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THE IMPACT OF ASSET PRICES AND THEIR INFORMATION VALUE FOR MONETARY POLICY

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Abstract:

In this paper we explore the contribution that asset prices appear to make to fluctuations in the economy and to inflation and hence to monetary policy, using a large international panel for the period 1970-2008. We show that house prices are important in the determination of economic activity and hence to monetary policy but that stock market prices, while offering information in many periods, form a rather weaker and less well determined linkage. Moreover the effects are asymmetric over the course of the economic cycle. Using an augmented Taylor rule we go on to show that monetary policy has not reacted much to asset prices but that long-run interest rates are clearly affected by house price inflation. Relationships tend to be weaker in recent years, probably as a result of greater stability in output growth and inflation. Nevertheless our results suggest that central banks would do well to consider asset prices in deciding monetary policy. Such information can be readily summarised, perhaps in the form of a Financial Conditions Index (FCI). The use and potential benefits of the FCI are illustrated in the paper.

Key words: monetary policy, house prices, asset prices, financial turmoil, Taylor rule

Classification JEL: E44, E5

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1. Introduction

It has long been accepted that asset prices and house prices in particular, have an important role to play in fluctuations in the economy. Moreover, the present crisis has heavily reinforced the importance of understanding this relationship. Altissimo et al. (2005) provide a helpful survey and conclude that with some small exceptions for investment in residential property the effect comes almost entirely through consumption.[1] However, the present crisis has dramatically increased the focus on linkages through the financial system. Asset prices are also clearly related to the inflationary process, both as part of the transmission mechanism of monetary policy and as indicators of future inflationary pressure (Goodhart and Hofmann, 2000). It is also clear that their role in the process is asymmetric over the course of the economic cycle. This asymmetry is expected to be different for stock market prices and house prices, the two most widely available asset prices. House prices also clearly influence consumers' expenditure, as housing provides the least cost route for consumers to obtain loans, through a mortgage on the property, thus enabling them to consume out of their wealth.[2] Stock prices affect a limited number of households directly but business activity more directly.

An asymmetric approach by monetary policy to stock prices over the cycle has been set out in Blinder and Reis (2005) for the Greenspan years in the US and confirmed by Greenspan himself (Greenspan, 2007). As it is difficult to decide whether stock market bubbles exist and to judge their extent, the central bank is better employed in warning people and pointing out the difficulties they may face than in trying to decide when and how to prick

[1] They play down the credit channel, discussed in Bernanke and Gertler (1995).

[2] Mayes (1979) suggests that the asymmetry in the house price cycle in the UK stemmed from a complex interaction of the constraints on production, prudential constraints on housing finance and a strong upward dynamic in the housing market.

such a putative bubble. The famous remarks on 'irrational exuberance' (Greenspan, 1996) illustrate this in practice – as Greenspan (2007) admits with the benefit of hindsight, he may have been a little premature. In pricking a 'bubble' the central bank may on the one hand slow real growth in the economy unnecessarily or on the other provoke a precipitate decline. The Greenspan approach instead would see monetary policy continuing to tighten slowly as inflation risks increased but moving much more rapidly when the downturn sets in to avoid the rapid fall in stock prices and associated financial concern turning into an outright recession with the danger of debt deflation. It is already clear from the monetary policy decisions of the Bernanke period that asymmetry in policy remains with much more rapid cuts, followed by a raft quantitative and credit easing measures as the zero bound was reached in the face of financial difficulties and an economic downturn than the steady and predictable rises as the economy grew and inflation started to rise. This approach is now subject to intense scrutiny in the light of the severity of the present crisis and measures to dampen the openness of the economy to fluctuations can be expected. Nevertheless, as Milne (2009) suggests, this will come largely through changes in structure and the regulation of financial institutions rather than through macro-economic policy per se.

The asymmetry in house prices is somewhat different from that associated with stock prices. Traditionally, for people who own their own homes, when prices peak, many sellers are reluctant to sell at a loss, especially if this means that they would realise negative equity. Hence the market tends to dry up and prices to fall rather more slowly than they increased, without the sudden and rapid declines that can characterise stock prices. However, their contribution to inflation tends to be rather more important. This can perhaps best be characterised as a liquidity channel as people cannot sell and collateral values fall. Changes in house prices can thus act as an indicator of the proportion of liquidity constrained households.

However, housing is increasingly becoming an investment as incomes and wealth rise hence the constraints and cyclical pressures may well be changing.

In this paper we consider these issues from a European perspective using quarterly data from start of 1970 to the end of 2008 for 15 countries – the EU15 less Luxembourg but plus Norway. Section 2 looks at the role of asset prices in aggregate demand. Section 3 introduces our approach to asymmetry while Section 4 considers the role of asset prices in the determination of monetary policy. Section 5 deals with their role in consumers' expenditure, and section 6 contains reflections and conclusions.

2 The Impact of Asset Prices on Economic Growth

The obvious place to start in exploring the impact of asset prices is to look at aggregate demand, as illustrated by Goodhart and Hofmann (2000), although doing so covers up the individual channels through which this effect might be transmitted.[3] We use a typical IS curve, where stock prices and house prices affect output in addition to the normal determinants of foreign demand, real interest rates and the real exchange rate. The particular form we use is shown in equation (1):

$$g_{it} = \alpha_0 + \alpha_1 g_{W,it} + \alpha_2 fx_{it} + \alpha_3 rr_{it} + \alpha_4 hp_{it} + \alpha_5 sp_{it} + \alpha_6 g_{it-1} + \mu_{it}, \quad (1)$$

where g denotes output growth, g_W the World (OECD) output growth, fx the real exchange rate vis-á-vis the US dollar, rr the (ex-post) real interest rate, hp the (annual real) rate of change in house prices, sp the (annual real) rate of change in stock prices and μ the error term. We also use the output gap, ∇y, instead of the growth rate as the output variable, for

[3] Altissimo et al. (2005) suggest that for stock prices, in addition to the obvious wealth effect on consumption, there might be an effect on investment through Tobin's Q, a balance sheet effect and a confidence effect, although the empirical evidence for the latter three is quite weak.

comparison.[4] For details of the data, see Appendix. Real interest rates and real exchange rates enter the estimating equations with a lag (see e.g. Table 1). Thus, there is no obvious simultaneity problem with them. In the case of house and stock prices such a problem can exist. It is only that the data do not strongly support the notion that the exogeneity assumption is violated.[5]

It is obvious, even before we start, that house prices and stock prices are likely to play different roles as they show little correlation (Figure 1). If we set this out in the time dimension, using medians, the difference in pattern is clear (Figure 2) – house price data are only available from the beginning of 1979 in our sample. Stock prices are much more volatile and show some peaks and troughs not reflected in house price data, the most obvious of which is the fall associated with the collapse of the dotcom boom in 2000.

It is immediately apparent (from Table 1) that both house prices and stock prices have a clear impact on output growth, with the effect being stronger in the case of house prices. The results are robust to differing lag lengths and the other coefficients have plausible signs and size. A one percentage point increase in interest rates has a similar effect on output growth to

[4] The function form is dictated by the fact that the level form data are nonstationary while the transformed variables in (2) are, in general, stationary (see Appendix for the panel unit root tests). Thus, the hypothesis of unit root can be rejected in all cases except for real exchange rates. With (the change rate of) real house prices the hypothesis can be rejected with individual unit roots but not in the case of a common unit root assumption. Because of theoretical reasons, it is difficult to take the real exchange rate result very literally, and therefore we do not differences of *fx*.

[5] Computing the Hausman-Wu test statistic for *hp* and *sp* gives the value 2.73 (0.067) which suggests that the violation of the exogeneity assumption is not very severe. A similar result is obtained if *hp* and *sp* are lagged by one period. Then the estimates and the explanatory power remain practically unchanged. We also computed the differencing test statistics for all equations. They showed some problems with the IS curve that includes both house and stock prices. That could explained by the (in)stability properties that are illustrated in Table 4.

a 2-3 percentage point change in the real exchange rate. This is slightly stronger exchange rate effect than we found using a shorter data period (Mayes and Viren, 2002).

If, however, we difference the model to enable us to use the Arellano-Bond GMM panel estimator, the results become a little less satisfactory (see the last column in Table 1). Both the interest rate and stock price terms become insignificant. It is not allowing for the simultaneous relationships through GMM which creates the problem. Indeed the GMM results are more plausible than their least squares counterparts. Our estimation period has been chosen by the maximum length of the data series available, rather than by any clear choice based on the existence of a single regime. Extending the model back to 1970 (while omitting the asset price terms) gives some problems with the exchange rate effect (Table 2, column 2), as does omitting the fixed effects (columns 3 and 4). Restricting the sample just to the euro area period (column 6) suggests that the interest rate has become less important. This is not unusual for a very credible regime (Blinder and Solow, 1973). With inflation rates approximately on target throughout the estimation period it is not really surprising if inflation has been relatively unimportant. Similarly it is not surprising to see that the stock price effect looks weak, since there was a substantial fall and recovery in most stock markets in that period, without any substantial effect on output.[6] In part this reflects the offsetting monetary policy. However, to some extent this can be circumvented by including policy in the model as we go on to do and in part the endogeneity will be accounted for in the GMM estimates.

A glance at Figure 3, suggests that the results obtained from using the output gap instead of output growth will be fairly similar as the two series have been moving quite

[6] Shortening the estimation period to just 8 years so that we incorporate only one business cycle is likely to lead to data specific problems. Even with the 28 years for our main estimation the period is somewhat shorter than might be ideal for purely statistical purposes but extending the data period also increases the chance of encompassing a regime change.

closely together. However, this is not quite the case (Table 3). The stock market coefficient has a tendency to show a perverse sign and is significantly so at the 5% level in the last two columns. The results are conventional if we take just the period of the euro area's existence (columns 4 and 5). Nevertheless, whichever specifications we look at it is very difficult to suggest that housing prices are not clearly related to the growth rate and the run of results suggests that stock prices also a likely to have an effect, albeit clearly weaker.

3 The Effect of Asymmetry

Thus far all our results consider a symmetric approach, assuming that it does not matter whether the economy is in the expansionary or contractionary phases of the growth cycle. Both economic theory stretching back to Keynes (1936) and beyond and previous empirical results (Mayes and Viren, 2000) suggest that such symmetry is unlikely and we find the same to be true here. The economic cycle itself is asymmetric with recessions tending to be sharper, shorter and shallower than expansions, at least in recent years for most European countries in our sample[7] if the Finnish crisis of the 1990s is excluded.[8] On the whole the asymmetry in the cycle is attributed, not so much to asymmetry in the shocks which assail economies, although this is the case if wars are included, but to asymmetries in behaviour. Although negative shocks tend to be transitory and positive shocks permanent (Nadal De Simone and Clarke, 2007). Many sources have been identified, in labour markets, in productivity (Artis et al., 1999), in exit and entry (Chetty and Heckman, 1986; Baldwin and Krugman, 1989). The asymmetries in real behaviour and in inflation, while closely related, are different

[7] Verbrugge (1998) provides a helpful exposition of the nature of asymmetry in the main macroeconomic variables in 22 countries, including most of those in our sample.

[8] The crises in the other Nordic countries round the same period, although traumatic, did not involve major falls in GDP. Finland's recession was however deeper than in 1929.

(Dupasquier and Ricketts, 1998, explore this for Canada, for example). Both fiscal policy and monetary policy have asymmetric elements to them (Mayes and Virén, 2004, 2005).

Given this rich background, there are several ways in which we could introduce asymmetry. Their appropriateness depends on the specification of the model and the extent of the data we have to hand. One approach is simply to follow the framework of Sims and Zha (2006) and assume that there is a regime switch that corresponds to the up and down phases of the cycle. This would imply that we simply estimate two different models depending upon the phase. These could perhaps explain the phenomenon that Keynes noted that recessions tended to shorter and sharper than expansions. A second possibility is to assume that there is more than one equilibrium, as in Sargent (2001) for example; where in one case the economy is dominated by optimistic expectations and in the other by pessimistic expectations – shocks driving them from one to the other. There is some attraction in this approach in the context of asset prices. One way of explaining the bull and bear phases of the stock market would be to use expectations in this manner. As forward-looking prices they will be heavily affected by expectations changes.

A further possibility would be to consider the difference in constraints that appear in the up and down phases by using a form of Friedman's (1957, 1993) plucking model, applied in Nadal De Simone and Clarke (2007) and Kim and Nelson (1999) for example. Here the assumption is that there is some maximal rate of growth determined by capacity and underlying technologies but that shocks drive the economy below that attainable level hence there is different behaviour when the economy is recovering from a shock from when it is running close to capacity. The model therefore finds that negative shocks tend to be temporary whereas positive shocks are more likely to be permanent, both driving the economy upwards and leading to clearly different behavioural responses. Housing (property) cycles might fit quite neatly into this framework as there are strong capacity constraints limiting the rate of expansion, with considerable lags involved. Moreover, given the interaction with financial markets, the up and down phases are characterised by rather different behaviour. When the market starts to go down people are inhibited from selling as otherwise they might realise collateral prices that are relatively low compared to the loans used to purchase. Indeed in some cases equity can become negative. This generates a complex interaction between prices and quantities. From the point of view of economic growth it is new construction that matters (in net terms at any rate) whereas prices reflect both the existing stock and new construction and are heavily dominated by the former.

All these various models explain why we should expect different behaviour over the cycle and between them suggest two general ways in which we might represent them. The first is simply to suggest that the coefficients are different in the two phases. The second is to assume that there is a single equilibrium but that adjustment to it varies according to the phase of the cycle. Thus, for example, the reaction to a downward shock may be more rapid than to a positive shock which leads to an extended period above the longer term equilibrium; see Enders and Siklos (1999) for example. We have explored this in Huang et al. (2001) in the case of monetary policy. Moreover, the switch between regimes may be a smooth transition with coefficients changing gradually over a number of periods, rather than an immediate switch from one to the other.

This gives us a considerable problem in choosing the best representation as the adjustment in behaviour will be spread across a number of equations in the model. Since we are limiting our main focus to the IS curve and the behaviour of monetary policy we have opted for a straight forward approach, which is a version of the first group described above, namely to assume that the coefficients in the model are different in the two phases.

To do this we introduce asymmetry through a threshold model (Tong, 1983; Teräsvirta and Granger, 1993). This means that we allow the variables of interest: the real exchange rate, real interest rate, house prices and stock prices to have different values if the economy is contracting from when it is expanding (see the first four columns of Table 4). It is immediately apparent that all the variables have clearly different effects in expansions compared to contractions, with the exception of stock prices.[9]

The nature of the effect is interesting as all variables expect foreign growth have a greater impact in an upturn than in a downturn. One possible way of thinking about this is to suggest that in expansions there will always be an element of capacity constraints that do not apply in a downturn. Thus there is some restraint in the way in which the economy can respond to a change in foreign demand. Interest rates and the exchange rate could be expected to have the same characteristics in some sort of real equivalent of the Phillips curve, where policy becomes less effective when the economy is relatively slack. Clearly we can produce arguments for other forms of asymmetry. For example, that producers will struggle to retain markets even if they are making short-run losses, because it will be much more expensive to try to enter a market having exited, as many contacts will be suspicious about the continuity of future supply.

In columns 5 to 7 of Table 4 we consider a different form the asymmetry might take. In the first four columns we defined the cycle in terms of the growth of GDP. We can also consider it in terms of the direction of change of asset prices. This gives a much more direct representation of the change in expectations. We look in particular at the role of the real interest rate as representing the main monetary policy variable. If house or stock prices are falling the real interest rate has a much more limited effect on output than when they are

[9] The coefficients are jointly different in the two phases as indicated by a Wald test. In addition to the switching regression threshold model we have examined the results using a Smooth Transition Regression (STR) model where a logistic function is used transform the transition variable. See Teräsvirta and Granger (1993) for details. Because the results with STR model were almost identical with the switching regression threshold models we dot report them here. Just to illustrate the similarity, compare columns 5 and 6 in Table 4.

rising. The may help explain in the next section on monetary policy, why it is that interest rates change more vigorously in the down phase of the cycle. Since we are looking here at European monetary policy this has nothing to do with any ‘Greenspan effect’. There has not been any suggestion that European countries have responded to house and stock market prices in the same explicit manner as has been developed in the US. What we see here, however, is a justification in Europe for just such an asymmetric policy response to asset price movements.

Of course we have to take both the asymmetry in the asset price movements themselves as well as in interest rates to judge the policy response. More rapid responses on the downside could simply represent the steepness of the decline not asymmetry in policy. That we move onto next.

What is also noticeable from Table 4 is that the single regime that we apply to the rest of the model when using asset prices as the threshold looks very similar to the up phase model in the growth threshold for foreign growth, the real exchange rate and the lag but like the down phase model for stock prices and house prices. This suggests a much more complex asymmetry and one focused very firmly on the asset price variables. First of all it does not seem to matter much whether we use stock prices or house prices as the threshold. This is rather surprising as Figures 1 and 2 indicate that the two of them have not moved particularly closely together. Secondly, since the influence of stock prices is very similar in the up and down phases, this implies that the major concern in Europe is house prices, perhaps reflecting the smaller role of stock market funding in much of Europe outside the UK. We therefore deliberately return to this in our discussion of the consumption function, as it is here that housing wealth may have its main effect on GDP. However, it is also interesting that whereas we saw a statistically significant difference in coefficients between the up and down phases in the first four columns that the single coefficient suffices in columns 5-7.

Part of the explanation is that rising prices have been more prevalent than falling ones in most countries – Germany being the most obvious exception. Thus while the first four columns split the sample roughly in half the split on asset prices is less equal.

4 Monetary Policy

The next step in our analysis is to see how much the asymmetry in behaviour may be due to asymmetry in policy responses. The obvious policy to look at is monetary policy, partly for practical reasons, as much of fiscal policy is set on an annual basis. However, earlier work on fiscal policy (Mayes and Virén, 2007) suggests that not only does policy in the euro area countries show a clear asymmetry in the sense that governments tend to ease up on consolidation during the up phase of the cycle but that there has been a clear shift in behaviour since 1996, first with the run up to qualification for Stage 3 of EMU and then with its operation.[10] There are, however, some problems, as it is difficult to describe the monetary policy of all the countries and over the whole period as being in the same regime. Many countries were shadowing the deutschemark and effectively following an exchange rate target in the period up to the formation of the euro area, while others were inflation targeting. Inside the euro area interest rates are even more tightly linked. Nevertheless, a Taylor rule seems to provide quite a reasonable representation of a wide range of policies. The estimated interest rate equation is thus a basic Taylor rule (with interest rate smoothing) which is augmented with house and stock prices. It takes the form:

$$r_{it} = \beta_0 + \beta_1 g_{it} + \beta_2 inf_{it} + \beta_3 HP_{it} + \beta_4 SP_{it} + \beta_5 r_{it\text{-}1} + \varepsilon_{it}, \qquad (2)$$

[10] The asymmetry is found in taxation rather than expenditure, which tends to be fairly symmetric over the cycle, reflecting automatic stabilization. However, taxes tend to be cut when the economy is in the up phase, thereby only partially offsetting the extended deficits that occur in downturns. Not all countries follow this pattern and Finland, for example, has shown much more symmetry and as a result its debt ratio has fallen more consistently than in some of its partner countries.

where *r* is the (nominal) short-term rate, *inf* the rate of inflation and *HP* and *SP* rates of change of nominal house and stock prices, respectively. ε is the error term. Estimating (2) allows us to see whether there has been any role for "activist" monetary policy in which also asset price inflation is accounted for.

We set the estimation up in a matching form to the IS curve, shown in Tables 1 to 4. In this case (Table 5) monetary policy seems little affected by house prices. There are however important differences between looking at the period as a whole and when we confine ourselves simply to the years when the euro area has been in existence. In the period as whole a Taylor rule works quite well. Both inflation and output, whether in growth rate or output gap format, have a clear influence. Yet in the euro area period inflation seems of little importance. Indeed with the output gap it has a perverse sign. This seems more difficult to explain. As we noted earlier, in part it is simply a reflection of the success of policy. Inflation in Europe has not in general been much outside the target range. However, it would perhaps be more appropriate to replace both the output gap and inflation by their forecast values as monetary policy is forward looking. To do this it would be necessary to incorporate the forecasts used by the policy makers. While this was possible for New Zealand (Huang et al, 2001) it is not possible for Europe as a whole, although some of the central banks have been publishing forecasts in recent years – driven initially by the adoption of inflation put more recently by a general realisation that greater transparency will make policy more understandable and hence help to focus inflation expectations on the target. We cannot get round this by using leading values of the variables as these are policy inclusive. In any case an appeal to rational expectations here would be inappropriate as we are concerned with the forecasts of the decision makers not the economy as a whole; see Mayes and Tarkka (2002) and Paloviita and Mayes (2005).

Stock prices do appear to have a slight influence in an intuitive manner – in an output gap framework stock prices and interests tend to work in opposite directions in their influence on inflation. High growth rates on the other hand can occur in the period immediately after a downturn and hence could have a positive link.

To some extent these results reflect the form of the equation and we get some different results from alternative specifications. So we also estimate interest rate equations which represent a standard term structure equation augmented with our additional regressors. The basic structure of these equations is:

$$\Delta r_{Lit} = \gamma_0 + \gamma_1\Delta r_{it} + \gamma_2(r_{Lit\text{-}1} - r_{it\text{-}1}) + \gamma_3 g_{it} + \gamma_4 inf_{it} + \gamma_5 HP_{it} + \gamma_6 SP_{it} + \upsilon_{it}, \qquad (3)$$

where r_L (r) is the (nominal) long (short) rate and υ_{it} is the error term. If we set γ_1 equal to zero the equation is a standard term-structure equation while if γ_1 is nonzero (possibly one) it comes close to the equations used in e.g. the NiGEM model.[11]

Here the results are somewhat different (Table 6). The influence of stock prices is still weak but that of house prices is now apparent when longer term interest rates are used. These are not the monetary policy instrument but reflect the change in monetary conditions and hence the bite of monetary policy.

There are other respects in which monetary policy is asymmetric, which will affect our results. Monetary policy appears to react much more strongly when there are serious threats of inflation than when the threats are fairly minor (Mayes and Virén, 2005). This asymmetry does not have a clear match with the phases of the cycle or rising or falling asset prices. The thresholds for this asymmetry are more complex and will tend to occur near the peaks and the troughs of the cycle. Clearly there are several ways we could try to incorporate this. Instead of looking at asset price inflation we could look at the acceleration in these prices, as sharp rises

[11] http://nimodel.niesr.ac.uk/

or falls may be far more likely to provoke reactions in monetary policy. Unfortunately we do not have enough data to explore these hypotheses properly.

It is of some interest to carry out some sort of contra-factual simulation with the conventional Taylor rule (which does include asset prices) for the EMU period to see how interest rates have deviated from those predicted by a model that is estimated with the pre 1999 data. Figure 5 gives some idea of the result: if the pre-EMU regime has continued after 1998 interest rated had been much higher in all countries except Germany (and Portugal from which we have a very short pre 1999 data set). The result can be interpreted in many ways. One may say that that the EMU has succeeded in gaining the same credibility as Germany used to have in old days. Alternatively, one may argue. EMU has pursued “too” loose” monetary policy. This interpretation comes close to Ahrend’s (2008) findings. His interpretation is that particularly the 2002-2005 period was characterized by loose monetary policy.

This conclusion is, in fact, re-enforced by computation of the so-called Financial Condition Index (FCI). In the FCI, the stance of monetary policy is measured not only by the real interest rate but also by the real exchange rate and change rates of real asset prices. Computing such an index (Figure 6) quite clearly shows that most of the EMU period can be characterized with relatively easy monetary policy[12]. Appreciation of the US Dollar after 2000 and the recent slowdown of stock and house prices represent some sort of exceptions to this rule. This in turn suggests that if asset prices developments had been properly accounted for monetary policy would indeed have been less accommodative.

5 Consumers Expenditure

[12] The FCI is computed using the following weights: rr 1.0, fx 0.3, hp 0.1 and sp 0.05. For details of constructing the FCI, see e.g. Mayes and Viren (2002).

Focusing on aggregate demand compounded a number of different routes through which asset prices could be having their effect on economic activity. We therefore look explicitly at the most obvious area where we should expect to see an influence from asset prices namely in the consumption function. We use a generalised form

$$cq_{it} = \delta_0 + \delta_1 g_{it} + \delta_2 rr_{it} + \delta_3 HP_{it} + \delta_4 SP_{it} + \delta_5 cq_{it-1} + \zeta_{it}, \qquad (4)$$

where *cq* is real consumers' expenditure, ζ is an error term and all other variables are defined as before. Clearly a properly specified function would use disposable income and wealth not GDP and asset prices as these are proxies but nevertheless they enable us to explore both the influence of asset prices and whether consumption is an area where asymmetry appears to important, as is shown in Table 7. Altissimo et al (2005) give a clear review of the literature on the wealth effect in the consumption and look at experience in trying to estimate the relationship, particularly for European countries. A further review and new estimates is to be found in Labhard et al. (2005). We are in good company in proxying wealth by asset prices (Ludwig and Sløk, 2002). The alternative of using incompatible definitions or omitting many of the countries is not very attractive. Furthermore house prices can have an effect on consumption by a variety of routes in addition to wealth. The simplest is that they affect borrowing constraints. Indeed without this effect it is not so clear why a change in house prices should affect consumption as having a house is a route to consuming housing services. When house prices rise so do implicit rentals (Campbell and Cocco, 2007).

The results are fairly similar to those expected. Real interest rates do not seem to be very important in the euro area period.[13] Both house prices and stock prices have an effect but

[13] This result reflects the dominance of the continental European countries in the sample. The interest rate effect is clearly stronger for the UK (and also for Finland) (Labhard et al., 2005).

significance levels are rather variable.[14] The effect from stock prices is small but that from house prices noticeable. This is the expected way round, as housing wealth is held by a much larger range of consumers than financial wealth that tends to be concentrated in the hands of the rich, whose (marginal) propensity to consume is lower (Carroll, 2004). It also conforms to the empirical results in Case et al. (2005) and Catte et al. (2004), although Ludwig and Sløk, (2002) obtain a larger coefficient for stock prices than housing prices. Slacalek (2006) suggests that on the basis of a sample of 16 OECD countries that each extra unit of wealth leads to a 0.03 increase in consumption.[15] Our long-run stock price estimates are roughly of this order of magnitude, although of course this makes no allowance for new wealth creation, only the revaluation effect. However, our stock price effect is only around one third of this. Our results fall between Slacalek's estimates and those of Labhart et al. (2005) who use a subset of 11 of Slacalek's 16 countries. The degree of persistence illustrated in Table 7, at around 0.6, is the same as Slacalek finds.

The evidence on asymmetry is rather thinner. It is only in the case of column 7, where stock prices are used as the threshold variable, that the Wald test suggests that the coefficients above and below the threshold are different at the 5% level. The coefficients themselves are different in each case and appear to tell a plausible story. Consumption is less affected by interest rates when asset prices are falling (or below their trend rate of growth as we explore for house prices in column 6). Consumption responds more to changes in ‘income’ when growth is positive or the output gap positive. We were expecting a stronger effect here as

[14] While our work focuses on macroeconomic data, there are cross-section studies that also find clear evidence of an effect on consumption from housing wealth – see for example Campbell and Cocco (2007) and Disney et al. (2007) for the UK.

[15] Slacalek (2006) includes the US, Australia, Canada and Japan to our sample but excludes Greece, Norway and Portugal. A second feature is that wealth effects are much larger in the Anglo-Saxon countries than in continental Europe. This may imply that the UK sits a little uneasily in our sample.

there is considerable evidence that people are reluctant to see their consumption fall in the short run when their incomes fall but are happy to take a proportion of any rise in the form of consumption (Duesenberry, 1949). This result is quite striking in Disney et al's (2007) study of the UK, where a surprise rise in house prices gets translated into small fall in saving (and hence rise in consumption) but a surprise fall in house prices leads to an even higher fall in saving – thus showing notable asymmetry.

Our results are not as clear cut as those of Labhard et al. (2005) who show both that the relationship between wealth and consumption is nonlinear – in that large changes in wealth have a less than proportionate effect on consumption than small changes – and that it is asymmetric, with consumption falling less when wealth falls than it rises when wealth rises.[16] We were expecting that house prices would be a clear indicator of the share of liquidity constrained households. This would provide a clear distinction between periods when the market is moving ahead normally and those when house prices fall with people facing negative equity problems and related constraints on the willingness to sell. Those who cannot realise their investments would then face liquidity constraints that would feed through into consumption. Consumption smoothing across the cycle requires the effective operation of financial markets, inter alia (Morduch, 1995) so the liquidity constraint should be asymmetric.

Contrary to what one might expect one might expect however, when house prices are falling consumption changes more with income than when they are rising. Possibly this is because the usual experience might be a fall in income in these conditions. This is of course in addition to the direct effect of the change in wealth as indicated by asset prices. However, perhaps the easiest way to look at this is that if asset prices and hence wealth is rising that can

[16] Labhart et al's panel of 11 OECD countries covers 8 of the 15 in our sample plus the US, Japan and Canada. Most reassuring from our point of view is their finding that in their panel estimation the hypothesis that the long run marginal propensity to consume from wealth is the same across the countries cannot be rejected and that its magnitude of a little over 6% is slightly larger but consistent with ours.

be a generator of increased consumption and income does not have such an important role to play.

6 Concluding remarks

There is a continuing debate over whether asset prices should be included in central banks' targets of price stability, irrespective of whether they have explicit inflation targets (Cecchetti et al., 2000; Goodhart, 2001). Until now, the general view has been that they should not be explicitly in the target or if they are it should be with a low weight (Bernanke and Gertler, 1999). However, the present crisis has heightened the view that central banks should react to asset prices more explicitly when they appear to be rising implausibly far or fast. Housing is clearly a consumption item so the cost of housing services should be included, although it presents measurement problems. Mortgage interest rates are typically excluded from such costs as their inclusion would leave central banks chasing their own tail since those costs reflect the setting of the monetary policy instrument. One of the simple issues is volatility. Asset prices are highly volatile and Woodford (1993) argues that central banks should put their policy emphasis on the stickiest prices. Hence prices should be inversely weighted in the target by their volatility. Wynne (2008) shows that for the United States, such an index of consumer prices, weighted both by expenditure shares and by inverse frequency of price changes, is highly correlated with headline inflation. The picture for the euro area is somewhat different. Simply weighting by inverse frequency of changes is much more closely related to core measures of inflation, while the double-weighted series has somewhat weaker correlations.

There is no doubt that asset prices are an information variable and hence should be taken into account. Whether they should be included in some wider measure of inflation as suggested by Reis and Watson (2007), included in indicators[17] - such as EuroCOIN or the

[17] Founi et al. (2001).

Chicago Fed National Activity Index (CFNAI)[18] - or treated less formally in the decision making discussion they should clearly be used in the modelling of economic behaviour, even though the lack of forecastability of stock prices in particular makes them useful in scenario and risk analysis rather than in forecasts beyond the short run.

Our research shows that both stock prices and especially house prices have a clear role in business cycles and in the inflationary process. Whether or not central banks use asset prices extensively in setting monetary policy, asset prices have a clear correlation with both short-run interest rates and the slope of the yield curve in European countries over the last thirty years, with some slight differences in the period of the euro area's existence. We have argued elsewhere (Mayes and Viren, 2002) that a simple way to consider these pressures is to construct a Financial Conditions Index, which adds the weighted contribution of stock prices and house prices to those of real interest rates and the real exchange rate in affecting inflation.[19] Normally this is done by taking the weights from an IS curve of the form of equation (1) by using the coefficients α_2 to α_5, although the impact requires the estimation of at least a Phillips curve so there is a link between the output gap and inflation (Goodhart and Hofmann, 2000). As Mayes and Virén (2002) show for the case of Finland, adding the real exchange rate to real interest rates to get an idea of the bite of monetary policy (i.e. forming a

[18] Stock and Watson (2000) suggest that asset prices make an important but rather unstable contribution to a composite indicator. Bryan et al. (2001) offer an alternative method.

[19] Wynne (2008) makes the interesting observation that there is an apparent correlation between inflation targeting and house price volatility among the OECD countries. It is of course debatable which is the cause and which the effect and other third factors may be at work as in Germany (Mayes, 2008) but it does raise the suspicion that maybe a wider view of price volatility in the economy has a role to play in ensuring monetary and financial stability.

Monetary Conditions Index)[20] can alter the impression considerably and adding house and stock prices to form a Financial Conditions Index changes it even further. In some cases the sign of the change from one period to the next and hence the implication for the change in policy stance is opposite. This can be seen from Figure 6 which also shows the usefulness of a close and systematic scrutiny of asset price developments when assessing the stance of monetary policy..

One major feature of the present analysis is that it confirms the suggestion that asset prices have an asymmetric effect on the economy and on policy. When the economy is expanding more rapidly or the output gap is positive then both house prices and real interest rates have about twice as great an effect on the economy as they do when there is a negative gap. In contrast, the effect of interest rates is much stronger when house prices or stock prices are falling than when they are rising.

It has been argued that for the United States at any rate there has been a stronger asymmetric relationship between monetary policy and stock prices in the form of the 'Greenspan standard' (Blinder and Reis, 2005; Greenspan, 2007). As prices rise beyond levels that seem to make sense from the point of view of fundamentals, policy will only tighten cautiously as the rise may be justified and there will not be strong pressure to prick any supposed bubble. On the way down however policy will react much more swiftly to head off any dangers of a damaging debt-deflation spiral (King, 1994). A similar approach seems to have emerged under the present Chairman of the Federal Reserve Board, Ben Bernanke, although house prices have also been playing an important role in the downturn. Our results only relate to Europe. Interest rates have been much more stable than in the US, particularly

[20] Grande (1997) suggests that an MCI, and by implication an FCI, may have more value as an indicator of future inflation than as an indicator of monetary policy. However, caution needs to be exercised in using such indicators, as they are shock dependent (Eika et al, 1997).

in the euro area. There, any influence from stock prices is quite weak but the influence of house prices is clear. There is some asymmetry in the responsiveness of policy depending on the strength of inflationary or deflationary pressures but it is not clear whether this relates to asset prices. Our threshold approach is well suited in this regard as it enables a direct test of whether there is some sort of tolerance limit beyond which more vigorous action will ensue. In general, we see less smoothing of asset price fluctuations by monetary policy than in the US but this is aided by stickiness of house prices in Germany, which is the largest economy in the euro area.

The nature of the impact of asset prices on the economy is clear from a consumption function, where they can be used to proxy the effect of wealth (Ludwig and Sløk, 2002). The marginal propensity to consume from wealth that can be derived is of the order of 0.06, which is in the middle of the range of estimates available for the OECD countries. The bulk of this effect comes from house prices and not stock prices, although the effect varies across the European countries, driven to a large extent by the relative importance of stock markets in company finance and the extent of direct ownership of housing (Maclennan et al., 1999). It is thus clear that house prices play an important role in the economic cycle and inflation in our sample of European countries, the EU 15 plus Norway and minus Greece, and that their impact varies of the course of the cycle.

Our results are, of course subject to a range of measurement, econometric and theoretical provisos. House price data typically show variations in definition across countries. Although we have experimented with a number of variants to test the robustness of our results, to quite some extent they will be dependent on the specification we have chosen. While our use of a panel of 15 countries enables us to derive estimates in a way which would be difficult for any individual country our assumption of parameter constancy (after allowing for fixed effects) is clear a very strong one even though it seems to be statistically consistent with the data.[21] The routes of influence, particularly through the monetary policy transmission mechanism, are complicated and can be illustrated to an extent by simulation (see Mayes and Virén, 2005, Fig. 6, for example)[22]. However, our model is rather too simplified to give it justice. What is clear is that there are distinct channels of influence from asset prices in addition to those from the exchange rate and the direct influence of interest rates through aggregate demand, even though the lag structures are likely to be much more complex than we can allow.

[21] Labhart et al. (2005) also have problems in testing for parameter constancy.

[22] With the current data, if we allow both house and stock prices to depend on real interest rates, the combined effect of interest rate on GDP becomes almost twice as large as with a single equation model (4) in Table 1 (the short-term GDP effects of a one per cent increase in real interest rate turned out to be -0.31 and -0.16 per cent, respectively). Thus, from the point of view of monetary policy, it is not trivial how the aggregate demand relationship is assumed to function.

Table 1 Basic IS curve specification with different lags

	1	2	3	4	5	6	7
g_W	.871	.820	.835	.320	.309	.756	.418
	(19.92)	(17.77)	(17.83)	(7.01)	(8.35)	(9.57)	(3.04)
fx	.023	.027	.026	.010	.006	.021	.016
	(8.07)	(8.90)	(8.69)	(4.85)	(3.69)	(2.96)	(3.32)
rr	-.055	-.074	-.055	-.032	-.021	-.028	-.005
	(2.91)	(4.30)	(3.37)	(2.69)	(2.13)	(1.00)	(0.09)
hp	.100	.094	.096	.035	.023	.081	.068
	(12.97)	(12.67)	(12.75)	(6.13)	(5.31)	(5.54)	(3.39)
sp	.006	.009	.008	.008	.007	-.002	-.008
	(3.02)	(4.53)	(4.96)	(5.41)	(6.24)	(0.62)	(0.85)
g_{-1}				.630	.679	-.248	.360
				(21.43)	(33.72)	(5.43)	(7.21)
R^2	0.623	0.632	0.629	0.802	0.800	0.191	..
SEE	0.0138	0.0136	0.0137	0.0100	0.0099	0.1039	0.0125
DW	0.638	0.644	0.643	2.127	2.223	2.095	..
Estimator	LS	LS	LS	LS	GLS	LS	GMM
Panel	CFE	CFE	CFE	CFE	CFE	Dif	Dif
Lags	0,0	2,4	2,2	2,2	2,2	2,2	2,2

The dependent variable is the growth rate of GDP, denoted by g. Number of observations is 1037 (with first differences, the number is 1022).. Numbers in parentheses are corrected t-ratios. Lags denote the fixed lags of *fx* and *rr*, respectively. CFE denotes the inclusion of fixed effects, Dif indicates that the data are differenced, LS denotes ordinary least squares and GLS, generalized least squares, while GMM denotes Generalized Method of Moments (Arellano-Bond) estimator. Then the J-statistic has the value of is 9.28 that is far from significant with the instrument rank of 15. If one tests the presence of fixed effects one can typically reject the hypothesis that these effects are identically equal to zero. Thus, e.g. in the case of equation (4) above the value of the F-test statistic is 7.80 which is significant at all conventional levels.

Table 2 Comparison of different IS curve specifications

	1	2	3	4	5	6
g_W	.397	.367	.224	.217	.794	.600
	(8.93)	(10.48)	(7.63)	(8.12)	(9.29)	(6.33)
fx	.009	-.001	.001	.001	.021	.017
	(4.00)	(0.47)	(0.31)	(0.27)	(3.37)	(3.45)
rr	-.059	-.016	-.023	-.021	-.043	-.041
	(4.89)	(1.13)	(2.00)	(1.93)	(1.70)	(1.38)
hp			.028	.018	.060	.044
			(5.10)	(3.74)	(3.37)	(3.70)
sp			.008	.007	-.002	.004
			(5.18)	(4.36)	(0.67)	(1.00)
g_{-1}	.683	.692	.759	.760	-.085	.447
	(24.05)	(20.36)	(28.03)	(34.82)	(1.83)	(7.34)
R2	0.787	0.695	0.781	0.549	0.096	0.791
SEE	0.0104	0.0139	0.0105	0.0105	0.0106	0.0089
DW	2.107	1.927	2.219	..	..	2.063
Estimator	LS	LS	LS	LAD	LAD	LS
Panel	CFE	CFE	None	None	None, dif	CFE
Lags	2,2	2,2	2,2	2,2	2,2	2,2
N	1037	1682	1037	1037	1037	449

Variables and other labels defined as in Table 1. The dependent variable is *g*. LAD denotes the least absolute deviations estimator. None denotes that no fixed or random effects are included, dif that the data (all variables) are differenced. If house and stock prices are not included, the sample size would increase considerably (i.e. from 1037 to 1682). Equation 6 is estimated from the sample of the EMU period 1999Q1-2006Q4.

Table 3 Estimation of the IS curve with the output gap variable

	1	2	3	4	5	6	7
gap_W	.457	447	.466	.683	.513	.797	.699
	(10.66)	(10.31)	(11.12)	(8.13)	(10.34)	(9.67)	(5.06)
fx	.003	.002	.004	.022	.014	.007	.015
	(2.18)	(1.33)	(2.43)	(5.37)	(5.83)	(1.49)	(2.90)
rr	-.010	-.004	-.030	-.010	-.034	-.052	-.080
	(1.14)	(0.41)	(3.39)	(4.03)	(2.89)	(2.58)	(1.18)
hp	.023			.022	.018	.038	.037
	(5.97)			(2.97)	(3.94)	(4.09)	(2.07)
sp	-.001			.002	.003	-.005	-.002
	(0.23)			(0.78)	(1.77)	(2.31)	(2.01)
gap_{-1}	.641	.601	.663	.263	.495	-.250	.138
	(19.59	(17.96)	(22.20)	(4.04)	(13.64)	(4.84)	(2.44)
R2	0.716	0.587	0.704	0.650	0.618	0.167	..
SEE	0.0070	0.0103	0.0071	0.0058	0.0055	0.0074	0.0080
DW	2.199	1.929	2.163	1.923	1.916	2.091	..
Estimator	LS	LS	LS	LS	GLS	LS	GMM
Panel	CFE	CFE	CFE	CFE	CFE	Dif	Dif
Lags	2,2	2,2	2,2	2,2	2,2	2,2	2,2
N	1037	1682	1037	449	449	1022	1022

Variables and other labels as defined in Table 1. The dependent variable is the output gap, denoted by *gap*. Equations in the two last columns (4-5) are estimated from the sample of the EMU period 1999Q1-2006Q4. The value of the J-statistic is 10.74 which is not significant with the instrument rank of 15.

Table 4 Comparison of stability of the IS curve

	1	2	3	4	5	6	7
g_W	.366	.260	.365	.280	.321	.321	.321
	(6.30)	(3.47)	(6.94)	(5.11)	(7.04)	(7.01)	(7.05)
fx	.013	.038	.010	.016	.011	.011	.009
	(4.35)	(1.80)	(4.41)	(0.55)	(4.96)	(4.83)	(4.06)
rr	-.030	-.060	-.029	-.042		-.065*	
	(1.86)	(2.93)	(1.98)	(2.75)		(2.86)	
$rr\|x\leq0$					-.052		-.050
					(3.21)		(3.29)
$rr\|x>0$					-.022		-.023
					(1.49)		(0.86)
hp	.018	.051	.011	.032	.030	.035	.035
	(2.36)	(5.86)	(1.88)	(5.22)	(4.47)	(6.14)	(5.96)
sp	.010	.009	.010	.007	.008	.008	.006
	(5.19)	(3.24)	(6.02)	(3.52)	(5.44)	(5.41)	(3.24)
g_{-1}	.636	.575	.659	.615	.624	.631	.640
	(17.80)	(10.08)	(25.81)	(16.18)	(21.03)	(21.43)	(21.39)
R^2	0.830	0.762	0.830	0.757	0.803	0.803	0.803
SEE	0.0090	0.0106	0.0089	0.0104	0.0099	0.0100	0.0099
DW	1.611	1.973	1.621	1.798	2.129	2.127	2.148
Estimator	LS	LS	GLS	GLS	LS	LS	LS
Panel	CFE	CFE	CFE	CFE	CFE	CFE	CFE
Lags	2,2	2,4	2,2	2,4	2,2	2,2	2,2
sample	gap≤0	gap>0	gap≤0	gap>0	all	all	all
x					*hp*	*hp*	*sp*
N	562	475	562	475	1037	1037	1037

The dependent variable is output growth. Notation is the same as in Table 1. Using the Chow test, it turns out that the parameter equality can be rejected (Thus, in the case of equations 1 and 2, F(21,106)=3.31)). Similarly, parameter constancy can be rejected in the case of equations 5 -7 where the constancy of interest rate effect over different house price (and stock price) growth regimes is analyzed.(thus, e.g. with equation 5, F(1,1015)=6.98). The equation in column 6 has been estimated with the Smooth Transition Model using the following logistic function of the coefficient of *rr*: 1/(1+exp(-.0005*(*hp*-0))).

Table 5 Impact of house and stock prices on interest rates

	1	2	3	4	5	6
g	.086	.115	.091			
	(4.45)	(6.73)	(6.33)			
gap				.181	.208	.250
				(6.36)	(4.61)	(7.89)
inf	.087	.087	.022	.070	-.016	.072
	(3.56)	(4.29)	(1.28)	(3.04)	(0.93)	(2.15)
HP	.000	.0001	-.003	.005	-.003	-.002
	(0.06)	(0.17)	(0.71)	(0.10)	(0.62)	(0.30)
SP	-.002	-.001	.003	.001	.004	.002
	(1.63)	(0.58)	(1.87)	(0.98)	(2.66)	(1.28)
r_{-1}	.938	.944	.881	.931	.819	.884
	(50.00)	(78.93)	(18.08)	(48.77)	(13.93)	(44.14)
R^2	0.953	0.953	0.900	0.954	0.911	
SEE	0.833	0.877	0.375	0.868	0.353	1.164
DW	1.853	1.750	1.709	1.897	1.778	..
Estimator	LS	CLS	LS	LS	LS	GMM
Panel	CFE	CFE	CFE	CFE	CFE	Dif
Sample	1979-07	1979-07	1999-07	1979-07	1999-07	1979-07
N	1076	1076	460	1076	460	1061

Notation as above, except where indicated. The dependent variable is the short-term interest rate, denoted by *r*. *inf* denotes the rate of inflation while *HP* and *SP* denote (here) the growth rates of nominal house and stock prices, respectively. Equations 3 and 5 are estimated from the sample of the EMU period 1999Q1-2007Q3. Otherwise, the estimation period is 1979Q1-2007Q3.

Table 6 Estimates of alternative interest rate equations

Dependent variable	Δr_L	Δr_L	Δr	Δr	Δr_L	Δr_L
constant	-.080	-.109	-.310	-.352	-.011	-.030
	(2.39)	(3.06)	(3.55)	(3.50)	(0.30)	(0.80)
Δr					.225	.223
					(5.39)	(5.39)
$(r_L - r)_{-1}$	.015	.007	.168	.163	-.023	-.030
	(1.24)	(0.54)	(3.46)	(3.41)	(1.54)	(2.05)
gap	.073	.058	.167	.164	.038	.022
	(5.35)	(4.09)	(6.22)	(5.89)	(2.59)	(1.48)
inf	-.002	-.011	.031	.025	-.009	-.017
	(0.27)	(1.22)	(2.06)	(1.71)	(1.14)	(1.96)
HP		.010		.006		.008
		(3.24)		(1.24)		(3.13)
SP		-.000		.002		-.001
		(0.58)		(1.53)		(1.56)
R^2	0.046	0.061	0.144	0.150	0.194	0.206
SEE	0.489	0.486	0.858	0.856	0.451	0.448
DW	1.314	1.325	1.781	1.802	1.390	1.391
Estimator	LS	LS	LS	LS	LS	LS
Panel	CFE	CFE	CFE	CFE	CFE	CFE

r_L is the long-term interest rate (government bond yield). Otherwise notation is the same as in Table 5. The sample period is 1979Q1-2007Q3. Number of observations is 962.

Table 7 Estimation of a "consumption function"

	1	2	3	4	5	6	7
g	.278	.233			.270	.270	.264
	(8.08)	(3.85)			(7.91)	(8.04)	(7.82)
$g\|x\leq 0$			.263	.309			
			(7.75)	(7.45)			
$g\|x>0$			.329	.250			
			(9.18)	(6.93)			
rr	-.030	-.022	-.030	-.026			
	(2.00)	(0.73)	(1.99)	(1.63)			
$rr\|x\leq 0$					-.034	-.042	-.058
					(1.46)	(2.19)	(3.01)
$rr\|x>0$					-.028	-.015	-.003
					(1.70)	(0.70)	(0.20)
hp	.015	.023	.015	.021	.014	.011	.014
	(2.40)	(1.87)	(2.34)	(2.65)	(1.97)	(1.51)	(2.19)
sp	.004	.001	.002	.004	.004	.003	.001
	(2.22)	(0.45)	(1.61)	(2.23)	(2.22)	(2.24)	(0.69)
cq_{-1}	.604	.603	.598	.600	.604	.604	.610
	(19.05)	(11.60)	(18.87)	(18.76)	(19.02)	(19.00)	(19.25)
R^2	0.787	0.793	0.791	0.789	0.788	0.788	0.790
SEE	0.0095	0.0088	0.0094	.0095	0.0095	0.0094	0.0094
DW	1.953	1.989	1.980	1.954	1.952	1.951	1.969
Estimator	LS	LS	LS	LS	LS	LS	LS
Panel	CFE	CFE	CFE	CFE	CFE	CFE	CFE
Period	79-07	99-07	79-07	79-07	79-07	79-07	79-07
x	..	..	*gap*	*hp*	*hp*	*hp*<3.3	*sp*
N	843	450	843	843	843	843	843

Notation as in previous tables. The dependent variable is the growth rate of private consumption *cq*. Here, the real interest rate *rr* appears without a lag. With the threshold models, the threshold value of the threshold variable *x* is zero except for equation (6) where it is 3.3 per cent. Although the coefficient estimates in threshold estimation appear to be different the hypothesis that the coefficients are equal cannot be rejected at the 5 per cent level of significance**.** Only with equation 7, the Wald test statistic is significant (F(1,823) = 6.49 (0.011)).

Figure 1 Scatter plot between change rates of house and stock prices

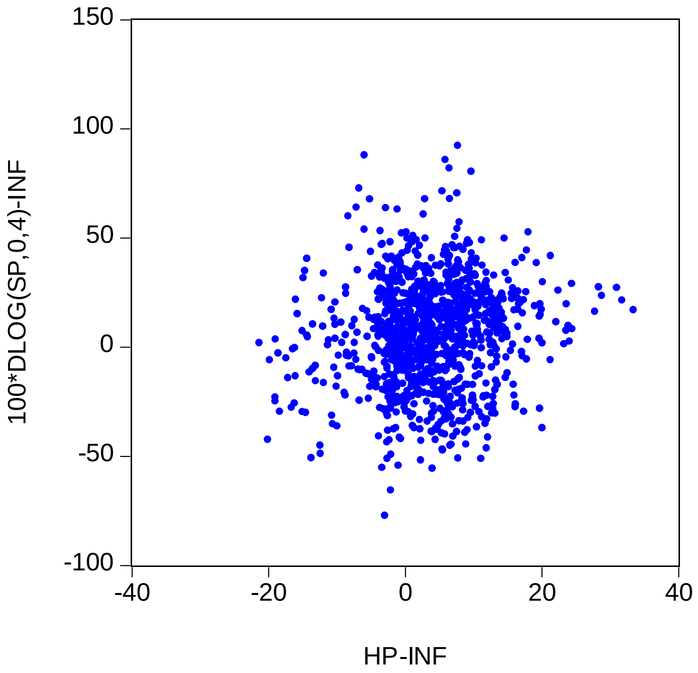


Figure 2 Times series of real house and stock prices (median values)

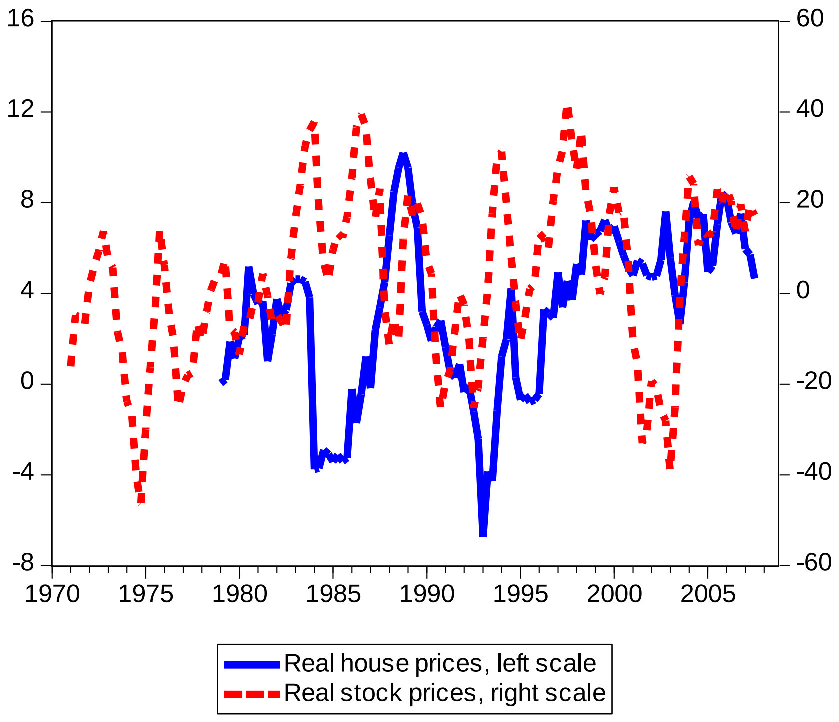


Figure 3 Median values of output growth and output gap

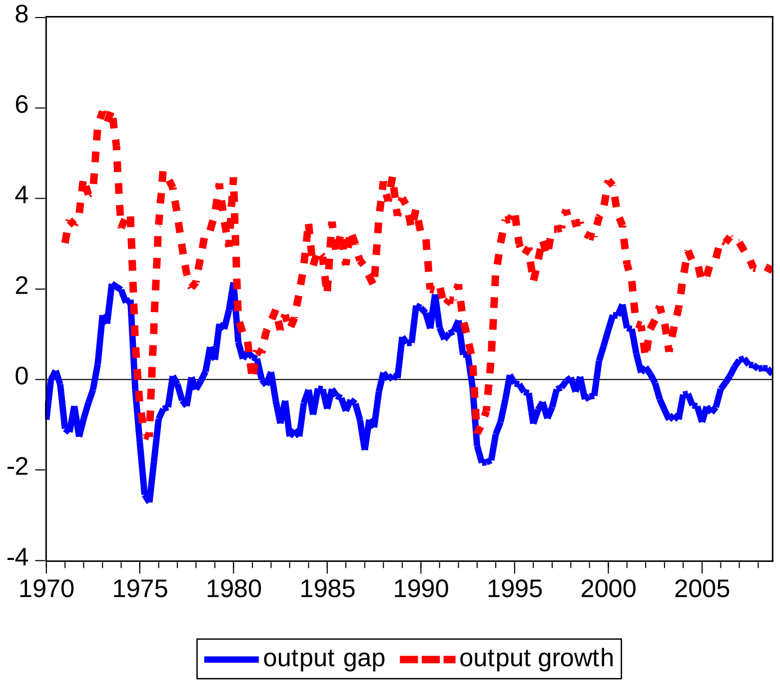


Figure 4 Confidence and house prices

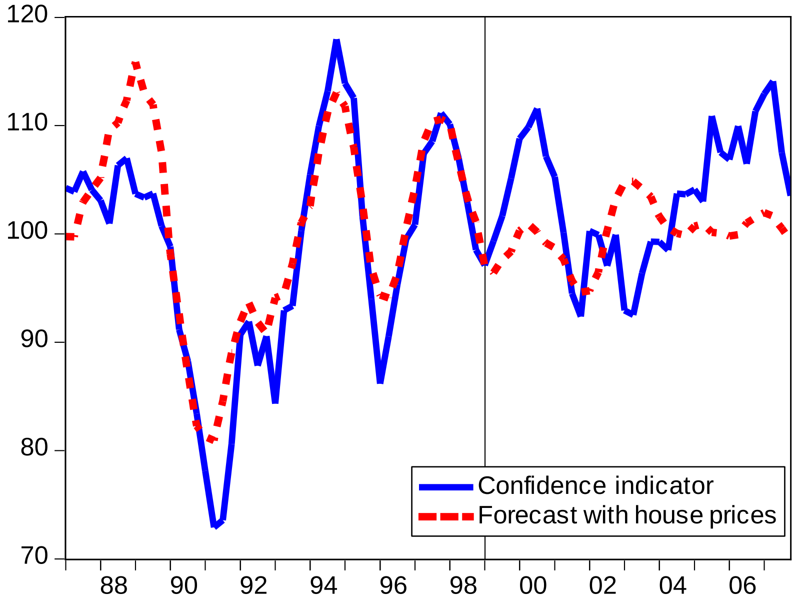


Figure 5 Interest rate forecast for the Euro period

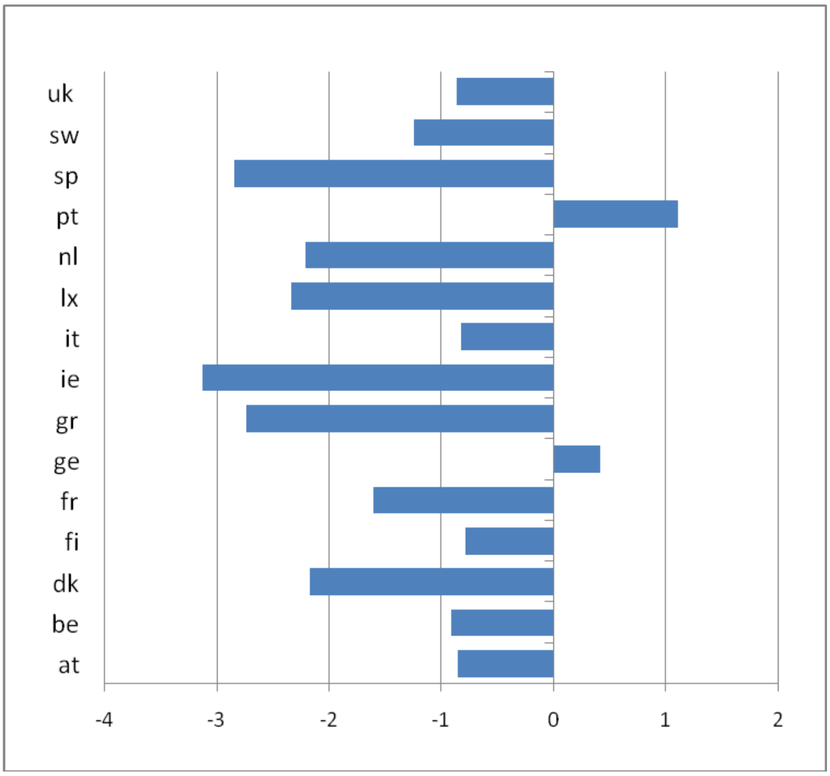
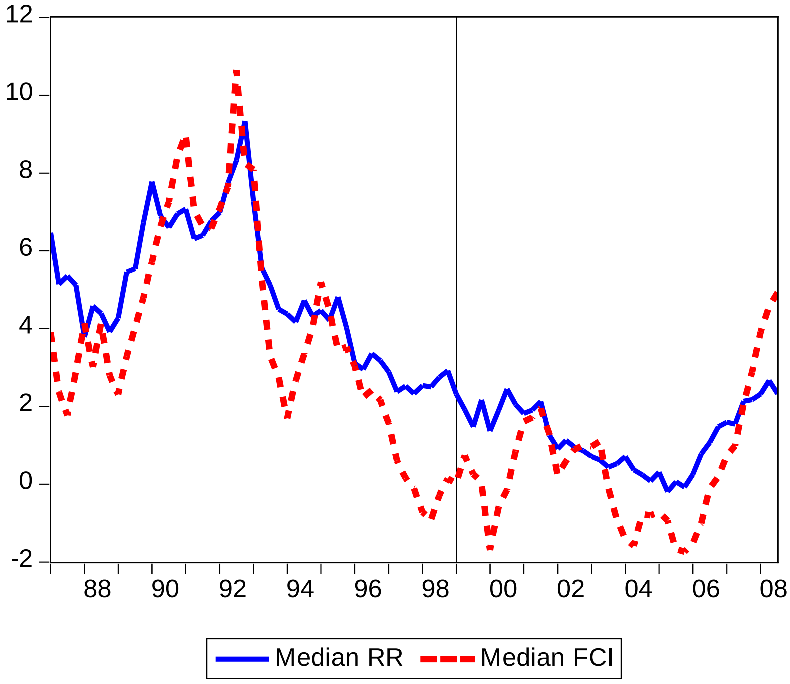


Figure 6 A FCI for the Euro area



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Appendix:

Panel unit root tests the main variables of the model

	Levin-Lin-Chu ‘t’	Pesaran-Shinn ‘W’
GDP growth, g	2.345 (0.095)	10.221 (0.000)
output gap, gap	4.699 (0.000)	15.132 (0.000)
real interest rate, rr	2.690 (0.004)	5.235 (0.000)
real exchange rate, fx	0.230 (0.409)	1.126 (0.130)
real house prices, hp	0.787 (0.215)	3.002 (0.013)
real stock prices, sp	2.791 (0.003)	5.268 (0.000)

Inside parentheses are the marginal significance levels. The number of cross sections is 16.

Data sources:

g = GDP growth rate is the four-quarter growth rate of Gross Domestic Product. *gap* is the output gap that is derived from the GDP using the Hodrick-Prescott filter. *rr* is the real ex-post interest rate that is derived as a difference between nominal short-term (3 month) interest rate and the four-quarter change rate of GDP deflator. *fx* is the real exchange rate that is derived from the nominal Euro/USD exchange rate and the GDP deflators of the USA and the home country. *hp* is the four-quarter change rate of real house prices that are derived from nominal house prices and GDP deflator. Similarly, *sp* (the change rate of real stock prices) are derived from nominal stock prices indexes and the GDP deflator. The data source for *g*, *gap*, *rr*, *fx* and *sp* is the OECD Main Economic Indicators data bank. House prices come from various national data sources (a more detailed list of those is available upon request from the authors)