection of economic fundamentals are not necessarily greater than those surrounding other economic concepts commonly used as indicators by central banks, such as the calculation of the degree of slack in the economy (i.e. the "output gap"). Indeed, recent studies by BIS and ECB staff have shown that simple statistical methods that analyse swift and persistent asset price movements can identify potentially dangerous periods of financial market exuberance. To some extent, these periods of market exuberance can be predicted by means of the careful analysis of money and credit developments. Most importantly, the leading relationship between private credit and asset price booms, which was shown for euro area share prices in 2005,[14] has in the meantime been confirmed by empirical studies covering several OECD countries with regard to both housing and equity prices.[15] The next sections describe these results and the methods used to obtain them in greater detail.

3 DETECTING ASSET PRICE BOOMS/BUSTS ON THE BASIS OF VARIOUS METHODS

The challenge of how to identify and quantify asset price bubbles and misalignments and/or financial imbalances has always been, and remains, an extremely difficult one. This challenge is compounded by the need, for operational monetary policy purposes, to recognise the additional complications of

9   See Loisel, O., Pommeret, A. and Portier, F., "Monetary policy and herd behavior in new-tech investment", mimeo, 2009.
10 There is only scant evidence of beneficial effects arising from asset price bubbles, and this is mainly limited to developing countries.
11 See, for example, Fahri, E. and Tirole, J., "Collective moral hazard, maturity mismatch and systemic bailouts", *NBER Working Papers*, No 15138, Cambridge, Massachusetts, 2009.
12 See, for example, Tirole, J., "Asset bubbles and overlapping generations", *Econometrica*, Vol. 53, No 6, 1985, pp. 1499-1528.
13 See Santos, M.S. and Woodford, M., "Rational asset pricing bubbles", *Econometrica*, Vol. 65, No 1, 1997, pp. 19-58.
14 See, for example, Chart 1 in the article cited in footnote 1.
15 See Alessi, L. and Detken, C., "'Real time' early warning indicators for costly asset price boom/bust cycles: a role for global liquidity", *Working Paper Series*, No 1039, ECB, Frankfurt am Main, 2009, and Agnello, L. and Schuknecht, L., "Booms and busts in housing markets: determinants and implications", *Working Paper Series*, No 1071, ECB, Frankfurt am Main, 2009.

a real-time assessment, such as lags in the publication of key time series and subsequent revisions to the data.

As a starting point, it is important to have a clear notion of what is meant by an asset price misalignment. From a policy perspective, it is of particular interest to identify those periods which can be labelled harmful booms/busts – i.e. those which have severe real economic effects. These periods often include currency and banking crises, which are usually preceded by a boom/bust cycle in asset prices that distorts the allocation of resources in the economy and harms macroeconomic stability for a prolonged period of time. When an asset price bubble bursts, a period of severe economic contraction may follow, characterised by the disorderly readjustment of markets, output losses, declines in property prices and heightened uncertainty.[16]

Recent economic literature has defined asset price misalignments and financial imbalances in various ways. The methods span a spectrum ranging from, on the one hand, purely statistical methodologies which identify particularly strong or weak asset price developments to, on the other hand, model-based analysis of fundamental explanations of developments in asset price indices. In either case, significant deviations from a given norm (defined by historical experience and the underlying model respectively) are considered booms or busts.

To illustrate the statistical methodologies, a variety of tools have been used to define asset price misalignments on the basis of simple univariate time series methods. For example, Bordo and Jeanne define a bust as a period in which the three-year moving average of the growth rate of the asset price index considered is lower than a given threshold (which, in their case, is represented by the average growth rate less a certain multiple of the standard deviation of the individual growth rates).[17] Since then the literature has expanded and this criterion has been extended by calculating the threshold level in different ways. These consist of either

choosing a different multiple of the standard deviation[18] or fixing the threshold at a constant value.[19] The latest studies also vary considerably with regard to the asset price index to be evaluated, which can be either separate stock and house price indices or composite indicators which take into account developments in both markets.[20] It goes without saying that all of these criteria can, conversely, also be applied to booms by considering the periods when the index exceeds corresponding thresholds.

Recently, progress has also been made on more fundamental methods for detecting asset price misalignments, such as the "quantile methodology", which relies on non-parametric quantile regressions.[21] This methodology is based on the estimation of the probability

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16 See the article cited in footnote 1.
17 See Bordo, M.D. and Jeanne, O., "Monetary policy and asset prices: does 'benign neglect' make sense?", *International Finance*, Vol. 5, No 2, 2002, pp. 139-164.
18 One of the most recent examples of studies applying a different time-varying threshold is the paper by Alessi, L. and Detken, C. cited in footnote 15, in which the criterion used for booms is a period of at least three consecutive quarters in which the asset price index is above its recursive trend plus 1.75 times the standard deviation. See also Gerdesmeier, D., Reimers, H.-E. and Roffia, B., "Asset price misalignments and the role of money and credit", *Working Paper Series*, No 1068, ECB, Frankfurt am Main, 2009, in which the authors define a bust as the composite asset price index falling below a threshold level (calculated as the mean minus 1.5 times its standard deviation) within a three-year period.
19 A fixed value for the threshold is considered in "Lessons for monetary policy from asset price fluctuations", Chapter 3, *World Economic Outlook*, IMF, Washington DC, October 2009. In this study, busts are defined as periods in which, in real terms, the four-quarter trailing moving average of the annual growth rate of asset prices falls below a fixed threshold, which is set at -5% for house prices and -20% for stock prices. Other recent papers which apply a fixed value threshold are: Detken, C. and Smets, F., "Asset price booms and monetary policy", in Siebert, H. (ed.), *Macroeconomic Policies in the World Economy*, Springer, Berlin, 2004; and Adalid, R. and Detken, C., "Liquidity shocks and asset price boom/bust cycles", *Working Paper Series*, No 732, ECB, Frankfurt am Main, 2007, in which the threshold for the aggregate real asset price index is 10% above its trend level.
20 For some examples, see: the paper by Alessi, L. and Detken, C. cited in footnote 15 and the paper by Gerdesmeier, D., Reimers, H.-E. and Roffia, B. cited in footnote 18 as regards asset prices; and Berg, A. and Pattillo, C., "Predicting currency crises: the indicators approach and an alternative", *Journal of International Money and Finance*, Vol. 18, No 4, 1999, pp. 561-586, as regards currency crises.
21 On the issue of identifying asset price bubbles in both stock and housing markets (including identification based on fundamental approaches), see Boxes 1 and 2 in the article cited in footnote 1.

distribution of asset prices conditional on their macroeconomic fundamentals. The basic hypothesis is that the probability distribution of the asset price index is not constant over time, instead changing as a function of the macroeconomic environment. Thus, a given asset price may be considered to be too high, normal or too low depending on the prevailing macroeconomic conditions. While the quantile method allows an analysis of the evolution of the dispersion and asymmetry of the distribution of asset prices over time, it also takes into account the dynamics of the macroeconomic fundamentals.[22]

Overall, the considerations above support the idea that the range of methods currently available for detecting periods of excessive asset price developments has widened. At the same time, on a general basis, it seems fair to argue that many crises (e.g. the Scandinavian crisis in the early 1990s and the East Asian crisis, as well as the most recent crisis) seem, to a large extent, to be picked up by most of these methods. This notwithstanding, uncertainties regarding the correct identification of those episodes in real time certainly still persist, thus warranting a cross-check of the results stemming from those different methods.

4 THE ROLE OF MONEY AND CREDIT AS EARLY WARNING INDICATORS

Having defined asset price bubbles or misalignments, an important issue from the policy-making perspective – of particular relevance if a leaning against the wind approach is being considered – is whether such misalignments and their resolution can be predicted reasonably far ahead. Economists use, inter alia, "early warning indicator" models, which aim to spot irregular patterns in other variables which tend to exhibit unusual behaviour prior to booms and busts.

A number of methods used to implement such an early warning approach are presented in the chart, with particular prominence given to those applied in recent studies by ECB staff.[23] This section briefly describes these methods, while the box (entitled "Early warning indicators for asset price imbalances: recent empirical evidence based on ECB studies") provides specific examples of their application.
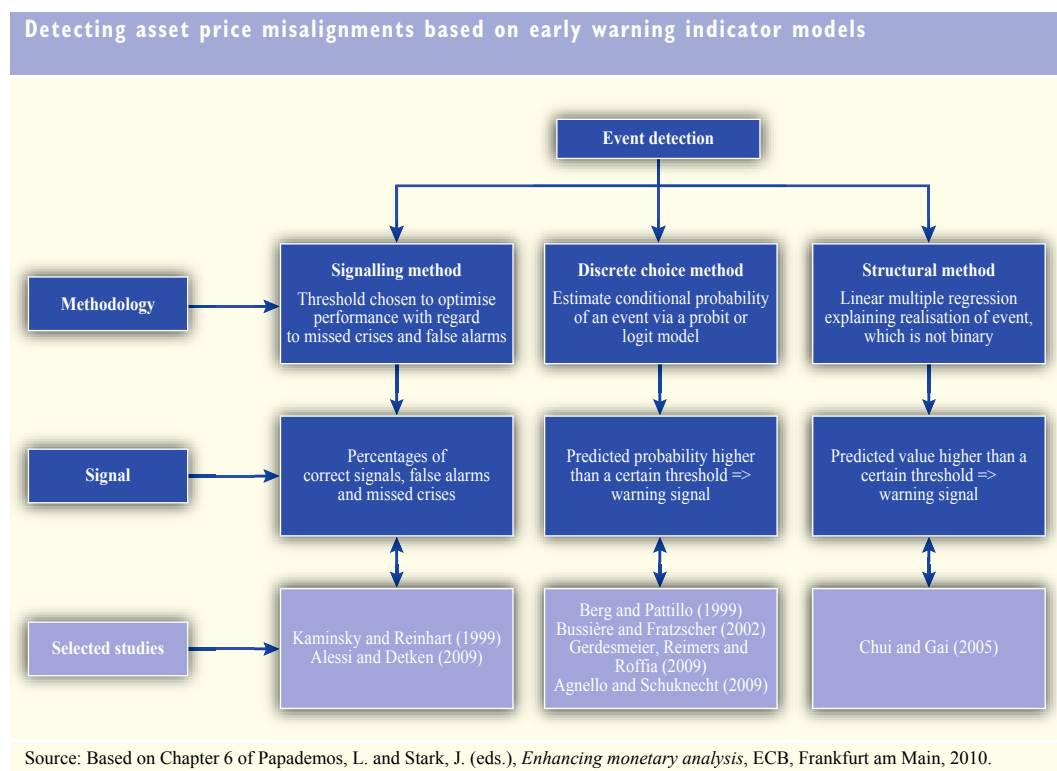
The first method is the "signalling" method. This methodology defines specific thresholds for each indicator variable. A warning signal for the occurrence of a boom or bust within a given period is issued whenever the indicator breaches that threshold, which could be set, for example, at a certain percentile of its own distribution. The choice of value for the threshold is important, as it affects the number of signals issued. For instance, if it is set too high, there will be too few signals and, therefore, the possibility of missing some busts. Conversely, if the threshold is too low, fluctuations in the variables will trigger more frequent alarms, a number of which will, however, be false alarms. In order to determine the optimal threshold, consideration should be given to the policy-maker's relative aversion to missed crises and false alarms.

The second method is the "discrete choice" methodology, which makes use of regression techniques to evaluate an indicator's ability to predict either a boom or a bust. More specifically, this methodology consists of running bivariate and/or multivariate probit/logit regressions and estimating the probability of a boom/bust within a given time frame. A warning signal is issued when this probability exceeds a certain threshold. While the discrete choice method has several advantages (inter alia, the possibility of testing the statistical significance of individual variables and deriving the probability of an event),[24] there

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22 A recent example of this approach can be found in Machado, J.A.F. and Sousa, J., "Identifying asset price booms and busts with quantile regressions", *Working Papers*, No 8/2006, Banco de Portugal, Lisbon, 2006. See also the article cited in footnote 1.

23 For other early warning indicator methods, see Chapter 6 of Papademos, L. and Stark, J. (eds.), *Enhancing monetary analysis*, ECB, Frankfurt am Main, 2010.

24 See, for example, the paper by Berg, A. and Pattillo, C. cited in footnote 20.

Detecting asset price misalignments based on early warning indicator models

	Event detection	
Methodology	**Signalling method** — Threshold chosen to optimise performance with regard to missed crises and false alarms	**Discrete choice method** — Estimate conditional probability of an event via a probit or logit model	**Structural method** — Linear multiple regression explaining realisation of event, which is not binary
Signal	Percentages of correct signals, false alarms and missed crises	Predicted probability higher than a certain threshold => warning signal	Predicted value higher than a certain threshold => warning signal
Selected studies	Kaminsky and Reinhart (1999) Alessi and Detken (2009)	Berg and Pattillo (1999) Bussière and Fratzscher (2002) Gerdesmeier, Reimers and Roffia (2009) Agnello and Schuknecht (2009)	Chui and Gai (2005)

Source: Based on Chapter 6 of Papademos, L. and Stark, J. (eds.), *Enhancing monetary analysis*, ECB, Frankfurt am Main, 2010.

is no clear evidence suggesting that it is superior to the signalling method, as was shown in the context of the recent crisis. For this reason, these methodologies can be seen as complementary and are often applied in parallel.

Some other methods for identifying booms and busts have been less common in the literature, but are now gradually gaining in importance. One example is the "structural" method, which consists of constructing an early warning model in a linear framework based on macroeconomic variables on both sides of the relationship and the definition of some thresholds triggering a signal.[25]

Although the use of these early warning indicators has been increasing in recent years (and with promising results in relation to the latest crises), it is fair to say that economic literature still remains divided with regard to confidence in these types of model being able to predict the next financial crisis (i.e. to successfully forecast out of sample).

This notwithstanding, recent BIS and ECB studies (discussed later on) seem to support a more optimistic outlook as regards this issue.[26]

While early warning models can provide a tool to derive signals (or the likelihood) of an upcoming boom/bust cycle in asset prices, a crucial aspect in the working of such models is the selection of the indicator variables which, according to historical regularities, exhibit unusual behaviour prior to such episodes.

Among these indicators, money and credit developments stand out for several reasons. In theoretical literature, a number

25 Chui, M. and Gai, P., *Private sector involvement and international financial crises – an analytical perspective*, Oxford University Press, Oxford, 2005.
26 For an argument in favour of the feasibility of establishing "… an effective and credible early warning system ... capable of producing relatively reliable signals of distress from the various indicators in a timely manner …", see Reinhart, C.M. and Rogoff, K.S., *This time is different*, Princeton University Press, Princeton, 2009, p. 281.

of relationships between money, credit and asset prices have been explored, such as the impact of liquidity and credit conditions on risk-taking and thus positions in asset markets. Moreover, looking at past empirical regularities, boom and bust cycles in asset markets seem, historically, to have been closely associated with large movements in money and credit aggregates, particularly in periods of either (i) asset price busts or (ii) booms that end in financial distress.[27]

The experience of recent years and several studies, including studies carried out at the BIS, the ECB and the IMF, have further corroborated these results. In particular, one robust finding across all of these studies is that various measures of excessive credit creation[28] (such as the deviation of the global credit-to-GDP ratio from its trend level and global credit growth) turn out to be good leading indicators of the build-up of financial imbalances in the economy.[29] This result is strengthened when the credit gap is combined with indicators of asset prices' deviation from trend levels (i.e. "gaps"). The interplay of credit and asset price gap indicators is mostly intended to capture the coexistence of asset price misalignments with the system's limited capacity to withstand the asset price reversal, whereby credit gaps provide a measure of leverage for the economy as a whole, thus proxying the shock absorption capacity of the system. One interesting feature of these results is that measures that capture the cumulative impact of excess credit creation appear to offer better signals than growth rate measures, which – by their very nature – capture only shorter-term dynamics. This result is consistent with the view that asset price bubbles are typically associated with the slow accumulation of financial imbalances over a relatively long period, a phenomenon that may be missed by traditional approaches to macroeconomic forecasting, which typically have a horizon of two to three years in mind.

There is some evidence that money, too, possesses good indicator properties for asset price booms and busts, as it represents a summary indicator of bank balance sheets. Among the recent studies which single out excessive money creation are works by Detken and Smets[30] and Adalid and Detken,[31] which find that strong real money growth appears to be a useful early indicator of the build-up of asset price misalignments that may lead to financial distress and costly adjustments in the economy. In general, however, the evidence is more robust for credit than for money, possibly because substitution effects between money and asset prices can sometimes be substantial, particularly in times of considerable financial turbulence and uncertainty. The box presents some of these findings and also provides an example of the application of the methodologies discussed in the previous section.

While these results have focused on the importance of domestic economic conditions for such cycles, recent empirical analysis has also indicated that the global liquidity situation may have an effect on the outlook for asset prices

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27 See Fisher, I., *Booms and depressions*, Adelphi, New York, 1932, and Kindleberger, C., *Manias, panics and crashes: a history of financial crises*, John Wiley, New York, 1978. Additional support as regards the consequences that excessive credit growth may have on the creation of bubbles can be found in the early work of the Austrian School. See, for instance, von Mises, L., *The Theory of Money and Credit*, Yale University Press, New Haven, 1953, and Hayek, F.A., *Monetary theory and the trade cycle*, Jonathan Cape, London, 1933.

28 In this context, it should be mentioned, however, that the concept of credit needs to be clarified. For instance, in the case of true-sale securitisation, financial market developments allowed credit to be taken off the balance sheet and thus disappear from official statistics based on bank balance sheets. This implies that data comprehensively measuring true leverage in the economy would provide better warning signals.

29 In addition to the ECB studies mentioned in footnote 18, see, for instance: Borio, C. and Lowe, P., "Asset prices, financial and monetary stability: exploring the nexus", *BIS Working Papers*, No 114, BIS, Basel, July 2002; the paper by Borio, C. and Lowe, P. cited in footnote 1; Borio, C. and Drehmann, M., "Assessing the risk of banking crises – revisited", *BIS Quarterly Review*, BIS, Basel, March 2009; and Helbling, T. and Terrones, M., "When bubbles burst", Chapter 2, *World Economic Outlook*, IMF, Washington DC, April 2003.

30 See the paper cited in footnote 19.

31 See the paper cited in footnote 19.

and domestic inflation.[32] In fact, some studies find global liquidity measures to be among the best early warning indicators for domestic asset price booms and busts.[33] Should these results be corroborated by further analysis, excess global liquidity could act as an additional signal for inflationary developments and financial imbalances.[34] While these results might, at first glance, seem to imply a less important role for national policies, such interpretations would clearly be premature for several reasons. First, global measures represent, by definition, the sum of national measures and thus, in a sense, the sum of national policies. Second, the results might reflect the fact that some markets tend to be driven by global events or are subject to strong international spillover effects, while other markets are driven by more local/domestic factors. In this respect, the results should be interpreted in the sense that global measures convey additional information supplementing national developments. At the same time, international developments might restrict the

ability of national policies to counter such imbalances effectively and emphasise the need for the consistent application of stability-oriented policies across all jurisdictions.

32 See: Ciccarelli, M. and Mojon, B., "Global inflation", *Review of Economics and Statistics*, Vol. 92, No 3, 2010, pp. 524-535; Browne, F. and Cronin, D., "Commodity prices, money and inflation", *Working Paper Series*, No 738, ECB, Frankfurt am Main, 2007; and Belke, A., Orth, W. and Setzer, R., "Liquidity and the dynamic pattern of asset price adjustment: a global view", *Journal of Banking and Finance*, Vol. 34, No 8, 2010, pp. 1933-1945. Other studies have investigated the issue of the effects of global liquidity on global/domestic inflation and output, including: Sousa, J. and Zaghini, A., "Monetary policy shocks in the euro area and global liquidity spillovers", *Working Paper Series*, No 309, ECB, Frankfurt am Main, 2004; Rüffer, R. and Stracca, L., "What is global excess liquidity, and does it matter?", *Working Paper Series*, No 696, ECB, Frankfurt am Main, 2007; and Borio, C. and Filardo, A., "Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation", *BIS Working Papers*, No 227, BIS, Basel, 2007.
33 See, for instance, the paper by Alessi and Detken cited in footnote 15.
34 For further discussion on the issue of global liquidity and its impact on domestic price stability, see "The external dimension of monetary analysis", *Monthly Bulletin*, ECB, Frankfurt am Main, August 2008.

Box

EARLY WARNING INDICATORS FOR ASSET PRICE IMBALANCES: RECENT EMPIRICAL EVIDENCE BASED ON ECB STUDIES

Designing an early warning system for asset price imbalances can be divided into three steps. The first step is to define asset price imbalances/misalignments (e.g. in terms of deviations from historical trends or in terms of their economic consequences). The second step involves selecting appropriate indicators and designing models to link the indicators to the misalignment. When the dependent (misalignment) variable is binary, signalling and discrete choice (probit/logit) methods are available to define an early warning indicator. The third and final step is the assessment of the predictive performance of the early warning indicator over a sample period and/or across a panel of countries. This third step is often carried out on the basis of the matrix below.

	Crisis	No crisis
Signal	A	B
No signal	C	D

A is the number of periods for which an indicator provides a correct warning signal – i.e. a crisis actually follows the signal within a pre-specified prediction horizon. B is the number of periods for which a false alarm is issued, while, conversely, C represents the number of periods for which the indicator fails to signal an approaching crisis. Finally, D is the number of periods for which

the indicator correctly provides no warning signal. Typically, the usefulness of an indicator is assessed by computing the noise-to-signal ratio – i.e. the number of false alarms divided by the number of correct signals.

This box looks in more detail at the application of some early warning indicator systems developed at the ECB which single out money and credit developments as crucial indicators for predicting asset price booms and busts.

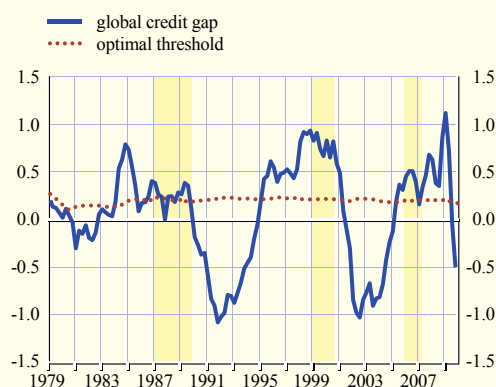### A signalling method for predicting boom/bust cycles in asset prices

The work carried out by Alessi and Detken[1] is based on the use of the signalling methodology to detect (high-cost) asset price booms. The procedure followed for the analysis is as follows. First, asset price booms are identified across 18 OECD countries using a quarterly aggregate price index consisting of BIS data on weighted real private property, commercial property and equity prices. The booms are identified as deviations from a country-specific recursive Hodrick-Prescott trend and then divided into low-cost booms and high-cost booms, the latter being defined as booms which are followed by a three-year period in which real GDP growth is lower than potential growth by at least three percentage points. Second, a set of economic and financial variables with different transformations are tested to ascertain their suitability as early warning indicators for high-cost boom/bust cycles in asset prices within a six-quarter forecasting horizon.

The analysis is done in such a way that only the information which would have been available at each point in time is considered (thereby taking publication lags in the time series into account). The threshold is obtained by minimising the loss function of the policy-maker, taking into account the policy-maker's relative aversion to events occurring without a signal being issued (missed crises) and signals being issued without an event occurring (false alarms).

The results reveal that, on average across countries, in the presence of balanced preferences, the global private credit gap and the global M1 gap are the best early warning indicators and reduce the policy-maker's loss in terms of preference-weighted errors by up to 25% relative to a situation in which the indicator is disregarded (see Chart A). The authors also test the model in relation to the latest financial crisis and investigate whether the asset price boom which began in the mid-2000s is predicted to be high-cost by their best indicators. The authors find that with regard to the latest "boom wave" around 2005-07, the picture is mixed, as the global private credit gap was

Chart A Developments in the global credit indicator and the optimal threshold for detecting asset price bubbles

(deviation of the global private credit-to-GDP ratio from its trend level)

Source: Update of the indicator presented by Alessi and Detken.
Notes: Series updated using annual GDP-PPP weights (taken from the IMF's World Economic Outlook) for the following countries: Australia, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, New Zealand, Spain, Switzerland, the United Kingdom and the United States. The shaded areas denote aggregate waves of asset price booms. The latest observation refers to the fourth quarter of 2009.

1 See the paper cited in footnote 15 of the main text.

sending persistent warning signals, while the global money (M1) gap was not. This result stresses the need to use a suite of models and indicators.

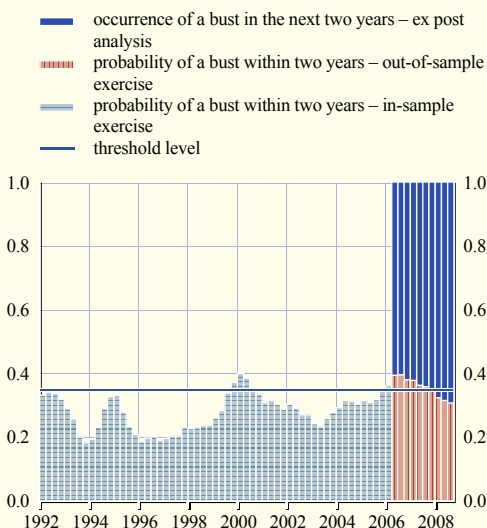## Panel probit models for predicting boom/ bust cycles in asset prices

An example of a probit model used to detect asset price busts is provided by the work of Gerdesmeier, Reimers and Roffia,[2] which estimates the probability of an asset price bust within the following two years. In this paper, a bust is defined as a period – within a rolling three-year sample – in which a composite asset price indicator (constructed as a weighted average of stock price and house price indices) declines below a level calculated as its mean minus 1.5 times its standard deviation with regard to its maximum in that period. The binary bust variable is then given a value of one if a bust occurs within the next eight quarters.

Chart B Probability of an asset price bust in the next two years in the euro area, based on a probit model

(probability; quarterly data)

- occurrence of a bust in the next two years – ex post analysis
- probability of a bust within two years – out-of-sample exercise
- probability of a bust within two years – in-sample exercise
- threshold level

Source: Based on the paper by Gerdesmeier, Reimers and Roffia.
Notes: The brown area represents the fitted probability (derived from a probit model as in specification B in the paper) of a bust occurring in the next eight quarters, while the dark blue area represents the detection of a bust. The threshold level is set at 0.35 (i.e. 35%).

By testing probit equations for a panel of 17 OECD countries using the general-to-specific methodology, a parsimonious specification is selected which contains the credit growth gap, changes in nominal long-term interest rates, the investment-to-GDP ratio and the lagged house price growth gap.[3] The model is then used to assess the situation for the euro area in the recent financial crisis, using the latest available dataset for the explanatory variables and the coefficients of the probit model estimated using the panel dataset for the period up to the first quarter of 2006, and running an out-of-sample exercise for the subsequent period. A fitted probability is then derived for the period up to 2009 and it is found that at the end of 2006 the fitted probability exceeded the threshold, so the model would have predicted the occurrence of a bust in the euro area within the following two years (see Chart B).

Finally, another ECB study by Agnello and Schuknecht, based on a similar method, finds additional evidence supporting the use of money and credit to predict real estate price booms/busts.[4] Looking at 18 industrialised OECD countries, the study identifies major and persistent deviations in house prices vis-à-vis country-specific long-term trends and estimates the probability of booms and busts occuring using a random effect panel probit model. The main findings are in line with those of the other two methods. Specifically, it turns out that the economic costs (in terms of GDP losses during the post-boom phase) depend significantly on the magnitude and the duration of the boom and on money and credit developments during that period. The set

2 See the paper cited in footnote 18 of the main text.
3 The estimation is based on a panel dataset including the following countries: Australia, Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.
4 See the paper cited in footnote 15 of the main text.

of variables which significantly affect the probability of experiencing booms and busts include short-term interest rates, domestic and global money and credit developments, and indicators of mortgage market deregulation. The associated probit model proves to be fairly successful in identifying booms and busts at an early stage.

Overall assessment

Overall, these recent ECB studies show that it is possible to identify early warning indicators for individual countries and groups of countries which perform reasonably well. They also implicitly confirm that leverage is one of the key indicators for predicting high-cost boom/bust cycles in asset prices. Nevertheless, indicators that have historically performed equally well can sometimes give different messages. The signals obtained should, therefore, be interpreted carefully and should be regarded as just one element in the information set used by decision-makers.

5 CONCLUSION

Both the experience acquired during the financial crisis and the findings of recent economic research have tended to shift the balance of the argument in the direction of being less sceptical about leaning against the wind. At the same time, it is recognised that the new evidence is not conclusive and a variety of practical issues need to be confronted if such an approach is to become operational.

In order to address these practical challenges, there is a need to develop signals warning of impending asset price bubbles, booms or busts. Recent research has sought indicators that provide sufficiently early warnings of asset price misalignments in real time in order to allow any corrective measures to be implemented in a timely way and thereby potentially be effective in containing the emerging financial imbalances and associated risks to macroeconomic and price stability. This work has produced encouraging results. In particular, various money and credit indicators appear to contain leading information on asset price dynamics.

Conducting a thorough monetary analysis as part of the process giving rise to monetary policy decisions can help to assess the extent to which assets with high price levels can be traced to – and at the same time become a source of – excess liquidity creation and an easing of credit supply. Detecting and understanding this link helps to form an opinion on whether developments observed in asset prices might already reflect the growth of an unsustainable bubble.

Monetary policy should not target asset prices or indices. Yet a monetary policy strategy that contains some elements of the leaning against the wind approach supports the maintenance of price stability by containing risks to price stability that may emerge in the longer term, beyond the horizons associated with traditional inflation forecasts. Indeed, the ECB's two-pillar monetary policy strategy implicitly incorporates an element of leaning against the wind, thanks to the prominent role played by its monetary analysis within a broader stability-oriented framework for monetary policy-making.

The medium-term orientation of the ECB's monetary policy strategy thus ensures that the implications of any financial imbalances and asset price misalignments and their unwinding are given due consideration in the formulation of monetary policy decisions, since such phenomena will have implications for the outlook for price developments at longer horizons. Given that the ECB's mandate requires the maintenance of price stability in the medium term, rather than at any specific arbitrary horizon, it is important that the ECB

monitor the slow accumulation of unsustainable financial imbalances which pose a threat to macroeconomic and price stability over the longer term. Maintaining a medium-term orientation, keeping a close eye on monetary and credit dynamics, and adopting a broader, stability-oriented view of policy-making – all key elements of the ECB's monetary policy strategy – supports this approach.