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Asset Prices As Indicators of Euro Area Monetary Policy: Their Role in Taylor Rule

Abstract

This paper estimates forward-looking (FLTR) and forecast-based Taylor rules (FBTR) for France, Germany, Italy, as well as the euro area. Since forward-looking Taylor rules are usually estimated via GMM, we perform extensive tests for over-identifying restrictions and instrument relevance, the latter generally eschewed in previous work. We find that asset prices can be highly relevant as instruments in policy rules. Forecast-based rules perform best using the root mean squared error metric and are best estimated in difference form. While asset prices improve Taylor rule estimates different ones prove most useful in different countries and this result could be seen as complicating the tasks of the ECB. Encompassing tests are used to select the "best" policy rule. On this score FBTR outperform FLTR. However, the forecast data suggest that these incorporate an information advantage over reaction functions estimated in the conventional manner. A policy implication is that central banks ought to release their own forecasts and the basis upon which they are generated.

Keywords: Monetary policy reaction functions, asset prices, instruments, European Central Bank

JEL Codes: E52, E58, C52

1. Introduction

The creation of the European Central Bank (ECB), followed by the start of European Monetary Union (EMU), resulted in a historic transfer of responsibility for monetary policy from many central banks to a single supra-national authority. The creation of a single monetary policy also took place at a time when central banks were becoming increasingly pre-occupied with the behavior of financial asset prices.

It is unlikely that all economic shocks had the same impact in each of the prospective euro area member states before, or even after, EMU. Moreover, at least until the end of 1998, it is likely that these shocks might have elicited different monetary policy responses. The behavior of short-term interest rates for three core euro area members, namely France, Germany, and Italy, and a synthetic euro area-wide short-term interest rate prior to 1999, followed by the actual euro area repo rate since 1999, reveals that while convergence in interest rates took place, it only becomes visually apparent the year before the ECB took over responsibility for monetary policy in the euro area. Prior to that time, interest rate spreads are sizeable and variable (not shown). Even if interest rate convergence is assumed to have taken place, there is still considerable inflation divergence (e.g., see Busetti et. al. 2006) and this may create difficulties in the long-run for a common currency area and complicate the implementation of a single monetary policy.

It is now standard practice to evaluate monetary policy based on Taylor rules, a device that explains central banks' reactions to inflation and the output gap. Whereas inflation performance used to be interpreted through the behavior of consumer prices alone, more questions are being asked about whether asset prices may indirectly have also played a role in the conduct of monetary policy. Central banks pay attention to asset prices (e.g., Bernanke 2004, European Central Bank 2001, 2005). Yet, central bankers are also unsure about how much, if any, information is contained in asset prices beyond that which can be derived from the past history of inflation and output.[1]

It is unclear whether the monetary authorities worry over perceived excesses in some asset price relative some equilibrium or fundamental value (e.g., as in the "irrational exuberance" statement made famous by Alan Greenspan), as opposed to their volatility. The transition to European Monetary Union may also have prompted some of the candidate national central banks to voice concerns over specific asset prices, depending on their perceived importance in potentially influencing inflation or output growth in their respective national economies. Consequently, whereas real exchange rate considerations may have mattered relatively more in the conduct of monetary policy for some countries, housing or equity price developments likely loomed larger in others. Not to be forgotten is the role of monetary aggregates. The ECB has been criticized for its emphasis on 'money', as part of its two pillars strategy of monetary policy (e.g., Gerlach and Svensson 2003, but see Scheller 2004). However, a "long run" view of the role of money as a determinant of inflation might well treat wish to treat "money seriously" (von Hagen and Hofmann 2006). Indeed, evincing

[1] Bernanke (2005) suggests that "Central bankers naturally play close attention to interest rates and asset prices,…[they] are potentially valuable sources of timely information about economic and financial conditions…[and] should embody a great deal of investors' collective information and beliefs about the future course of the economy." Others, including Alan Greenspan, have also suggested either that asset prices have only an indirect effect on interest rates or were largely ignored in the past (Norris 2005) while Greithner (2006), President of the New York Fed, is somewhat more emphatic about the role of asset prices in monetary policy: "…monetary policy still has to take into account the impact of significant movements in asset values on output and inflation."

a concern for other types of asset prices could signal a form of "tunnel vision" in the conduct of monetary policy (e.g., European Central Bank 2005). The best that can be said then about the link between asset prices and interest rates is that central bankers are conflicted about their role in influencing policy.[2] In any event, whether asset price developments play a role in interest rate developments in the euro area prior to and since the creation of the ECB is an empirical question. In this paper, we are primarily interested in the indicator properties of different asset prices.

It is widely assumed that policy-making is forward-looking. Depending on the form of the reaction function, this requires variables that are unobservable. Current best practice involves estimating forward-looking Taylor rules (FLTR) using GMM. Our approach asks whether asset prices are relevant instruments in an econometric sense. Currently, relatively little attention is paid to choosing instruments, and still less whether they are statistically relevant in an estimated reaction function. We are the first to report an extensive series of instrument relevance tests for monetary policy rules, and the results shed light on the potential dissimilar concerns faced by euro area central banks prior to EMU. The results also have implications for our findings for euro area-wide data. Hence, while estimated rules may look alike across the countries considered, the information sets that produce the seemingly comparable outcomes differ.

[2] "It is far from obvious that bubbles, even if identified early, can be preempted at a lower cost than a substantial economic contraction and possible financial destabilization – the very outcomes we would be seeking to avoid." (Greenspan 2004). Gruen, Plumb, and Stone (2005) show that the informational requirements needed to support an activist response to asset price bubbles are quite substantial.

An alternative approach asks how central banks set interest rates in response to forecasts. Such forecasts, at least indirectly, may incorporate asset price developments if they are indicators of future inflation and output developments (e.g., Svensson 2003). There have been comparatively fewer attempts to estimate, and empirically evaluate, forecast-based Taylor rules (FBTR). Since forward- and forecast-based policy rules are non-nested hypotheses of interest rate determination, we also report encompassing tests to decide whether one type of rule is capable of statistically dominating the other.

The plan of the paper is as follows. The next two sections discuss the potential role of asset prices as indicators of monetary policy actions. We then report estimates of FLTR and FBTR for three core euro area countries, namely France, Germany, and Italy.[3] The paper concludes with a summary and conclusions are drawn.

Briefly, adding assets prices as instruments in FLTR produces not only more plausible reaction functions but ones that achieve a better fit. However, the asset price found to be most relevant in a statistical sense differs across the countries considered. For example, a monetary aggregate usually performs well for most countries considered but estimates can be improved by taking into account equity or housing prices. We interpret these results to mean that asset price developments influenced expectations of inflation and the output gap in core euro area countries. However, as different asset prices appeared to influence monetary policy setting behavior in individual euro area countries this could be construed as complicating the

[3] Policy rules for smaller euro area members including Austria, Belgium, Finland, and the Netherlands were also examined but, as these did not materially affect the conclusions reported below, we do not discuss them any further. The real GDP of the three core area countries considered in this paper accounts for roughly three-quarters of euro area-wide real GDP.

task of the ECB. Finally, FBTR encompass FLTR in each country, as well as for the euro area as a whole. A policy implication is that central banks, who possibly have some comparative informational and technical advantage in the production of such forecasts, should routinely make such forecasts publicly available.[4]

2. Asset Prices as Indicators in Taylor Rules

While tradition, and a considerable amount of empirical evidence, points to inflation, output, and a desire to minimize interest rate volatility as chief among the concerns of most central banks (e.g., Favero and Rovelli 2003, but see Rudebusch 2002 and Lansing 2002), recent events have prompted some to consider the possibility that asset prices also play a role in a policy reaction function.[5]

Asset prices have been considered by some as a separate determinant of interest rates while others have argued against the notion that a central bank might indirectly react to such variables. For example, Bernanke and Gertler (1999) make the case against including a reaction to asset prices whereas Cecchetti et al. (2000) argue in favor of adding equity returns to a standard Taylor rule. While Cecchetti et al.'s paper investigates a relatively wider range of policy rules, they do not actually search for the optimal rule. Filardo (2004) points out that if non-fundamental asset price movements can have real economic effects, then they should be incorporated into the central bank's policy rule.

[4] Since 2003, the ECB publishes the Survey of Professional Forecasters (http://www.ecb.int/stats/spf). The data go back to 1999. Note that these are not the ECB's forecasts. When using central bank forecasts there is potentially an additional complication for the consumers of such forecasts (see Goodhart 2005, and below).

[5] While some of the debate has turned on whether the monetary authority should target asset price developments, central banks have argued against this position because they treat asset prices as forward-looking indicators of inflation and/or the output gap.

Since the debate partly centers on the information content of asset prices for the future course of the economy, this paper tackles the issue from a different angle.[6] There is little doubt that central bankers monitor asset price developments, though it is unclear whether this is a long standing practice or a more recent development. It is also debatable whether some asset prices (e.g., exchange rates) attract more attention than others (e.g., equity returns or housing prices) from the monetary authorities. In any event, as argued by Clarida (2001, p. 318), the guiding principle implicit in the FLTR concept, is that "…central banks look at everything but only to the extent that 'everything' is useful in forecasting inflation and possibly output." Since asset prices are obvious candidates for addressing this issue we examine their role as instruments for inflation and the output gap in FLTR. For most euro area economies one might well argue that policy makers have undoubtedly been concerned with real exchange rate movements (e.g., Leitemo 1999, Leitemo and Røisland 1999, and Medina and Valdés 2002). In the past several years, however, attention has turned to the behavior of equity, housing, or some other asset price indicators, as central banks are increasingly seen as having to stem the cycle of booms and busts in asset prices. Indeed, central banks can be thought of as reacting to some weighted average or linear combination of asset prices (e.g., Smets 1997).

Financial innovation since the 1980s, and the shift in emphasis in the conduct of monetary policy toward reliance on an interest rate instrument, has reduced the predictive role of monetary aggregates for inflation in the "long-run", and output in the short-run.

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[6] Still another alternative, not considered in this paper, is to broaden the definition of inflation. Goodhart (2001), for example, advocates a measure of inflation that goes beyond merely incorporating the effects of changing prices for goods and services to also include the impact of asset prices (e.g., equity and housing prices).

Nevertheless, monetary aggregates play a role in the operational framework of the ECB, and its key progenitor prior to 1999, namely the Deutsche Bundesbank. Hence, as did Clarida, Gali, and Gertler (1998), and Gerdesmeier and Roffia (2004), we also consider a monetary aggregate.

Theories that treat asset price movements as indicators of future inflation or economic activity have a long tradition but empirical evidence has had a more difficult time reaching anything approaching a consensus (e.g., see Stock and Watson 2003, 2005). Even if it is deemed desirable to incorporate a role for asset prices, the investigator faces a number of additional difficulties. In particular, there is no widespread agreement on how best to define equilibrium real exchange rate or asset price levels though these problems seem no less intractable than defining the "trend" in output used in deriving an output gap measure.[7] Following most authors, we rely on variations of "standard" filters to approximate the variables of interest.

Table 1 presents a selection of published estimates of Taylor rules, primarily for euro area countries. Only estimates of forward-looking reactions functions are shown though there are several backward-looking Taylor rule estimates published (e.g., see Gerdesmeier and Roffia 2004, and references therein). The steady-state estimates for inflation tend to be consistent with the "Taylor principle", according to which a larger than unit nominal interest rate response is required for any unit increase in inflation. Table 1 also reveals considerable variation in the estimated weights on the inflation and output gap objectives, the role of asset

[7] In the case of equity and possibly housing prices, matters are complicated still further because there is possibly an element of "irrational exuberance" or a "bubble" component that is difficult to measure empirically. This paper does not address all of these issues.

prices is usually not investigated, nor is the robustness of results or the relative suitability of forward or forecast-based models extensively analyzed.[8]

Bernanke and Gertler (1999) examine how stock prices affect interest rate determination in the U.S. and Japan. Cecchetti (2003) also reports that the Fed reacted to stock market developments relying again on a Taylor rule type equation. Clarida, Gali and Gertler (1998) add a real exchange rate, as do Gerdesmeier and Roffia (2004), with mixed results at best. While a real exchange rate variable in a Taylor rule can be statistically significant, it is generally economically small (also see Taylor 2001, and Leitemo and Söderström 2001). Indeed, Clarida, Gali and Gertler (2000) argue that closed and open economy policy rules ought to be qualitatively the same (alse see Clarida (2001). For the sake of completeness, we also estimate an extended Taylor rule where the real exchange rate is an additional determinant. Our conclusions are unaffected. Consistent with the findings of others (see above), the real exchange rate variable is either statistically insignificant and is always economically insignificant.

3. Estimation and Testing Strategy

We begin with a standard version of Taylor's rule:

$$i_t = \bar{i} + \gamma_{\tilde{\pi}} \tilde{\pi}_t + \gamma_{\tilde{y}} \tilde{y}_t + \rho i_{t-1} + \upsilon_t \tag{1}$$

where i_t is the (nominal) interest rate instrument of monetary policy, $\bar{i} = (1-\rho)\alpha$ the sum of the steady-state real interest rate and the annual inflation target (also see equation (2) below), $\tilde{\pi}$ and $\tilde{y}$ denote, respectively, the inflation and output gaps, ρ is the interest rate persistence or smoothing term, and υ_t denotes a residual term. The inflation gap is simply

[8] Gerdesmeier and Roffia (2004) perform an extensive comparison of forward versus backward-looking Taylor rules for the euro area.

the difference between expected and targeted inflation rates, $E_t(\pi_{t+n}) - \pi^*$. The output gap is the percentage deviation of real GDP from its potential level, and $\gamma_{\tilde{y}} = (1-\rho)\theta$ are weights policy makers place on inflation and output gap objectives while the central bank's steady-state reactions are captured via estimates of β and θ, respectively.[9] Therefore,

$$i_t^* = \alpha + \beta_n E_t(\pi_{t+i}) + \theta_n E_t(\tilde{y}_{t+k}) \tag{2}$$

where i_t^* is the interest rate target, $E_t(\tilde{\pi}_{t+i})$ and $E_t(\tilde{y}_{t+k})$ are the conditional expectations of inflation and of the output gap, i or k periods ahead, $i, k \geq 0$.[10] Since $E_t(\tilde{\pi}_{t+i})$ and $E_t(\tilde{y}_{t+k})$ are unobservable, proxies must be used. Alternatively, the central bank could be viewed as setting monetary policy on the basis of forecasts of inflation and output growth. Central bank forecasts or private sector forecasts serve this purpose. For the countries examined here we use both public and private sector forecasts.[11] We can write a forecast-based Taylor rules (FBTR), where $i = k = n$, as follows:

$$i_t = \bar{i} + \gamma_{\tilde{\pi}}^* \tilde{\pi}_{t+n,t}^f + \gamma_{\tilde{y}}^* \tilde{y}_{t+n,t}^f + \rho i_{t-1} + \upsilon_t , \tag{1a}$$

where $\tilde{\pi}_{t+n,t}^f$ and $\tilde{y}_{t+n,t}^f$ are, respectively, published forecasts of inflation (or the inflation gap) and the output gap $t+n$ periods ahead made at time t, and n=4,8.

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[9] In an optimizing framework (e.g., Clarida, Gali, and Gertler 2000), these weights also reflect to some extent the underlying structure of the economy as well as the persistence of economic shocks.

[10] In equation (2) the inflation target has been normalized to zero. Equation (1) is then derived from the relation $i_t = \rho i_{t-1} + (1-\rho) i_t^* + \upsilon_t$. Moreover, while there is no requirement that $i = k$, this is the general practice followed in empirical work.

[11] Goodhart (2005), Jansson and Vredin (2003), Siklos (2002), and Siklos and Wohar (2006) also estimate policy rules relying on central bank forecasts.

A difficulty with forecasts is that it is not immediately clear whether the published forecasts are based on the assumption that interest rates are unchanged.[12] Second, depending on the source of the forecast, updating is done at different intervals, namely monthly, quarterly, or even semi-annually. Third, forecasts are for inflation (or real GDP growth) covering a calendar year. Yet it is conceivable that, as the forecast period approaches, the arrival of additional data are used to change forecasts. As a result, we assume that the data available to the forecaster is augmented as far as possible to reflect the data that would be used to generate inflation and real GDP growth forecasts for the relevant calendar year. Clearly, we do not know exactly the information set used by the various forecasters. Hence, our attempt to control for the changing span of time between the forecast period and the data that would be available in generating the forecast is only an approximation.

There is an additional issue that arises in the estimation of FBTR (and, to some extent, FLTR). The available span of data is relatively short and covers a period when interest rates were falling (see below).[13] Second, the measurement problems concerning the output gap, for example, may be exacerbated in FBTR since, with one exception, we rely on forecasts of real GDP growth and not those of the output gap. As Walsh (2003) and others have noted, first

[12] Fuhrer and Tootell (2004) point out that if the correlation between the contemporaneous asset price in question and lagged interest rate changes is significant, this will tend to bias the coefficient on the asset price variable in the estimated policy rule away from zero. Goodhart (2005) shows for UK data that using "ex post" forecasts, that is, conditioned on known interest rate decisions, results in a potentially serious misspecification.

[13] In other words, it is conceivable that, even in the presence of a trend, nominal interest rates have a unit root. Siklos and Wohar (2006) consider the implications for estimating Taylor type rules.

differencing of such series mitigates the problem. Consequently, estimates of FBTR are for a version of (1a) in first differences which yields

$$\Delta i_t = \gamma^*_{\Delta\tilde{\pi}} \Delta\pi^f_{t+n,t} + \gamma^*_{\Delta\tilde{y}} \Delta\tilde{y}^f_{t+n,t} + \rho\Delta i_{t-1} + \zeta_t \tag{1b}$$

where all the variables have been defined, Δ is the difference operator, and ζ_t is the residual of the FBTR rule in first differences.[14]

As noted previously, there is some evidence about the desirability of incorporating a mix of forward or even forecast-based elements. Goodhart (2005, p. 1) points out that while the past history of output and inflation may be important determinants of the future course of these variables, "…they will surely never be the *only* determinants of those forecasts" [italics in original]. One way of evaluating the relative contributions of FLTR versus FBTR, not heretofore considered elsewhere, is to ask whether one type of reaction function statistically encompasses the other. In this fashion, we are to test whether it might be preferable to estimate such rules as linear combinations of each other.

Next, the question arises how to proxy the inflation target π^*. Usually, π^* is assumed to be a constant (say 2%). Since our conclusions were unaffected by the type of inflation gap proxy used, we only report results which assume a constant inflation objective.[15] This has the slight advantage of allowing for a comparison with the bulk of the literature on Taylor rules.

[14] The unit root property of the series in question suggests the possibility of cointegration but no such property was found in the data, again likely because of the available sample.

[15] We used an HP filter with a standard smoothing parameter (1600) and a larger smoothing parameter (4800). We also estimated an inflation target as the mid-point of the spread between the average annual inflation rate in the euro area countries and the average annual inflation rate in the three lowest inflation rate countries in the euro area plus 1.5%, as specified in the Maastricht Treaty (article 121, ex article 109j). The conclusions are robust to all these alternatives.

Similarly, estimation of the output gap has been problematic. As with the inflation gap, we utilize an HP filter and various standard detrending schemes, as there are no practical alternatives for the output gap for the countries in our sample.[16]

Following much of the empirical literature we estimate (1), and its variants, via GMM, in spite of questions raised about its reliability (e.g., see Mavroeidis 2004, Jondeau, Le Bihan, and Galles 2003). A crucial issue concerns the choice of instruments and, more importantly, their relevance. Typically, the *J*-test for goodness of fit is usually reported without much comment.[17] Nevertheless, focusing on such a test alone also poses problems because one risks choosing a model with theoretically implausible coefficients in the rule. Therefore, we augment the tests for over-identifying restrictions by reporting the GMM information criterion (GMMIC) suggested by Andrews (1999). This test indicates whether the chosen instruments are orthogonal to the error term. Hall and Peixe (2003) propose the canonical correlation instrument relevance test (CCIC; also see Hall 2005).

We also consider a test for instrument relevance based on the two stage least squares (TSLS) estimation approach. Shea (1997) points out that regressing the endogenous variables against the chosen instruments can be misleading if there is more than one endogenous

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[16] Stock and Watson (2003) recommend a one-sided HP filter. Much of the literature uses a two sided HP filter for convenience, or an alternative measure of the economy's capacity, but comparable time series are not available for the vast majority of euro area countries. We also generate, but do not report here, estimates of the output gap based on a Blanchard-Quah type decomposition with no impact on our conclusions.

[17] Authors sometimes rely on this test to determine the horizon used by the policy makers. However, as we shall see, it is difficult to reject the null of the validity of chosen instrument sets. Hence, it is difficult to discriminate among competing versions of the same estimated policy rule.

variables in the estimated specification. Jondeau, Le Bihan, and Galles (2004) report simulation evidence suggesting even small mis-specifications can lead to implausibly large coefficients for the forward looking variables estimated equations via GMM. Godfrey (1999) develops a simple measure for computing instrument relevance based on a TSLS estimation specification.[18] With this in mind, we use asset prices, among other variables, as instruments and test both their impact on the fit of estimated policy rules, as well as their relevance as instruments.[19]

Once the reaction functions are estimated we can back-out the implied target interest rates over time, i.e., i_t^*, to determine how well a reaction function "fits" with actual interest rate developments in the individual countries considered. Finally, we report statistical encompassing tests to determine which of the two kinds of reaction functions, if any, provides the best "fit" overall (Chong and Hendry 1986).

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[18] While the test for instrument relevance is based on two stage least squares it has the advantage that it can accommodate more than one endogenous variable and does not rely on GMM. Recent tests for instrument relevance are more complex when there is more than one endogenous variable. Jim Stock's weak instruments web page updates information on this topic (ksghome.harvard.edu/~jstock/ams/websupp/index.htm).

[19] An objection that can be raised is that GMM is a non-linear estimation technique while the tests of instrument relevance used here are based on TSLS estimates. Since GMM is the estimation technique of choice we retain its use. Furthermore, relying on other tests of instrument relevance (e.g., the F-test as in Stock, Wright, and Yogo (2002) we obtain comparable results (see next section). Gerdesmeier and Roffia (2004) report finding few substantive differences between their GMM and two stage least squares estimates for the euro area. We also consider whether the volatility of asset prices serve as superior instruments in forward-looking rules (results not shown). Our conclusions are unchanged.

4. Data and Empirical Evidence

4.1 Data and Preliminaries

Data are quarterly at the source, or converted to the quarterly frequency by taking monthly averages where necessary. For real GDP, seasonally unadjusted data were used and adjustment was made using X-11. To generate the output gap we use the HP filter with various smoothing parameters but eventually settled on the standard value of 1600 as our conclusions were unaffected by alternative values up to 9600 considered. For the euro we also rely on estimates of the output gap used in the euro area-wide model.[20]

The BIS made available its aggregate asset price index (Borio and Lowe 2002). Therefore, we can get some idea of the potential impact of relying on a weighted average of key asset prices.[21] The following individual asset prices we consider include: housing prices, equity prices, the real exchange rate, a measure of financial conditions proxied by the financial conditions index[22], and a broad monetary aggregate. Next, we transform all variables, except the nominal interest rate, measured in percent, into 100 times the fourth order log difference, that is, $(\log X_t - \log X_{t-4})$, where X is the variable of interest.

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[20] Data were obtained from the Bank of Finland. However, members of the Euro Area Business Cycle Network at www.eabcn.org may also access the relevant time series.

[21] In the empirical results we rely on the nominal measure. The BIS's asset price index is essentially a weighted average of equity, residential and commercial property prices, where the weights are their respective shares in private sector wealth. The calibration of weights has changed over time since the index was first introduced (Borio, Kennedy, and Prowse 1994).

[22] The estimated weights reported in Goodhart and Hofmann (2000) were used. The financial conditions index can be thought of as an extension of the monetary conditions index, representing a linear combination of interest rates and exchange rates, to include housing and stock prices.

Turning to FBTR, we employ one-year ahead forecasts of inflation, real GDP growth, or the output gap. The relevant forecasts were obtained from Consensus Economics, *The Economist*, and the OECD. The first two are private sector forecasts while the OECD is a public agency supported by several governments. Both Consensus and *The Economist* forecasts are monthly and were converted to the quarterly frequency via simple averaging. OECD forecasts are semi-annual and simple interpolation was used to generate quarterly forecast equivalents. Forecasts are for the CPI (or the HCPI in the case of the euro area) and real GDP growth except OECD forecasts where output gap forecasts were employed.

Figure 1 plots estimated gaps in housing, stock prices and in the BIS's aggregate asset price index based on different filtering techniques. To gain additional perspective, the gaps are shown alongside periods of "booms and bust" cycles, as defined by Bordo and Jeanne (2004) and Detken and Smets (2004), and dated using a type of moving average of the relevant asset price shown. There appear to be few differences between HP filtering and quadratic or cubic de-trending, the most commonly used techniques in this context, though the amplitudes are larger when de-trending is used or when a larger smoothing parameter is chosen for the HP filter. No "bust" period in equity prices were identified by Bordo and Jeanne (2004) for Germany and France, at least for the period covered here. Yet, both HP filtering as well as cubic detrending reveal substantial stock price declines on more than one occasion. For Italy, the two bust periods identified by Bordo and Jeanne (2004) appear broadly consistent with either filter used. However, in this setup, comparable price declines at the beginning of the sample as well as during the later 1990s did not make the grade.

Turning to housing prices (middle panel in Figure 1), downturns identified via various filters broadly match those reported in Bordo and Jeanne (2004) but only one boom period shown here across the three countries considered. Finally, when we use the BIS's nominal aggregate asset price index, and compare its behavior with the so-called high and low cost booms reported in Detken and Smets (2004), we find general agreement with the application of an HP filter to the data.

Gaps in the BIS's aggregate asset price index (bottom of Figure 1) reveal some differences relative to gaps in housing and equity prices. For example, for France, there are two large positive gaps in asset prices around 1990, and then again in 2000-01, which are not entirely mirrored in the other asset price movements depicted in the same figure. Much the same can be said for the development of asset prices in Germany and Italy. While our results could be sensitive to the choice of filters, the empirical evidence shown below relies on the standard menu of detrending filters used in the extant literature.

Using published forecasts in a FBTR may be misleading if forecasts are inefficient or unbiased (Fuhrer and Tootell 2004). A simple test of forecast efficiency consists in estimating the following regression:

$$z_{t+i} = \delta_0 + \delta_1 z_{t+i}^f + \sum_{k=1}^{j} \delta_{2k} x_{t-k} + \xi_t \,, \tag{3}$$

where z_{t+i} is inflation or the output gap, z_{t+i}^f are the forecasts from Consensus Economics, *The Economist*, and the OECD Economic Outlook. Forecasts are generally for $i = 4,8$. x_{t-k} (k is set either to 1 or 4) includes the BIS's aggregate asset price index, the rate of change in housing prices, equity prices, or the real exchange rate. Forecast efficiency implies that the forecasts are not influenced by lags of some, or all, asset prices. That is, one is unable to reject the null hypothesis that $\delta_{2k} = 0$, for all k=1, *j*. Unbiasedness requires not only forecast efficiency, but the non-rejection of the joint null that $\delta_0 = 0, \delta_1 = 1$.

Estimation results (not shown but available on request) of (3) reveal that, for inflation, lags in the BIS's index nor housing prices improve the explanatory power of equation (3). The results are somewhat more mixed for the equity and real exchange rate variables. For example, *The Economist*'s forecasts for inflation in France and Italy appear inefficient. Otherwise all other forecasts are efficient. When all three asset prices are considered jointly, only OECD forecasts display some inefficiency. Turning to the output gap, there is almost no evidence of forecast inefficiency regardless of the source of the forecast.[23] Our findings show strong evidence of forecast efficiency for the BIS's index, and when all three asset prices enter equation (3) jointly. All the available forecasts do, however, appear to be unbiased.

Equation (3) is the usual test of forecast efficiency. Filardo (2004) suggests that, lagged forecasts should also be insignificantly related to z_t.[24] When we re-estimate (3) adding lags of z_t the results (not shown but available on request) are mixed. Therefore, conditional on x_{t-k}, at least some forecasts of z_{t+i} could be improved by the addition of the past history of z_t. Since x_{t-k} consists of asset prices alone, this is suggestive of a non-fundamental component. We leave the implications of this result for future research.

4.2 Instrument Selection and Relevance

Table 2 panel A shows *J*-test statistic for the non-rejection rates for the null that the over-identifying restrictions are acceptable. Since it is unclear how forward-looking central banks

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[23] Other than for the OECD, where forecasts of the output gap are available, forecasts are for real GDP growth. Whether (3) uses GDP growth or a proxy for the output gap does not change the outcome of the forecast efficiency tests.

[24] This seems like a sensible requirement since non-rejection of the null that $z_{t-i} = 0, i \geq 1$ implies that knowledge about the past history of asset prices does not improve predictions of inflation or the output gap.

are, equation (2) is estimated for i, j= 0,8. Examining the results for France, Germany, and Italy, it is difficult to discriminate among instrument sets and horizons in spite of the relatively large number of instrument sets considered and the inclusion of a wide variety of asset prices as instruments. Interestingly, the situation changes dramatically when euro area-wide data are considered. While the non-rejection rates are modest at short horizons, the *J*-test rejects the over-identifying restrictions at horizons of a year or longer.

Panel B of Table 2 considers Andrews' GMMIC. To conserve space, results are shown only for the cases where inflation and the output gap enter the FLTR either contemporaneously or four quarters ahead. Regardless of the specification considered the instrument set most orthogonal to the error term consists of a combination of individual asset prices, namely the real exchange rate, housing prices, and equity returns. Nevertheless, if an investigator were to choose a common asset price for all cases considered, a monetary aggregate is a fairly good choice most of the time.

As argued in Hall and Peixe (2003), Andrews' test represents a necessary but not a sufficient condition for determining the suitability of the chosen instrument set. Panel C of Table 2 shows their CCIC test of instrument relevance. The conclusions reached earlier (i.e., panel B) are generally unchanged. However, it is interesting to note that if a more parsimonious instrument set is desired, the BIS' asset price index would be chosen for Germany and the euro area while housing price inflation, or a monetary aggregate, would be good choices for France and Italy.

4.3 Steady-StateTaylor Rule Coefficient Estimates and the Role of Asset Prices

Table 3 presents estimates of the steady-state parameters in FLTR for a variety of instrument sets. Previous instrument tests were based on GMM estimation and these are known to be sensitive to the chosen specification. Accordingly, we supplement GMM-based tests with instrument relevance tests based on TSLS estimates of (2). Additionally, we show the root mean squared error (RMSE) for the difference between actual and implied nominal interest rates for each specification considered (i.e., equation (2)).

Generally, the various diagnostic tests find evidence in favor of the instrument set consisting of a combination of individual asset prices. This result certainly fits with the notion that central banks take account of a variety of indicators when setting the instrument of monetary policy. Not surprisingly perhaps, the real exchange rate is a close second, at least based on the RMSE criterion.

The impact of using different instrument sets is clearly seen from the steady-state parameter estimates on the inflation and output gap variables. The coefficients on inflation range from 0.94 to 1.93 across the three countries considered, with responses smallest for France and largest for Germany. Indeed, for Germany and Italy, the responses are typically significantly above one, as required by the Taylor principle. Interestingly, if the policy rule is chosen on the basis of instrument relevance, the coefficient on inflation is generally smaller than when the "standard" set of instruments is used. This could mean that asset price developments led some central banks to respond more cautiously. These estimates are also well within the range of earlier published results as can be seen by comparing our estimates with those shown in Table 1. Finally, the estimates also convey the notion that the soon to be core euro area members may well have responded differently to inflation over the sample considered.

Turning to the output gap, the steady-state coefficients are generally insignificant, at least if a 5% critical value is adopted, but become positive and statistically significant when the instrument set is one of the preferred ones, based on the various diagnostic tests previously considered. Hence, the significance of the output gap is clearly a function of instrument choice.

Next, we turn to estimates for the euro area shown in Table 4. The most striking result is the difference between estimates that alternatively include and exclude the era since the ECB took over sole responsibility for the conduct of monetary policy in the euro area. Based on full sample estimates, the ECB appears to react more aggressively to inflation and the output gap than for a sample that ends in 1998. Indeed, the ECB appears to react most aggressively to the output gap either when the standard set of instruments is used or when the set is augmented with lags in the money gap. In contrast, the ECB reacts positively and significantly to the output gap, and somewhat less aggressively to inflation, when a combination of different asset prices serves as instruments. Nevertheless, it should be noted, based on the additional instrument relevance tests, and the RMSE criterion, that either a euro area-wide wealth measure, or the money gap, are the additional instruments that appear to improve estimates of the policy rule.

Table 5 presents RMSE estimates for the FBTR (1b). The results are clear-cut. First, paralleling the results for FLTR, specifications that rely on one year forecasts of the output gap and inflation, and are augmented by lags in a combination of asset prices, provide the best overall fit among the various specifications considered. This is true for all three countries considered, as well as for the euro area-wide data. Furthermore, forecasts from *The Economist* outperform slightly those based on Consensus forecasts while OECD forecasts, which are published only semi-annually, perform most poorly of all. Lastly, at least based on Consensus Forecasts, there is little deterioration in the in-sample forecasting performance between one and two year-ahead forecasts. The latter is typically the horizon used by central banks when they decide what the appropriate stance for monetary policy is. A comparison between the RMSE either for final revised data, real-time data, or forecast-based data suggest the latter provide superior estimates.

To gauge the comparative advantage of one type of policy rule over another, Table 6 presents encompassing tests that rely on the best performing FLTR and FBTR policy rule estimates.[25] At the 1% level of significance the results reveal a clear-cut preference for FBTR over FLTR. Of course, one must be mindful of the potential information advantage embedded into the published forecasts used here. In a sense the encompassing test confirms this result. It is tempting, therefore, to conclude overall in favor of the FBTR as the preferred specification. However, as we know relatively little about the model or methods used to generate the published forecast used here, it is too early to reach a definitive conclusion on this score. Nevertheless, the performance of FBTR suggests that more central banks ought to release their own forecasts and inform the public about the basis upon which these are generated.

5. Conclusions

It is commonplace to estimate forward-looking policy rules. Relatively little effort has been devoted to ascertaining the performance and relevance of different instrument sets used in generating a central bank's response to inflation and the output gap. Instrument relevance tests suggest that asset prices, especially a combination that includes a real exchange rate, equity returns, and housing prices, play a significant role in determining the responses to

[25] The sample begins in 1991 (1996 for the euro area) due to data limitations in the forecast data. See Section 4.1.

inflation and the output gap in the euro area before and since the ECB became solely responsible for monetary policy in the euro area. More importantly, the choice of instruments has a significant impact on the steady-state response of central banks to inflation and the output gap. Nevertheless, any improvements in estimating FLTR must confront the fact that forecast-based rules typically outperform them. Whether this result is partly, or largely, due to the possibility that some forecasts incorporate the effects of changes in the stance of monetary policy is unclear but clearly warrants additional research. Indeed, if our findings hold up, a policy implication is that central banks ought to be encouraged to release their own forecasts.

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Table 1: Selected Estimates of Taylor Rule Parameters

Author	Type[2]	Inflation	Output Gap	Other	Sample
Bernanke and Gertler (1999)	FLTR	1.12 - 2.21 1.60 - 1.71	0.20 - 0.33 0.14 - 0.20	0.19 - 0.29 -.08	Japan 1968 – 89 US 1968 - 89
Chadha, Sarno, Valente (2003)	FLTR	1.69 - 2.39 0.98 - 1.46 1.10 - 2.37	-0.72 - 1.07 -0.61 - 0.60 -0.02 - 0.05	0.07/0.02 0.01/0.89 0.02/0.002	US UK Japan 1979 - 2000
Clarida, Gali and Gertler (1998)	FLTR	1.10 - 1.37 1.81 - 2.04 1.05 - 2.20 0.48 - 0.98 0.59 - 1.33 0.59 - 0.91	0.25 - 0.35 0.03 - 0.10 0.14 - 0.52 0.17 - 0.28 -0.07 - 0.88 -0.03 - 0.22	0.05-0.12 0.06-0.09 -0.78-0.53 0.09 2.91 -0.03	Germany[4] Japan US UK France Italy 1979 - 89
Clausen and Hayo (2003)	FLTR	2.28 2.89 2.02	1.73 0.49 2.46	NA NA NA	France Germany Italy 1979 - 96
Faust, Rogers and Wright (2001)	FLTR	1.31	0.18	NA	Germany, 1985-1998
Gerdesmeier and Roffia[3] (2004)	FLTR FLTR	1.82 1.86	0.77 0.26	NA 0.41[1]	Euro area 1985 - 2002
Gerlach and Schnabel (2000)	FLTR	0.98 - 1.62	0.22 - 0.32	-0.03 - (-0.56)[1]	1990 - 98 Euro-11
Gerlach-Kristen (2003)	FLTR	2.73	1.44	NA	Euro area 1988 - 2002
Hayo and Hofmann (2003)	FLTR	1.25	0.32	NA	Germany 1990 – 98
Jansson and Vredin (2003)[5]	FBTR	2.13	0.13	NA	Sweden 1994-2001
Kuttner (2003)[5]	FBTR	2.83	1.35	NA	Sweden 1994-2003

Table 1: Selected Estimates of Taylor Rule Parameters (Continued)

Note: [1] money growth, lagged inflation, fed funds rate, or real euro/$ exchange rate (range of coefficients shown); [2] type of reaction function: FLTR = forward-looking Taylor Rule; FBTR = Forecast-based Taylor Rule; [3] the first set of estimates are for their equations (20), (21), Table 3; the second set is for their equations (13a), (13b), Table 6; their extended Taylor rule adds stock returns for Germany. The authors assume that the euro area and the EU3 are adequately represented by German data (op. cit., p. 16); [4] A real exchange rate vis-á-vis the DM or the US$ added for all countries, except the US, where money growth is an added variable in the Taylor rule. [5] Rely on central bank point forecasts (Riksbank)

Table 2: Testing Over-Identifying Restrictions: 1978 - 2003

Panel A: Rejection Frequencies[1]

i = quarters ahead for inflation; j = quarters ahead for the output gap														
i =0, k=0 to 8			*i = 0 to 8, k=0*			*i,j=4*			*i,j=3*			*i,j=5*		
France	Germany	Italy	France	Germany	Italy	France	Germany	Italy	France	Germany	Italy	France	Germany	Italy
25.4	23.8	19.0	23.8	22.2	25.4	14.3	14.3	28.6	71.4	28.6	42.9	14.3	28.6	14.3
Euro area[2]			Euro area			Euro area			Euro area			Euro area		
47.6	41.2		36.5	41.3		85.7	100		57.1	100		100	100	

Panel B: GMMIC

k = 0 (quarters ahead for the output gap)								
i=quarters ahead for inflation	Standard	Monetary Aggregate	Equity returns	Real exchange rate	Housing prices	BIS asset prices	Financial conditions index	Combined
France 0	-51.3	-68.1	-66.9	-66.0	-68.1	-67.3	-67.7	-100.9
France 4	-51.3	-67.3	-65.5	-68.4	-67.7	-66.7	-68.7	99.1
Germany 0	-48.7	-65.7	-69.5	-65.6	-65.2	-63.8	-64.8	-99.7
Germany 4	-51.8	-65.1	-67.1	-67.0	-65.9	-64.9	65.2	-99.2
Italy 0	-52.6	-69.3	-68.2	-67.4	-65.8	-66.7	-65.4	-98.0
Italy 4	-50.8	-66.6	-65.8	-66.3	-64.5	-63.2	-65.3	-97.7
EuroArea 0	-54.4	-65.1	-67.2	-65.2	NA	-70.1	-69.5	-100.4
EuroArea 4	-55.0	-66.0	-68.8	-68.7	NA	-70.0	-70.3	-101.0
k = 4								
France 4	-50.3	-66.1	-67.5	-66.2	-67.9	-67.8	-66.9	-100.0
Germany 4	-50.8	-67.2	-66.4	-67.2	-64.4	-64.7	-64.6	-99.0
Italy 4	-51.2	-67.4	-65.9	-67.4	-64.9	-62.9	-66.6	-97.8
Euro Area 4	-54.8	-68.7	-71.2	-69.5	NA	-72.8	-73.1	-104.4

Panel C: CCIC

Instrument Set	France	Germany	Italy	Euro Area
Standard	-60.347	-60.170	-59.495	-61.775
Monetary Aggregate	-60.356	-59.600	-59.543	-75.172
Equity returns	-60.354	-60.219	-59.525	-76.714
Real exchange rate	-60.403	-60.230	-59.502	-76.726
Housing prices	-60.421	-60.222	-59.525	NA
BIS asset prices	-60.379	-60.272	-59.510	-77.718
Financial conditions index	-60.388	-60.224	-59.504	-74.519
Combined	-95.137	-94.955	-93.756	-110.98

Notes: 1. *i* and *j* refer to the number of quarters ahead in inflation and the output gap, respectively, as specified in equation (2). The frequencies refer to the fraction of times the Null hypothesis (i.e., that the over-identifying restrictions are valid) cannot be accepted at the 5% level. For France, Germany and Italy all results are for the sample 1978-1998. All data are quarterly. Based on all permutations of the instrument set.

2. For the euro area the first column is for the 1978-1998 sample; the second column is for the sample 1978-2003.

Table 3: Taylor Rule: Steady-State Coefficient Estimates and Additional Instrument Relevance Tests

GMM Estimates of Steady-State Parameters

Instrument Set	β	θ	ρ	r_{π}^{2}	$r_{\tilde{y}}^{2}$	RMSE	F-test	
							π	$\tilde{y}$
FRANCE								
Combined	1.12 (0.52)	3.88 (0.01)	0.89	0.60	0.97	0.97	294	5.40
BIS index	0.97 (0.88)	2.50 (0.17)	0.90	0.70	0.26	0.99	292	4.06
Equities	0.98 (0.93)	-1.43 (0.54)	0.87	0.51	0.07	1.00	279	4.29
FCI	1.09 (0.00)	2.15 (0.19)	0.90	0.73	0.21	0.95	266	5.89
Housing	1.04 (0.91)	7.30 (0.24)	0.92	0.03	0.43	1.07	365	1.62
Real ER	1.02 (0.00)	1.14 (0.28)	0.88	0.81	0.34	0.95	277	6.60
Money	1.47 (0.30)	0.95 (0.17)	0.86	0.12	0.42	0.54	36.17	4.28
Standard	0.94 (0.76)	-0.36 (0.91)	0.87	0.45	0.05	0.99	360	5.15
GERMANY								
Combined	1.52 (0.01)	1.36 (0.00)	0.89	0.99	0.94	0.52	32.33	4.84
BIS index	1.89 (0.00)	0.39 (0.29)	0.85	0.46	0.45	0.58	38.44	6.92
Equities	1.84 (0.01)	1.44 (0.00)	0.88	0.49	0.36	0.59	43.90	6.59
FCI	1.83 (0.00)	0.41 (0.11)	0.78	0.43	0.45	0.60	35.70	6.36
Housing	1.93 (0.00)	0.89 (0.03)	0.86	0.02	0.63	0.59	38.27	2.96
Real ER	1.43 (0.00)	1.03 (0.00)	0.88	0.95	0.49	0.51	41.81	5.88
Money	1.13 (0.78)	3.99 (0.52)	0.91	0.26	0.26	0.94	233	8.23
Standard	1.93 (0.00)	0.69 (0.10)	0.85	0.35	0.30	0.59	50.31	7.58
ITALY								
Combined	1.25 (0.01)	1.04 (0.05)	0.81	0.18	0.56	0.94	228	3.41
BIS index	1.37 (0.04)	2.21 (0.11)	0.81	0.14	0.26	1.01	251	4.84
Equities	1.45 (0.06)	3.15 (0.09)	0.85	0.12	0.16	1.02	266	4.90
FCI	1.38 (0.00)	2.15 (0.02)	0.82	0.15	0.36	1.00	289	4.87
Housing	1.30 (0.02)	1.54 (0.10)	0.80	0.00	0.39	0.98	268	1.94
Real ER	1.26 (0.00)	1.10 (0.16)	0.79	0.14	0.37	0.95	298	4.83
Money	1.64 (0.27)	4.44 (0.38)	0.86	0.44	0.42	1.05	303	5.66
Standard	1.53 (0.06)	3.85 (0.09)	0.84	0.13	0.18	1.10	336	6.42

Legend: FCI is the Financial Conditions Index, Real ER is the real exchange rate, Money is a broad monetary aggregate. All other variables are defined in the text.

Note: Standard refers to the Taylor rule as in (2) with a standard instrument set consisting of a constant, 3 lags of the interest rate, 4 lags of inflation and the output gap, and 4 lags of the rate of change of oil prices. See Table 2 notes for additional explanations of terms and instrument set definitions. β is the steady state inflation parameter, θ is the steady state parameter on the output gap, and ρ is the interest rate smoothing parameter. r^2_p is the partial R-squared measure developed in Godfrey (1999), where p = π, θ. It is calculated as (se^{OLS}/se^{GMM}) X (RSD^{GMM}/RSD^{OLS}) where *se* is the standard error estimates for the coefficients on the endogenous variables ($\pi, \tilde{y}$), and RSD is the residual standard deviations for the regressions estimated either via OLS or GMM. Partial r^2 need not add up to 1 across columns. Data are quarterly. Estimates use GMM with a Bartlett kernel, Newey-West bandwidth, and HAC weighting matrix. RMSE = root mean squared errors. Sample is quarterly, 1978-1998. p-values in parenthesis for the Null that β=1 (except for the real exchange rate and the FCI where the Null is β=0) and θ=0. Wald test (F-version) that the coefficients on lagged values of relevant asset prices are jointly insignificant. An F-statistic of at least 10 is normally required to conclude that the instruments are adequate.

Table 4: Taylor Rule: Steady-State Estimates and Additional Instrument Relevance Tests for the Euro Area

Instrument Set	β	θ	ρ	r_{π}^{2}	$r_{\tilde{y}}^{2}$	RMSE	F-test	
							π	$\tilde{y}$
1978 - 1998								
Combined	1.44 (0.02)	3.72 (0.00)	0.87	0.34	0.30	0.60	463	6.88
BIS index	1.32 (0.19)	2.71 (0.00)	0.89	0.30	0.86	0.55	541	9.71
Equities	1.42 (0.05)	3.73 (0.00)	0.88	0.16	0.16	0.59	533	7.77
Real ER	1.38 (0.00)	3.14 (0.00)	0.87	0.34	0.29	0.58	587	8.23
Wealth	1.26 (0.00)	5.06 (0.07)	0.93	0.47	0.44	0.67	449	11.36
Money	-0.03 (0.86)	0.11 (0.77)	0.98	0.34	0.30	0.47	360	10.89
Standard	1.38 (0.45)	4.97 (0.34)	0.95	0.33	0.17	0.72	534	13.76
1978 - 2003								
Combined	1.90 (0.01)	6.49 (0.01)	0.91	0.40	0.32	0.62	500	9.84
BIS index	1.67 (0.07)	4.86 (0.03)	0.93	0.28	0.81	0.54	542	13.81
Equities	1.90 (0.07)	6.51 (0.09)	0.92	0.14	0.11	0.61	568	11.34
Real ER	1.78 (0.00)	5.20 (0.01)	0.90	0.38	0.30	0.59	600	11.64
Wealth	1.61 (0.00)	8.43 (0.23)	0.95	0.47	0.35	0.67	531	14.90
Money	1.20 (0.92)	0.11 (0.64)	0.98	0.49	0.37	0.47	336	17.33
Standard	2.28 (0.63)	0.24 (0.63)	0.97	0.31	0.14	0.75	636	18.35

Note: See the note to Table 3. *Wealth* is the deviation of the log of real wealth for the euro area from its HP filtered level. Data were obtained from the euro area wide model. Also see Legend to Table 3.

Table 5: Root Mean Squared Errors in Forecast-Based Taylor Rules

Instrument Set	FRANCE				GERMANY				ITALY				EA		
Asset Price	Cons 1	Cons 2	OECD	Econ	Cons 1	Cons 2	OECD	Econ	Cons 1	Cons 2	OECD	Econ	Cons 1	OECD	Econ
Combined	0.59	0.60	0.91	0.58	0.21	0.23	0.41	0.19	0.87	0.78	0.96	0.80	INS[2]	0.16	INS
BIS index	0.73	0.78	0.96	0.76	0.28	0.31	0.59	0.30	1.01	0.85	1.03	1.00	0.23	0.21	0.24
Equities	0.72	0.77	0.95	0.76	0.28	0.32	0.59	0.30	0.93	0.82	1.01	0.93	0.15	0.30	0.21
FCI[1]	0.64	0.68	3.23	0.68	0.24	0.30	1.58	0.25	1.00	0.87	3.97	0.93	0.24	0.29	0.29
Housing	0.72	0.76	0.96	0.74	0.30	0.31	0.57	0.31	1.03	0.88	1.00	0.98	INS	INS	INS
Real ER	0.67	0.67	0.98	0.70	0.29	0.32	0.48	0.26	1.03	0.87	1.02	0.95	0.24	0.24	0.23
Standard	0.75	0.79	0.99	0.78	0.32	0.35	0.60	0.33	1.04	0.90	1.03	1.01	0.38	0.33	0.37
Money	0.70	0.76	3.42	0.73	0.26	0.28	1.39	0.27	0.98	0.87	4.10	0.94	0.21	0.66	0.32

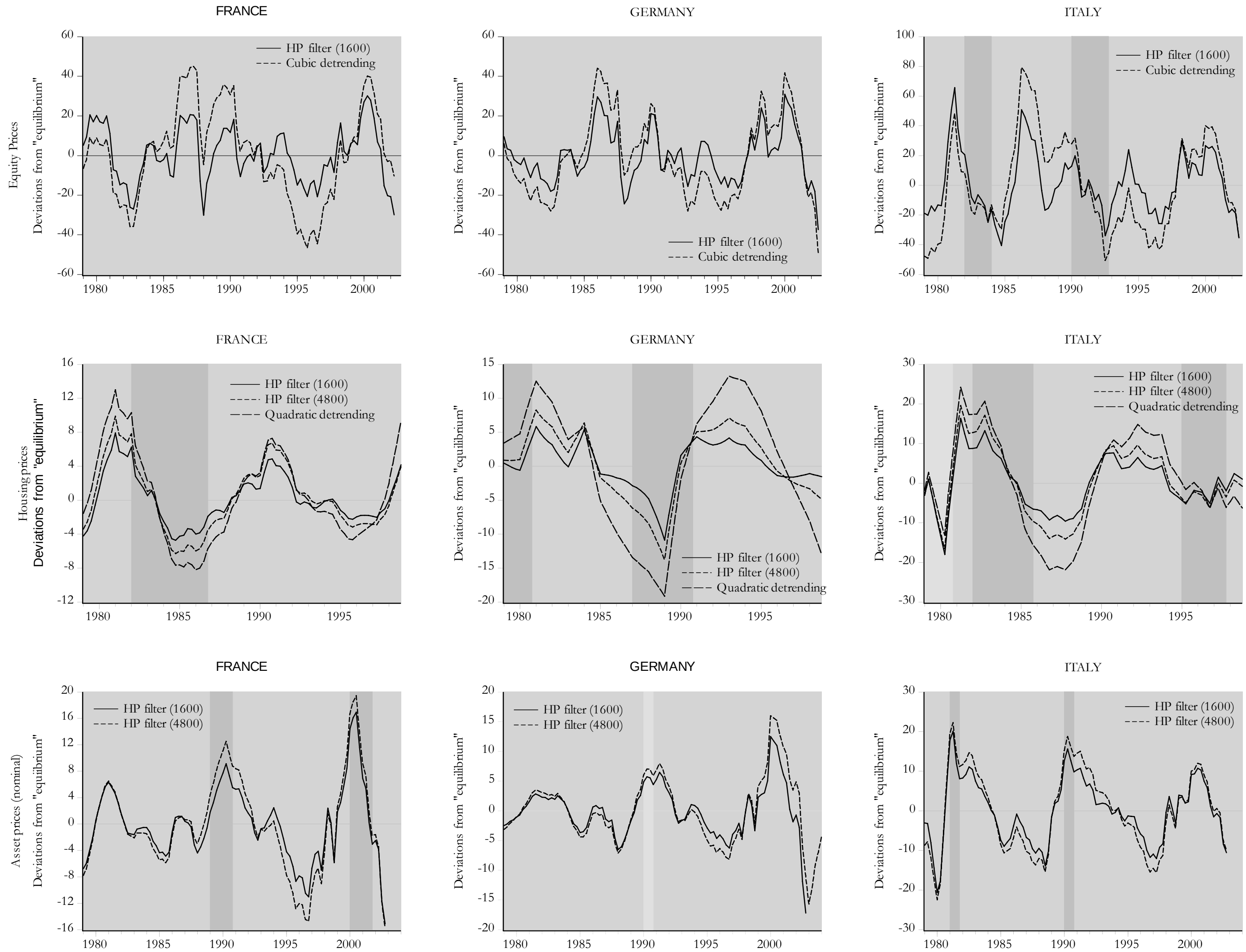
Note: The RMSE is based on equation (1b). Asset price variables enter in levels. Cons 1 and Cons 2 are, respectively, one and two year-ahead forecasts of inflation and real GDP growth. OECD is the one year ahead forecasts of inflation and the output gap from OECD *Economic Outlook*. Econ is the one year ahead forecast of inflation and real GDP growth from *The Economist*. 1. Euro area financial wealth measure; 2. INS means insufficient or no data available. Also, see Legend to Table 2.

Table 6: Encompassing Tests

Country, Sample	Type of Rule	Test Statistic
France, 1991 - 99	FBTR FLTR	0.85 (0.07)* 0.17 (0.08)**
Germany, 1991 - 99	FBTR FLTR	0.98 (0.03)* 0.02 (0.03)
Italy, 1991 - 99	FBTR FLTR	0.92 (0.08)* 0.09 (0.08)
Euro Area, 1996 - 2002	FBTR FLTR	0.97 (0.03)* 0.04 (0.03)

Note: The test statistic is derived from estimates of the specification $i_t = \lambda_0 i_t^f + \lambda_1 i_t^e + \chi_t$ where i_t^f is the implied interest rate estimated from a FBTR and i_t^e is the implied interest rate obtained from a FLTR. The chosen FBTR are: France, German, and the euro area (Combined), Italy (Money). The chosen FLTR are: France, Germany, Italy, euro area (Combined). The last column gives the coefficient values and the standard error for the null $\lambda_0 = 0, \lambda_1 = 0 (1^{st}\ row); \lambda_0 = 1, \lambda_1 = 0 (2^{nd}\ row)$. * indicates whether the null that $\lambda_0 = 1$ is rejected at the 5% level, while ** indicates that the null that $\lambda_1 = 0$ is rejected at the 1% level.

Figure 1: Gaps in Asset Prices in Three Euro Area Countries



Note: Gaps are log levels of the series shown less “equilibrium” proxy, estimated either via an HP filter (smoothing parameter shown in the Figures) or quadratic detrending. The shaded areas are boom and bust cycles, as reported in Bordo and Jeanne (2004), and Detken and Smets (2004). No cycles in equity prices for France and Germany were reported in either study.