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Massimiliano Marcellino and Alberto Musso

EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

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MASSIMILIANO MARCELLINO

and

ALBERTO MUSSO

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Massimiliano Marcellino Alberto Musso[1]

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ABSTRACT

This paper provides real time evidence on the usefulness of the euro area output gap as a leading indicator for inflation and growth. A genuine real-time data set for the euro area is used, including vintages of several alternative gap estimates. It turns out that, despite some difference across output gap estimates and forecast horizons, the results point clearly to a lack of any usefulness of real-time output gap estimates for inflation forecasting both in the short term (one-quarter and one-year ahead) and the medium term (two-year and three-year ahead). By contrast, we find some evidence that several output gap estimates are useful to forecast real GDP growth, particularly in the short term, and some appear also useful in the medium run. A comparison with the US yields similar conclusions.

Key words: Output gap, real-time data, euro area, inflation forecasts, real GDP forecasts, data revisions.

JEL classification codes: E31, E37, E52, E58.

[1] *Marcellino*: European University Institute, Bocconi University and CEPR, massimiliano.marcellino@eui.eu. *Musso*: European Central Bank, alberto.musso@ecb.int. We thank, without implicating, Todd Clark for many useful suggestions. We are also grateful to Wolfgang Lemke, Simon van Norden, Ken West, and participants to an ESCB seminar, the 5th Eurostat Colloquium and a CES-IFO workshop for useful comments. All remaining errors are the sole responsibility of the authors. The opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the European Central Bank.

I. Introduction

The large empirical literature on the predictive content of the output gap for inflation for the US tends to suggest that models relating inflation to the output gap – typically called Phillips curves – while exhibiting good in sample fits, tend to result in poor out of sample performance, especially in real time (see for example Clark and McCracken (2006) and the references therein). Against this background, and given the limited informative content of in sample fit analyses, in this paper we assess the real time forecasting performance for euro area inflation of output gap measures when inserted as explanatory variables in a Phillips curve model.

Despite the fact that most often the usefulness of the output gap for forecasting is assessed with respect to inflation, it has been suggested, for example by Giannone and Reichlin (2006), that also the ability to predict real GDP growth can be a useful criterion to evaluate the output gap. We propose a possible justification in terms of cointegration analysis and error correction models for the use of gap measures as leading indicators of growth. More precisely, potential output can be seen as a stochastic trend of output, implying a role of the output gap in the context of error correction models (speed of adjustment). Since changes in potential output take place slowly, real GDP growth should adjust to reduce deviations from potential, and the gap could therefore provide useful information for forecasting real GDP growth. A more structural explanation for the role of the gap can be derived from models such as in Mesonnier and Renne (2007), which allow to express output growth as a function of the past output gap and/or interest rate gap. Hence, we will also empirically assess the real time forecasting performance of gap measures as leading indicators of euro area GDP growth.

Since there is no uniquely accepted or best method to compute an output gap, we compare a large set of alternative measures, including simple filter based estimates relying on real GDP, measures based on capacity utilization, estimates based on multivariate unobserved component models, and a variety of estimates from international organizations such as the IMF, OECD and European Commission. In addition, we construct gap measures by averaging those described so far. Averaging is a particular way of pooling, and from the forecasting literature it is well known that pooling, and in particular averaging, a set of forecasts can yield substantial gains in terms of mean square forecast error reduction, see e.g. Stock and Watson (1999). Moreover, averaging can reduce problems of parameter instability and it is also a way to take into account method uncertainty.

To the best of our knowledge, this is the first paper to undertake such an extensive evaluation in real time of the forecasting role of the output gap in the euro area. The results complement the in-sample comparison in Marcellino and Musso (2009), whose findings cast serious doubts on the usefulness of the output gap for structural analysis or economic policy making in the euro area due to its unreliability in real time.

We anticipate that the forecasting results for inflation are in general discouraging. Instead, a few output gap measures do significantly improve short and medium term forecasts of GDP growth. Capacity utilization based gap measures perform particularly well. Hence, while gap measures are quite unreliable as coincident indicators of economic activity, some of them

could represent useful leading indicators for the euro area. We derive similar results also for the US, over a comparable sample period.

The paper is structured as follows. Section 2 briefly describes the real time data and gap measures. Section 3 assesses the usefulness of euro area real-time output gap estimates for inflation forecasting. Section 4 presents a similar exercise for forecasting real GDP growth. Section 5 compares the results for inflation and growth with those for the US. Section 6 summarizes the conclusions of our analysis. Additional material and more detailed results are presented in Appendices.

II. Data

In this Section we briefly describe the alternative gap measures used in the forecasting analysis for the euro area and the US. Additional details and in-sample evaluations and comparisons can be found in Marcellino and Musso (2009).

We consider five different types of output gaps. First, measures based on capacity utilization: the deviations from the average value and from a linear trend. Since capacity utilization figures are not revised, changes in the real time vintages are only due to recursive estimation of the mean of the variable, and of the slope of the linear trend. The data are from the European Commission survey on the manufacturing sector.

Second, estimates computed on the basis of the multivariate unobserved components (UC) model of Proietti, Musso and Westermann (2007), which combines a production function and a Phillips curve equation. We consider three alternative versions: the common cycle ("CC") one, where all cyclical components are driven by the cycle in capacity utilisation; the pseudo-integrated cycles ("PIC") one, where all cyclical components are driven also by idiosyncratic cycles; and the bivariate version ("BIV"), where the Kalman filter is applied directly to output rather than to the components of the production function, see Proietti, Musso and Westermann (2007) for additional details.

Third, measures provided by international organizations. These include annual estimates published twice a year by the European Commission (in the context of their annual Spring and Autumn forecasts), the IMF (in the context of the annual Spring and Autumn World Economic Outlook) and the OECD (in the context of the annual June and December OECD Economic Outlook). Note that the EC has two sets of estimates, one based on deviations from a trend derived by applying the HP filter to each euro area country series and then aggregating the result ("EC-T"), and another representing deviations from a trend estimates within a production function approach ("EC-P"), which was started in 2002. The IMF and the OECD gap measures are also based on a production function approach.

Fourth, measures obtained by applying standard filters to the real GDP levels. In particular, we consider the HP filter ("HP"), the Baxter and King (1999) band-pass filter ("BP"), and deviations from a linear trend ("LIN"). In order to reduce the impact of the so-called end-of-sample bias we extend each vintage of real GDP data via a simple AR(4) model (applied to the year-on-year growth rate), apply the filters to the extended levels and finally, as

suggested by Baxter and King (1999), we disregard the last three years of filtered data. For the HP filter we use a smoothing coefficient (lambda) of 1600, as was suggested by Hodrick and Prescott (1997) for quarterly data and as is typically done in the literature, while for the band-pass filter we use the cut-off frequencies suggested by Baxter and King (1989), i.e. we keep only the components of the data between the cut-off frequencies between 1.5 and 8 years.

Fifth, we construct gap measures by averaging some of those in groups 1-4. Averaging is a particular way of pooling, and from the forecasting literature it is well known that pooling, and in particular averaging, a set of forecasts can yield substantial gains in terms of mean square forecast error reduction, see e.g. Stock and Watson (1999). Moreover, averaging is also a way to take into account method uncertainty, since there is no uniquely accepted or best method to compute a gap. We consider five averages: of all gaps in groups 1-4 ("Average All"), of those belonging to the production function approach ("Average PFA", including CC, PIC, EC-P, IMF and OECD), of those from international organizations ("Average Org", including EC-T, EC-P, IMF and OECD), of those from the UC models ("Average UC", including CC, PIC and BIV) and of those from the standard filters ("Average Filters", including HP, BP and LIN).

It is also worth mentioning that, in order to construct a set of quarterly vintages of quarterly estimates, the following steps were undertaken when needed:

- For those vintages for which data before 1991 was not available, estimates were extended backwards using (the changes in) the previously available historical vintage from the same source, or the closest subsequently available historical vintage if previous vintages also lacked historical data.
- Annual data were interpolated to derive quarterly series. We compared alternative approaches, which produced similar results likely because few data points are interpolated and the source data is fairly smooth. In the end, we fitted a local quadratic polynomial for each observation of the annual series, and then used this polynomial to fill in all observations of the quarterly series associated with the period. The quadratic polynomial is formed by taking sets of three adjacent points from the source series (two for end-points) and fitting a quadratic so that the average of the quarterly points matches the annual data actually observed. [2]
- To construct the quarterly database, the latest available biannual vintage was used to represent the quarterly vintage. Thus, for example, the IMF Spring estimates of 2003 (which became available in April 2003) were used to represent the 2003Q2 and 2003Q3 vintages, while the Autumn estimates of 2003 (which became available in October 2003) were used to represent the 2003Q4 and 2004Q1 vintages.

Table 1 summarises the characteristics of the output gap estimates for the euro area used in the paper. Overall, 19 to 34 vintages are available, depending on the set of estimates.

[2] To evaluate the expected size of the interpolation error, we have aggregated the last vintage of the quarterly CC gaps to annual data, and applied the interpolation method described in the text to obtain interpolated quarterly values of CC. The correlation between the actual and interpolated values of CC is higher than 0.98. Linear or cubic interpolation resulted in correlation values around 0.90.

Table 1 – Vintages of euro area output gap estimates

Data and estimates*	Definition of trend	Sample period**	Frequency***	Vintages		Source
Real GDP		1985Q1-2006Q4	quarterly data	2001Q1-2007Q2	(26)	EABCN
Capacity utilisation rate	Average	1985Q1-2006Q4	quarterly data	2001Q1-2007Q2	(26)	European Commission
Capacity utilisation rate	Linear trend	1985Q1-2006Q4	quarterly data	2001Q1-2007Q2	(26)	European Commission
UC - CC	Prod Fn Approach	1985Q1-2006Q4	quarterly data	2002Q3-2007Q2	(20)	own estimates
UC - PIC	Prod Fn Approach	1985Q1-2006Q4	quarterly data	2002Q3-2007Q2	(20)	own estimates
UC - BIV	Bivariate model	1985Q1-2006Q4	quarterly data	2002Q4-2007Q2	(19)	own estimates
EC - Trend	HP trend	1985Q1-2006Q4	annual data	1999Q1-2007Q2	(34)	European Commission
EC - Potential	Prod Fn Approach	1985Q1-2006Q4	annual data	2002Q4-2007Q2	(19)	European Commission
IMF	Prod Fn Approach	1985Q1-2006Q4	annual data	1999Q1-2007Q2	(34)	IMF
OECD	Prod Fn Approach	1985Q1-2006Q4	annual data	1999Q1-2007Q2	(34)	OECD
Band-pass filter	Stochastic trend	1985Q1-2006Q4	quarterly data	2001Q1-2007Q2	(26)	own estimates
Hodrick-Prescott filter	Stochastic trend	1985Q1-2006Q4	quarterly data	2001Q1-2007Q2	(26)	own estimates
Linear trend filter	Linear trend	1985Q1-2006Q4	quarterly data	2001Q1-2007Q2	(26)	own estimates

Source: EABCN, EC, IMF, OECD and own estimates.

Notes: Real GDP data are from the EABCN (see Giannone et al., 2008, for details).

* EC, IMF and OECD publish biannual estimates. To construct the quarterly vintages for each quarter the latest available vintage is used.

** Each vintage available at time T includes data from 1985Q1 to T-2. For those vintages for which no data prior to 1991 was available estimates have been extended backwards using the (changes of the) previously available historical estimate (or if not available the first subsequent estimate).

*** Annual data were interpolation via quadratic match average option of Eviews to derive quarterly estimates.

In the case of the US, we only focus on the three filter based estimates of output gaps, namely, the HP filter ("HP"), the Baxter and King (1999) band-pass filter ("BP"), and deviations from a linear trend ("LIN"). The filters are computed using the same specification choices as for the euro area. Table 2 summarises the characteristics of the US output gap estimates used in the paper.

Table 2 – Vintages of US output gap estimates

Data and estimates	Definition of trend	Sample period	Frequency	Vintages		Source
Real GDP		1947Q1-2006Q4	quarterly data	1965Q4-2007Q1	(166)	RTDSM
Band-pass filter	Stochastic trend	1985Q1-2006Q4	quarterly data	1965Q4-2007Q1	(166)	own estimates
Hodrick-Prescott filter	Stochastic trend	1985Q1-2006Q4	quarterly data	1965Q4-2007Q1	(166)	own estimates
Linear trend filter	Linear trend	1985Q1-2006Q4	quarterly data	1965Q4-2007Q1	(166)	own estimates

Source: RTDSM and own calculations.

Notes: Real GDP data downloaded from the Federal Reserve Bank of Philadelphia's Real Time Data Set for Macroeconomists (RTDSM), code: GDPC1.

III. Inflation forecasts based on output gap estimates in real time

The large empirical literature on the predictive content of the output gap for inflation for the US tends to suggest that models relating inflation to the output gap – typically called Phillips curves – while exhibiting good in sample fits, tend to result in poor out of sample performance, especially in real time (see for example Clark and McCracken, 2006). Against this background, and given the limited informative content of in sample fit analyses, we perform an out of sample assessment in real time of the various output gap measures based on a general benchmark Phillips curve model. As suggested by the empirical literature, starting from Orphanides and van Norden (2002, 2005), it is key to perform such an exercise in real time. Instead of simply comparing the mean squared error (MSE) of the different models, it is also important to analyse the statistical significance of the MSE difference, especially in the presence of a relatively limited number of vintages. In this respect it is necessary to bear in mind that standard tests of MSE comparison may be misleading, as that they do not take into account the real time nature of the data. In order to evaluate this aspect, we compare results based on standard tests with recent tests proposed by Clark and McCracken (2009) that take into account the real time nature of the data. Finally, we perform robustness analyses along some dimensions, such as changing the specification of the forecasting model, the sample period, or the reference series.

We use quarterly data from 1985 onwards, a decision informed by the results of Musso et al (2009) which show that a traditional Phillips curve for the euro area from 1970 onwards is characterised by instability (and some signs of nonlinearity) concentrated in the mid-1980s. Thus, starting from 1985 allows carrying out the analysis with a simple linear Phillips curve. In order to keep the analysis as simple as possible, the inflation measure used will be the GDP deflator. The reason for this choice is that, as indicated by Musso et al (2009), a euro area Phillips curve based on the GDP deflator allows to ignore supply shocks such as oil price or exchange rate changes, which on the contrary appear to play an important role in Phillips curves based on the HICP. An alternative choice would be to use some measure of core inflation, or HICP excluding volatile components. However, apart from the arbitrary choice of such measure among the several available ones (see for example Cristadoro et al., 2005)), the problem is that no real time dataset is available for these measures. Finally, as regards the question of the order of integration of inflation, given the fact that there does not seem to be a widespread consensus on this debated issue (see for example the discussion on this issue with reference to the euro area in the context of the ECB Inflation Persistence Network, as summarised for example by Altissimo et al., 2006), we do not take a stand and follow the approach typically used in the empirical literature of referring to changes in inflation (see, e.g., Stock and Watson, 2003, and Clark and McCracken, 2006).

III. 1. Inflation forecasting assessment: out-of-sample real time evaluation

Following Stock and Watson (1999, 2003) and Clark and McCracken (2009), we compute forecasts of the change in inflation π_t at horizon τ from reduced-form Phillips curves:

$$\pi_{t+\tau}^{(\tau)} - \pi_t = \alpha + \sum_{k=0}^{3} \beta_k \Delta\pi_{t-k} + \gamma x_t + \delta \Delta x_t + u_{t+\tau} \qquad (1)$$

where $\pi_t^{(\tau)} \equiv (400/\tau)\ln(p_t / p_{t-\tau})$, $\pi_t^{(1)} \equiv \pi_t$ and x_t is the output gap (expressed in terms of percentage deviations from trend or potential output).

The benchmark model against which to compare the forecasts of the Phillips curve-based model is an autoregressive (AR) model for inflation:

$$\pi_{t+\tau}^{(\tau)} - \pi_t = \alpha + \sum_{k=0}^{3} \beta_k \Delta\pi_{t-k} + \varepsilon_{t+\tau} \qquad (2)$$

which is essentially the same model as (2) but without the output gap measure. We consider four forecast horizons: one quarter ($\tau = 1$), one year ($\tau = 4$), two years ($\tau = 8$), and three years ($\tau = 12$).

As discussed, we use quarterly data from 1985 onwards and the GDP deflator to derive the reference inflation measure. For each slack indicator the forecast period covers the sample period for which vintages are available (instead of selecting the same forecast period for all cases, which would result in a loss of several observations, which we prefer to avoid given the already limited sample size). Thus, for example, using the IMF output gap estimates, whose vintages are available from 1999Q1 onwards, for each forecast origin *t* from 1999Q1 onwards we (recursively) estimate the forecast models (1) and (2) with the data that was available in that quarter (reaching up to the previous quarter, *t-1*) and construct forecasts for periods *t* and beyond (for to the four above-mentioned forecast horizons). The starting point of the model estimation sample is always 1985Q1. We then evaluate the forecasts against the latest available vintage of inflation available.

Tables 3 and 4 summarise the results of the exercise comparing the forecast of inflation at different horizons in the short run (one quarter and one year) and the medium run (two and three years) from the AR(4) model and the Phillips curve model with the output gap, based on the mean squared error (MSE).

Tables 5 and 6 report the tests of equal forecast accuracy, based on both the conventional tests and the above-mentioned adjusted tests. In particular, conventional tests to do not consider that model (2) is nested in (1) and that real time data are used (see e.g. Aruoba (2008)), while the corrections proposed by Clark and McCracken (2005, 2009) can handle both features. Specifically, if there were no revisions, one could use the conventional t-test against the critical values simulated in Clark and McCracken (2005). This is called MES-t(conv) in the tables.[3] If instead there were predictable revisions, an adjusted t-statistics (labelled MSE-t (Ω) by Clark and McCracken, 2009), should be compared with normal critical values. However, as shown in Marcellino and Musso (2009), in our context there are revisions but there is no clear evidence to discriminate the "noise" or "news" hypotheses. Hence, rather than the MSE-t (Ω) statistic we report the MSE-F statistic of Clark and McCracken (2005) that, according to the simulation experiments reported in their later paper, performs well in a variety of situations, including the "news" case. It is reassuring that in most cases the MSE-t (Ω)) and MSE-F statistics provide similar evidence (results available upon request).[4]

[3] Note that we use two-sided critical values since, while the nesting model should have lower MSE than the nested model, the opposite could also happen, e.g. in the case of parameter instability or marginally significant regressors, see e.g. Clements and Hendry (1999).

[4] We are very grateful to Todd Clark for providing us with a copy of his programmes for his paper Clark and McCracken (2007). All computations for the out-of-sample forecasting exercise have been carried out with WinRats Pro 7.00 (see Estima, 2007).

Table 3 – Inflation forecast accuracy in the short term

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE (AR)	MSE (OG)	diff
		forecast horizon h = 1 quarter			forecast horizon h = 4 quarters		
CAP-AV	2001:01-2006:04	1.570	1.621	-0.051	0.898	0.881	**0.017**
CAP-TR	2001:01-2006:04	1.570	1.626	-0.056	0.898	0.922	-0.024
EC - T	1999:01-2006:04	1.342	1.427	-0.085	0.798	0.903	-0.105
EC - P	2002:04-2006:04	1.447	1.550	-0.103	0.696	0.872	-0.176
IMF	1999:01-2006:04	1.342	1.458	-0.116	0.798	0.965	-0.167
OECD	1999:01-2006:04	1.342	1.472	-0.130	0.798	0.970	-0.172
UC - CC	2002:03-2006:04	1.588	1.784	-0.196	0.751	0.997	-0.246
UC - PIC	2002:03-2006:04	1.588	1.834	-0.246	0.751	0.992	-0.241
UC - BIV	2002:04-2006:04	1.447	1.570	-0.123	0.696	0.803	-0.107
BP	2001:01-2006:04	1.570	1.659	-0.089	0.898	1.009	-0.111
HP	2001:01-2006:04	1.570	1.641	-0.071	0.898	0.961	-0.063
LIN	2001:01-2006:04	1.570	1.623	-0.053	0.898	0.961	-0.063
AV-All	2001:01-2006:04	1.570	1.665	-0.095	0.898	0.951	-0.053
AV-PFA	2001:01-2006:04	1.570	1.726	-0.156	0.898	1.086	-0.188
AV-Org	2001:01-2006:04	1.570	1.683	-0.113	0.898	1.048	-0.150
AV-UC	2001:01-2006:04	1.570	1.688	-0.117	0.898	1.049	-0.151
AV-Fil	2001:01-2006:04	1.570	1.644	-0.073	0.898	0.980	-0.082

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE.

Table 4 – Inflation forecast accuracy in the medium term

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE (AR)	MSE (OG)	diff
		forecast horizon h = 8 quarters			forecast horizon h = 12 quarters		
CAP-AV	2002:04-2006:04	1.101	1.028	**0.073**	1.028	1.019	**0.010**
CAP-TR	2002:04-2006:04	1.101	1.044	**0.057**	1.028	1.112	-0.084
EC - T	2000:04-2006:04	1.604	1.546	**0.058**	2.205	1.971	**0.234**
EC - P	2004:03-2006:04	0.933	1.070	-0.137	0.853	1.099	-0.247
IMF	2000:04-2006:04	1.604	1.670	-0.067	2.205	2.239	-0.034
OECD	2000:04-2006:04	1.604	1.750	-0.146	2.205	2.353	-0.148
UC - CC	2004:02-2006:04	1.013	1.299	-0.286	0.947	1.463	-0.516
UC - PIC	2004:02-2006:04	1.013	1.154	-0.141	0.947	1.105	-0.158
UC - BIV	2004:03-2006:04	0.933	1.033	-0.101	0.853	1.102	-0.249
BP	2002:04-2006:04	1.101	1.166	-0.065	1.028	1.025	**0.003**
HP	2002:04-2006:04	1.101	1.092	**0.009**	1.028	1.005	**0.023**
LIN	2002:04-2006:04	1.101	1.128	-0.027	1.028	1.041	-0.013
AV-All	2002:04-2006:04	1.101	1.032	**0.069**	1.028	0.982	**0.047**
AV-PFA	2002:04-2006:04	1.101	1.219	-0.118	1.028	1.124	-0.096
AV-Org	2002:04-2006:04	1.101	1.190	-0.089	1.028	1.059	-0.031
AV-UC	2002:04-2006:04	1.101	1.197	-0.096	1.028	1.206	-0.177
AV-Fil	2002:04-2006:04	1.101	1.127	-0.026	1.028	1.025	**0.003**

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE.

As regards the short run, in all cases the MSE of the forecasts based on the AR(4) models are lower than those based on the Phillips curve model, independently on which set of output gaps estimates were used and for both horizons (Table 3). Moreover, in most cases this difference is statistically significant, suggesting that adding the output gap worsens the predictions of inflation (Table 5).

For the medium run results are similar (Table 4). Only in very few cases the MSEs of the forecasts based on the AR(4) models are higher than those based on the Phillips curve model (for the ECT and HP filter cases at both horizons and the band-pass filter case for the three year horizon). However, in all of these few cases the adjusted t-statistics suggest that this difference is not statistically significant (Table 6). Thus, output gaps estimates do not appear to contribute to any significant improvement in forecasting inflation in the medium run. Note that the adjusted statistic provides different indications compared to the conventional statistic in a number of occasions, which suggests that it is important to take into account these adjustments to reduce the probability of deriving misleading results.

There do not appear to be major differences across output gap estimates. For example, it does not appear to be the case that estimates of the EC, IMF and OECD (based on methods which impose some smoothness prior on potential output growth) perform significantly better or worse compared to UC estimates (based on methods which do not impose any smoothness prior). Few minor differences can be detected, as already discussed, but it should be recognised that for the various sets of estimates a different number of vintages is available, implying that results may not be fully comparable.

Table 5 – Tests of equal inflation forecast accuracy in the short term

Output gap model	Evaluation sample	MSE-t (conv)	MSE-F	MSE-t (conv)	MSE-F
		h = 1 quarter		h = 4 quarters	
CAP-AV	2001:01-2006:04	-0.784 *	-0.758 n.s.	**0.276 n.s.**	**0.415 n.s.**
CAP-TR	2001:01-2006:04	-1.072 *	-0.828 n.s.	-0.528 n.s.	-0.555 n.s.
EC - T	1999:01-2006:04	-2.555 *	-1.910 *	-2.144 *	-3.378 *
EC - P	2002:04-2006:04	-1.334 *	-1.132 *	-2.214 *	-2.823 *
IMF	1999:01-2006:04	-2.465 *	-2.545 *	-2.141 *	-5.019 *
OECD	1999:01-2006:04	-2.977 *	-2.834 *	-2.100 *	-5.138 *
UC - CC	2002:03-2006:04	-2.592 *	-1.980 *	-3.822 *	-3.700 *
UC - PIC	2002:03-2006:04	-3.002 *	-2.416 *	-3.567 *	-3.647 *
UC - BIV	2002:04-2006:04	-2.053 *	-1.335 *	-2.180 *	-1.863 n.s.
BP	2001:01-2006:04	-3.268 *	-1.281 *	-2.441 *	-2.312 n.s.
HP	2001:01-2006:04	-2.924 *	-1.040 n.s.	-2.768 *	-1.380 n.s.
LIN	2001:01-2006:04	-3.332 *	-0.782 n.s.	-2.107 *	-1.383 n.s.
AV-All	2001:01-2006:04	-1.425 *	-1.371 *	-0.663 *	-1.180 n.s.
AV-PFA	2001:01-2006:04	-2.337 *	-2.163 *	-1.880 *	-3.633 *
AV-Org	2001:01-2006:04	-2.093 *	-1.607 *	-1.889 *	-3.009 *
AV-UC	2001:01-2006:04	-1.752 *	-1.670 *	-2.755 *	-3.020 *
AV-Fil	2001:01-2006:04	-3.339 *	-1.084 n.s.	-2.461 *	-1.753 n.s.

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table 6 – Tests of equal inflation forecast accuracy in the medium term

Output gap model	Evaluation sample	MSE-t (conv)	MSE-F	MSE-t (conv)	MSE-F
		h = 8 quarters		h = 12 quarters	
CAP-AV	2002:04-2006:04	**2.102 ***	**1.205 n.s.**	**0.162 n.s.**	**0.122 n.s.**
CAP-TR	2002:04-2006:04	**1.707 ***	**0.930 n.s.**	-1.422 *	-0.977 n.s.
EC - T	2000:04-2006:04	**0.580 ***	**0.930 n.s.**	**1.745 ***	**2.487 n.s.**
EC - P	2004:03-2006:04	-1.751 *	-1.278 n.s.	-3.470 *	-1.346 n.s.
IMF	2000:04-2006:04	-0.767 *	-0.996 n.s.	-0.367 n.s.	-0.317 n.s.
OECD	2000:04-2006:04	-1.316 *	-2.090 n.s.	-1.620 *	-1.324 n.s.
UC - CC	2004:02-2006:04	-5.699 *	-2.422 n.s.	-9.151 *	-2.468 n.s.
UC - PIC	2004:02-2006:04	-4.739 *	-1.346 n.s.	-8.771 *	-1.003 n.s.
UC - BIV	2004:03-2006:04	-2.455 *	-0.973 n.s.	-4.774 *	-1.357 n.s.
BP	2002:04-2006:04	-3.860 *	-0.949 n.s.	**0.433 n.s.**	**0.034 n.s.**
HP	2002:04-2006:04	**0.741 ***	**0.147 n.s.**	**2.819 ***	**0.298 n.s.**
LIN	2002:04-2006:04	-0.677 *	-0.406 n.s.	-0.371 n.s.	-0.160 n.s.
AV-All	2002:04-2006:04	**1.314 ***	**1.145 n.s.**	**0.786 ***	**0.616 n.s.**
AV-PFA	2002:04-2006:04	-1.205 *	-1.645 n.s.	-0.963 *	-1.110 n.s.
AV-Org	2002:04-2006:04	-1.097 *	-1.274 n.s.	-0.355 n.s.	-0.375 n.s.
AV-UC	2002:04-2006:04	-1.802 *	-1.366 n.s.	-2.792 *	-1.913 n.s.
AV-Fil	2002:04-2006:04	-0.904 *	-0.387 n.s.	**0.170 n.s.**	**0.040 n.s.**

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Looking at different sub-samples, there are broadly no indications that the forecast performance of Phillips curve models with the output gap may have improved much in the more recent period, say from 2003 onwards, relative to the AR(4) model (see Appendix I). The only noticeable differences with respect to the results in the previous subsection are that there are larger gains in terms of MSE for two-tear ahead EC-T gap based forecasts when evaluation is conducted over 2000:4-2002:4, and for this sample there are gains also for two-year ahead EC-P, OECD, and UC-BIV gap based forecasts. However, none of these gains are statistically significant according to the modified t-statistics by Clark and McCracken (2009). Moreover, the two-year ahead EC-T gap based forecast no longer beats the AR over the more recent subsample 2003:1-2006:4. [5]

Using only the level of the output gap or only its change instead of both variables does not affect the results substantially (results available upon request).

Finally, to assess the impact of real-time data we compare results based on the three simple filters considered (BP, HP, LIN) applied to the real time vintages to those based on the filters applied to the pseudo-real time estimates. For the other sets of estimates this comparison is not possible, either because the real time data for some series needed to estimate the gap is not available or because often judgment is also used to occasionally adjust estimates. As shown in Appendix II, results for the three simple filters tend to be very similar, which suggests that data revisions in the underlying series seem to play a minor role for the euro

[5] For completeness, we should mention that the performance of the gap measures could be better for the formulation of density rather than point forecasts, see e.g. Garratt et al. (2009).

area, at least over the sample under analysis. Marcellino and Musso (2009) provide additional in sample evidence on this issue.

III. 2. Inflation forecasting assessment: robustness analysis

In order to assess whether results depend on the rather simple Phillips curve specification adopted, we perform a similar out-of-sample exercise with a more general Phillips curve. In particular, taking as reference the Phillips curve included in the Area Wide Model of Fagan et al. (2005), we include among the regressors also import prices (y_t) and unit labour costs (z_t):

$$\pi_{t+\tau}^{(\tau)} - \pi_t = \alpha + \sum_{k=0}^{3} \beta_k \Delta\pi_{t-k} + \gamma_X x_t + \delta_X \Delta x_t + \tag{3}$$

$$+ \gamma_Y y_t + \delta_Y \Delta y_t + \gamma_Z z_t + \delta_Z \Delta z_t + u_{t+\tau}$$

The benchmark is also adjusted to take into account these additional factors, and corresponds to the same equation without the output gap:

$$\pi_{t+\tau}^{(\tau)} - \pi_t = \alpha + \sum_{k=0}^{3} \beta_k \Delta\pi_{t-k} + \tag{4}$$

$$+ \gamma_Y y_t + \delta_Y \Delta y_t + \gamma_Z z_t + \delta_Z \Delta z_t + \varepsilon_{t+\tau}$$

Overall, forecasting results based on these generalised functions tend to be very similar (all results reported in Appendix III). In particular, while the MSE of the equations with the output gap is occasionally lower, especially in the medium term, it is never the case that the difference is significant for the cases when the equation with the gap appears to perform better.

A second robustness check aims at assessing the role of the reference "final" vintage considered. Following Clark and McCracken (2009) as well as Romer and Romer (2000), we consider an alternative definition of reference series compared to the latest available vintage. More precisely, taking into consideration the revisions which affect in particular the first release of the data, we consider as reference series the second release of the GDP deflator. Results based on the second release are again very similar to those based on the latest available vintage (see Appendix IV for all results).

In summary, despite some differences across output gap estimates and forecast horizon, the results in this section point clearly to a lack of usefulness of real-time output gap estimates for inflation forecasting in the euro area, both in the short term and the medium term.

IV. GDP growth forecasts based on output gap estimates in real time

Despite the fact that most often the usefulness of the output gap for forecasting is assessed with respect to inflation, it has been suggested, for example by Giannone and Reichlin (2006), that also the ability to predict real GDP growth can be a useful criterion to assess the output gap. We propose a possible justification in terms of cointegration analysis and error correction models. More precisely, potential output can be seen as a stochastic trend of output, implying a role of the output gap in the context of error correction models (speed of

adjustment). Since changes in potential output take place slowly, real GDP growth should adjust to reduce deviations from potential, and the gap could therefore provide useful information for forecasting real GDP growth. A more structural explanation for the role of the gap can be derived from models such as in Mesonnier and Renne (2007), which allow to express output growth as a function of the past output gap and/or interest rate gap.

We undertake a similar exercise as that for inflation, using vintages form 2001Q1 onwards, since this is the first available real time vintage for euro area real GDP growth. In terms of models, following Stock and Watson (2003), we compute forecasts of real GDP growth Y_t at horizon τ based on the specification:

$$Y_{t+\tau}^{(\tau)} = \alpha + \sum_{k=0}^{3} \beta_k Y_{t-k} + \gamma x_t + \delta \Delta x_t + u_{t+\tau} \quad (5)$$

where $Y_t^{(\tau)} \equiv (400/\tau)\ln(y_t / y_{t-\tau})$, $y_t^{(1)} \equiv y_t$ and x_t is the output gap (expressed in terms of percentage deviations from trend or potential output). Again, we consider four forecast horizons: one quarter ($\tau = 1$), one year ($\tau = 4$), two years ($\tau = 8$), and three years ($\tau = 12$).

The benchmark model against which to compare the forecasts of this model is an autoregressive (AR) model for real GDP growth:

$$Y_{t+\tau}^{(\tau)} = \alpha + \sum_{k=0}^{3} \beta_k Y_{t-k} + \varepsilon_{t+\tau} \quad (6)$$

Tables 7 and 8 contain the results for forecasting real GDP growth at different horizons in the short run (one quarter and one year) and the medium run (two and three years), using the AR(4) model with or without the different measures of output gap.

As regards the short run, in several cases the MSE of the forecasts based on the AR(4) models are lower than those based on the model with the output gap. But there are some output gap estimates that do improve the forecasts, in particular those based on capacity utilization or on averages of unobserved component model based gap measures (Table 7).

For the medium run, the results are qualitatively similar but now a few other gap measures in addition to those based on capacity utilization seem to yield lower MSEs, in particular those based on the BP or linear filters and the average of all gap measures (Table 8). The gains are sometimes very large, in particular when using either capacity utilization or the average of all the gap measures.

Moreover, the test results reported in Tables 9 and 10 indicate that the forecast gains arising from the gap measures mentioned above are strongly statistically significant both in the short or in the medium run. Interestingly, this clear result only emerges when using the proper MSE-F statistic of Clark and McCracken (2005).

Table 7 – Real GDP growth forecast accuracy in the short term

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE (AR)	MSE (OG)	diff
		forecast horizon h = 1 quarter			forecast horizon h = 4 quarters		
CAP-AV	2001:01-2006:04	1.574	1.346	**0.228**	0.838	0.635	**0.203**
CAP-TR	2001:01-2006:04	1.574	1.324	**0.250**	0.838	0.789	**0.049**
EC - T	2001:01-2006:04	1.574	1.879	-0.305	0.838	1.410	-0.572
EC - P	2002:04-2006:04	1.556	1.388	**0.167**	0.560	0.879	-0.319
IMF	2001:01-2006:04	1.574	1.853	-0.278	0.838	1.468	-0.629
OECD	2001:01-2006:04	1.574	1.643	-0.069	0.838	1.001	-0.163
UC - CC	2002:03-2006:04	1.469	2.244	-0.775	0.638	0.665	-0.027
UC - PIC	2002:03-2006:04	1.469	10.244	-8.775	0.638	4.859	-4.221
UC - BIV	2002:04-2006:04	1.556	5.339	-3.783	0.560	0.852	-0.292
BP	2001:01-2006:04	1.574	3.291	-1.717	0.838	0.842	-0.003
HP	2001:01-2006:04	1.574	7.195	-5.621	0.838	7.750	-6.912
LIN	2001:01-2006:04	1.574	1.517	**0.058**	0.838	0.753	**0.085**
AV-All	2001:01-2006:04	1.574	3.756	-2.182	0.838	0.651	**0.187**
AV-PFA	2001:01-2006:04	1.574	2.265	-0.691	0.838	1.095	-0.257
AV-Org	2001:01-2006:04	1.574	1.745	-0.171	0.838	1.232	-0.394
AV-UC	2001:01-2006:04	1.574	1.527	**0.047**	0.838	0.537	**0.301**
AV-Fil	2001:01-2006:04	1.574	12.289	-10.715	0.838	1.708	-0.870

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and models with the Output Gap (OG), respectively. "diff" refers to the difference between these two MSE.

Table 8 –Real GDP growth forecast accuracy in the medium term

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE (AR)	MSE (OG)	diff
		forecast horizon h = 8 quarters			forecast horizon h = 12 quarters		
CAP-AV	2002:04-2006:04	0.707	0.234	**0.472**	0.626	0.128	**0.498**
CAP-TR	2002:04-2006:04	0.707	0.645	**0.062**	0.626	0.576	**0.050**
EC - T	2002:04-2006:04	0.707	0.907	-0.200	0.626	0.832	-0.206
EC - P	2004:03-2006:04	0.240	0.715	-0.475	0.219	0.559	-0.340
IMF	2002:04-2006:04	0.707	1.477	-0.770	0.626	1.145	-0.519
OECD	2002:04-2006:04	0.707	0.650	**0.056**	0.626	0.384	**0.242**
UC - CC	2004:02-2006:04	0.262	0.224	**0.038**	0.285	0.272	**0.013**
UC - PIC	2004:02-2006:04	0.262	2.282	-2.019	0.285	0.720	-0.435
UC - BIV	2004:03-2006:04	0.240	0.769	-0.529	0.219	0.641	-0.421
BP	2002:04-2006:04	0.707	0.598	**0.108**	0.626	0.574	**0.052**
HP	2002:04-2006:04	0.707	4.109	-3.402	0.626	1.363	-0.736
LIN	2002:04-2006:04	0.707	0.599	**0.107**	0.626	0.579	**0.047**
AV-All	2002:04-2006:04	0.707	0.314	**0.392**	0.626	0.277	**0.350**
AV-PFA	2002:04-2006:04	0.707	0.696	**0.011**	0.626	0.509	**0.117**
AV-Org	2002:04-2006:04	0.707	0.905	-0.198	0.626	0.710	-0.083
AV-UC	2002:04-2006:04	0.707	0.888	-0.182	0.626	0.540	**0.086**
AV-Fil	2002:04-2006:04	0.707	2.964	-2.257	0.626	1.399	-0.772

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and models with the Output Gap (OG), respectively. "diff" refers to the difference between these two MSE.

Table 9 – Tests of equal real GDP growth forecast accuracy in the short term

Output gap model	Evaluation sample	MSE-t (conv)	MSE-F	MSE-t (conv)	MSE-F
		h = 1 quarter		h = 4 quarters	
CAP-AV	2001:01-2006:04	0.617 n.s.	**4.061** *	0.878 *	**6.716** *
CAP-TR	2001:01-2006:04	0.594 n.s.	**4.539** *	0.675 *	1.299 n.s.
EC - T	2001:01-2006:04	-0.615 n.s.	-3.893 *	-1.921 *	-8.520 *
EC - P	2002:04-2006:04	0.324 n.s.	**2.048** *	-0.938 *	-5.080 *
IMF	2001:01-2006:04	-0.550 n.s.	-3.607 *	-1.922 *	-9.007 *
OECD	2001:01-2006:04	-0.173 n.s.	-1.005 n.s.	-0.927 *	-3.411 *
UC - CC	2002:03-2006:04	-1.099 *	-6.214 *	-0.272 n.s.	-0.611 n.s.
UC - PIC	2002:03-2006:04	-2.524 *	-15.418 *	-1.861 *	-13.030 *
UC - BIV	2002:04-2006:04	-2.719 *	-12.046 *	-2.071 *	-4.797 *
BP	2001:01-2006:04	-1.980 *	-12.520 *	-0.024 n.s.	-0.085 n.s.
HP	2001:01-2006:04	-3.981 *	-18.749 *	-3.784 *	-18.729 *
LIN	2001:01-2006:04	0.866 *	0.910 n.s.	1.622 *	2.375 n.s.
AV-All	2001:01-2006:04	-2.235 *	-13.941 *	1.270 *	**6.019** *
AV-PFA	2001:01-2006:04	-1.119 *	-7.323 *	-1.239 *	-4.926 *
AV-Org	2001:01-2006:04	-0.373 n.s.	-2.352 *	-1.591 *	-6.710 *
AV-UC	2001:01-2006:04	0.104 n.s.	0.746 n.s.	0.854 *	**11.769** *
AV-Fil	2001:01-2006:04	-4.221 *	-1.294 *	-1.075 *	-10.693 *

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table 10 – Tests of equal real GDP growth forecast accuracy in the medium term

Output gap model	Evaluation sample	MSE-t (conv)	MSE-F	MSE-t (conv)	MSE-F
		h = 8 quarters		h = 12 quarters	
CAP-AV	2002:04-2006:04	1.877 *	**34.319** *	3.207 *	**50.579** *
CAP-TR	2002:04-2006:04	1.092 *	1.631 n.s.	0.883 *	1.137 n.s.
EC - T	2002:04-2006:04	-5.018 *	-3.753 n.s.	-5.025 *	-3.213 n.s.
EC - P	2004:03-2006:04	-6.873 *	-6.641 n.s.	-9.647 *	-3.647 n.s.
IMF	2002:04-2006:04	-2.958 *	-8.867 *	-4.217 *	-5.891 n.s.
OECD	2002:04-2006:04	0.391 n.s.	1.465 n.s.	2.540 *	8.201 n.s.
UC - CC	2004:02-2006:04	0.828 *	1.886 n.s.	0.705 n.s.	0.335 n.s.
UC - PIC	2004:02-2006:04	-1.998 *	-9.735 *	-3.338 *	-4.230 n.s.
UC - BIV	2004:03-2006:04	-1.499 *	-6.877 n.s.	-2.454 *	-3.947 n.s.
BP	2002:04-2006:04	0.986 *	3.077 n.s.	0.469 n.s.	1.187 n.s.
HP	2002:04-2006:04	-2.639 *	-14.077 *	-1.421 *	-7.025 n.s.
LIN	2002:04-2006:04	4.123 *	3.047 n.s.	1.052 *	1.059 n.s.
AV-All	2002:04-2006:04	1.684 *	**21.240** *	2.583 *	**16.444** *
AV-PFA	2002:04-2006:04	0.088 n.s.	0.269 n.s.	1.932 *	2.988 n.s.
AV-Org	2002:04-2006:04	-1.566 *	-3.722 n.s.	-1.436 *	-1.523 n.s.
AV-UC	2002:04-2006:04	-0.692 *	-3.479 n.s.	0.392 n.s.	2.070 n.s.
AV-Fil	2002:04-2006:04	-2.311 *	-12.947 *	-1.431 *	-7.177 n.s.

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

To assess the consequence of the use of real-time data we compare results based on the three simple filters considered (BP, HP, LIN) applied to the real time vintages to those based on the filters applied to the pseudo-real time estimates. For the other sets of estimates this comparison is not possible, either because the real time data for some series needed to estimate the gap is not available or because often judgment is also used to occasionally adjust estimates. As for the case of inflation, results for the three simple filters tend to be very similar (see Appendix V).

Furthermore, and similar to the case of inflation, if we consider as reference series the second release of real GDP, rather than the first one, results are very similar (see Appendix VI for detailed results).

Finally, looking at different sub-samples, there are broad indications that the forecast performance of the models with the output gap may have improved in the more recent period, say from 2004 onwards, relative to the AR(4) model, especially in the short run but in several cases also for the medium run (detailed results reported in Appendix VII). However, it should be considered that the evaluation samples in this case become very short.

Overall, the results suggest that selected output gap estimates may improve real GDP growth forecasts even in real-time and for basically each horizon. Measures based on capacity utilization, linear filters, and averages of all gap measures perform particularly well.

V. A comparison with the US

To assess the generality of the results we have obtained for the euro area, we have repeated the forecasting exercise for inflation and GDP growth using two US datasets. First, data over the sample 1950:1-2006:4 with vintages from 1970 (as in Clark and McCracken (2009)); second, data over the sample 1985:1-2006:4 with vintages from 2001 (as for most euro area cases). As mentioned in Section II, due to data availability, we only focus on filter based output gap measures.

V.1. Inflation forecasting

Tables 11 and 12 summarize the results for forecasting US inflation using the AR(4) model with or without the alternative output gap measures, for each of the two different estimation and evaluation samples.

A clear difference between the full sample and post 1985 results emerges. Over the longer sample, all gap measures have predictive content for inflation, the gains in terms of lower MSE are fairly large and increase with the forecast horizon. In addition, in most cases the gains are statistically significant, see Tables 11 and 12. However, in the after 1985 sample, the only gap measure that preserves some predictive gains is BP, but the gains are very small and never statistically significant, when evaluated with the proper Clark and McCracken (2009) statistic.

Table 11 – Inflation forecast accuracy in the short term in the US

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
forecast horizon h = 1 (one-quarter ahead)						
		Estimation sample starting in 1950				
BP	1965:04-2006:04	1.928	1.759	**0.169**	*0.953* *	*15.747* *
HP	1965:04-2006:04	1.928	1.763	**0.165**	*0.686* *	*15.304* *
LIN	1965:04-2006:04	1.928	1.754	**0.174**	*0.726* *	*16.269* *
AV-Fil	1965:04-2006:04	1.928	1.765	**0.163**	*0.725* *	*15.155* *
		Estimation sample starting in 1985				
BP - 2001	2001:01-2006:04	0.845	0.808	**0.038**	*0.365 n.s.*	*1.074 n.s.*
HP - 2001	2001:01-2006:04	0.845	0.863	-0.018	*-0.102 n.s.*	*-0.473 n.s.*
LIN - 2001	2001:01-2006:04	0.845	0.890	-0.044	*-0.326 n.s.*	*-1.145 n.s.*
AV-Fil - 2001	2001:01-2006:04	0.845	0.867	-0.021	*-0.138 n.s.*	*-0.569 n.s.*
forecast horizon h = 4 (one-year ahead)						
		Estimation sample starting in 1950				
BP	1966:03-2006:04	1.993	1.632	**0.361**	*1.257* *	*35.575* *
HP	1966:03-2006:04	1.993	1.690	**0.302**	*1.136* *	*28.803* *
LIN	1966:03-2006:04	1.993	1.802	**0.191**	*0.555* *	*17.056* *
AV-Fil	1966:03-2006:04	1.993	1.722	**0.271**	*0.787* *	*25.334* *
		Estimation sample starting in 1985				
BP - 2001	2001:04-2006:04	0.522	0.484	**0.038**	*0.363 n.s.*	*1.568 n.s.*
HP - 2001	2001:04-2006:04	0.522	0.647	-0.125	*-0.858* *	*-3.864* *
LIN - 2001	2001:04-2006:04	0.522	0.724	-0.203	*-1.216* *	*-5.594* *
AV-Fil - 2001	2001:04-2006:04	0.522	0.683	-0.162	*-0.938* *	*-4.728* *

Note: Estimation sample starts in the first quarter of the year indicated in the corresponding panel and recursively ends in the period before the forecast evaluation sample.

"MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

A more detailed sub-sample analysis suggests that the forecasting role of gap for inflation has decreased substantially when evaluated over 1985-2006 with respect to 1970-1985, but some gains remain and are significant. There are still some gains from the BP based gap even after 2001 and 2004, but they are very small no longer statistically significant (detailed results in Appendix VIII). These results are broadly similar to those reported in Clark and McCracken (2009) for the HP-based output gap with reference to the evaluation period 1970-2003.

In summary, focusing on the more relevant post 1985 real time forecasting results, the findings for the US are qualitatively similar to those for the euro area, and overall support the lack of significant predictive content of output gap measures for inflation, both in the short and in the medium term.

Table 12 – Inflation forecast accuracy in the medium term in the US

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
forecast horizon h = 8 (two-years ahead)						
		Estimation sample starting in 1950				
BP	1967:03-2006:04	4.776	3.416	**1.360**	*1.621* *	*62.520* *
HP	1967:03-2006:04	4.776	3.355	**1.421**	*1.781* *	*66.481* *
LIN	1967:03-2006:04	4.776	3.891	**0.885**	*0.860* *	*35.716* *
AV-Fil	1967:03-2006:04	4.776	3.415	**1.361**	*1.400* *	*62.555* *
		Estimation sample starting in 1985				
BP - 2001	2002:04-2006:04	0.891	0.685	**0.206**	*6.044* *	*4.816* *n.s.*
HP - 2001	2002:04-2006:04	0.891	0.949	-0.058	*-0.923* *	*-0.983* *n.s.*
LIN - 2001	2002:04-2006:04	0.891	1.456	-0.565	*-3.279* *	*-6.207* *
AV-Fil - 2001	2002:04-2006:04	0.891	1.146	-0.255	*-2.429* *	*-3.556* *n.s.*
forecast horizon h = 12 (three-years ahead)						
		Estimation sample starting in 1950				
BP	1968:03-2006:04	7.384	6.977	**0.406**	*0.797* *	*8.911* *
HP	1968:03-2006:04	7.384	6.541	**0.842**	*1.559* *	*19.702* *
LIN	1968:03-2006:04	7.384	6.303	**1.081**	*0.894* *	*26.236* *
AV-Fil	1968:03-2006:04	7.384	6.217	**1.167**	*1.415* *	*28.720* *
		Estimation sample starting in 1985				
BP - 2001	2003:04-2006:04	1.409	1.374	**0.035**	*0.174* *n.s.*	*0.304* *n.s.*
HP - 2001	2003:04-2006:04	1.409	1.611	-0.202	*-2.117* *	*-1.504* *n.s.*
LIN - 2001	2003:04-2006:04	1.409	2.332	-0.923	*-8.464* *	*-4.749* *n.s.*
AV-Fil - 2001	2003:04-2006:04	1.409	1.938	-0.529	*-6.124* *	*-3.275* *n.s.*

Note: : Estimation sample starts in the first quarter of the year indicated in the corresponding panel and recursively ends in the period before the forecast evaluation sample.

"MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

V.2. Real GDP growth forecasting

We now assess whether the positive role of selected gap measures for forecasting real GDP growth we have detected for the euro area is present for the US as well. As for inflation, the evaluation will be based on two sample periods. The results are summarized in Tables 13 and 14 for, respectively, the short run and the medium run.

It turns out that the gap measures under evaluation are in general useless for forecasting real GDP growth. There are minor differences across the two subsamples, with some small gains for HP gap over the longer sample. And an evaluation for the most recent period, after 2004, finds basically the same negative results (see Appendix IX for details).

In the case of the euro area, the results were better for the linear filter based gap, and also for the BP gap in the medium run. A possible explanation for the different results for the US and the euro area is the fairly different growth path of the two areas.

Table 13 – Real GDP growth forecast accuracy in the short term in the US

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
forecast horizon h = 1 (one-quarter ahead)								
		Estimation sample starting in 1950						
BP	1965:04-2006:04	11.575	13.795	-2.221	*-0.935*	*	*-26.402*	*
HP	1965:04-2006:04	11.575	11.584	-0.010	*-0.010*	*	*-0.141*	*
LIN	1965:04-2006:04	11.575	11.638	-0.064	*-0.108*	*	*-0.901*	*
AV-Fil	1965:04-2006:04	11.575	13.224	-1.650	*-0.817*	*	*-20.458*	*
		Estimation sample starting in 1985						
BP - 2001	2001:01-2006:04	3.320	4.099	-0.779	*-0.430*	*n.s.*	*-4.373*	*
HP - 2001	2001:01-2006:04	3.320	4.004	-0.684	*-0.835*	*	*-3.929*	*
LIN - 2001	2001:01-2006:04	3.320	3.491	-0.171	*-0.574*	*n.s.*	*-1.130*	*
AV-Fil - 2001	2001:01-2006:04	3.320	3.752	-0.432	*-0.364*	*n.s.*	*-2.648*	*
forecast horizon h = 4 (one-year ahead)								
		Estimation sample starting in 1950						
BP	1966:03-2006:04	5.457	5.613	-0.155	*-0.196*	*	*-4.460*	*
HP	1966:03-2006:04	5.457	5.292	**0.165**	*0.274*	*	***5.016***	*
LIN	1966:03-2006:04	5.457	6.199	-0.742	*-1.050*	*	*-19.260*	*
AV-Fil	1966:03-2006:04	5.457	6.692	-1.235	*-1.357*	*	*-29.712*	*
		Estimation sample starting in 1985						
BP - 2001	2001:04-2006:04	1.282	1.630	-0.348	*-0.873*	*	*-4.272*	*n.s.*
HP - 2001	2001:04-2006:04	1.282	2.403	-1.121	*-1.364*	*	*-9.330*	*
LIN - 2001	2001:04-2006:04	1.282	1.314	-0.032	*-0.224*	*n.s.*	*-0.490*	*n.s.*
AV-Fil - 2001	2001:04-2006:04	1.282	1.722	-0.440	*-1.774*	*	*-5.112*	*n.s.*

Note: : Estimation sample starts in the first quarter of the year indicated in the corresponding panel and recursively ends in the period before the forecast evaluation sample.

"MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table 14 – Real GDP growth forecast accuracy in the medium term in the US

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
forecast horizon h = 8 (two-years ahead)						
		Estimation sample starting in 1950				
BP	1967:03-2006:04	3.471	3.138	**0.333**	*1.071* *	***16.684*** *
HP	1967:03-2006:04	3.471	3.337	**0.135**	*0.371* *	***6.331*** *
LIN	1967:03-2006:04	3.471	4.810	-1.338	*-2.226* *	*-43.691* *
AV-Fil	1967:03-2006:04	3.471	4.583	-1.112	*-1.765* *	*-38.088* *
		Estimation sample starting in 1985				
BP - 2001	2002:04-2006:04	0.719	0.886	-0.166	*-1.407* *	*-3.006 n.s.*
HP - 2001	2002:04-2006:04	0.719	1.630	-0.911	*-1.952* *	*-8.942 n.s.*
LIN - 2001	2002:04-2006:04	0.719	0.752	-0.032	*-0.436 n.s.*	*-0.689 n.s.*
AV-Fil - 2001	2002:04-2006:04	0.719	1.249	-0.529	*-1.974* *	*-6.784 n.s.*
forecast horizon h = 12 (three-years ahead)						
		Estimation sample starting in 1950				
BP	1968:03-2006:04	2.191	2.277	-0.086	*-0.568* *	*-5.802* *
HP	1968:03-2006:04	2.191	2.511	-0.320	*-1.227* *	*-19.513* *
LIN	1968:03-2006:04	2.191	3.726	-1.535	*-3.139* *	*-63.026* *
AV-Fil	1968:03-2006:04	2.191	2.995	-0.804	*-1.842* *	*-41.056* *
		Estimation sample starting in 1985				
BP - 2001	2003:04-2006:04	0.269	0.432	-0.164	*-2.288* *	*-4.541 n.s.*
HP - 2001	2003:04-2006:04	0.269	1.061	-0.792	*-3.792* *	*-8.961 n.s.*
LIN - 2001	2003:04-2006:04	0.269	0.385	-0.117	*-3.542* *	*-3.629 n.s.*
AV-Fil - 2001	2003:04-2006:04	0.269	0.734	-0.465	*-3.201* *	*-7.607 n.s.*

Note: Estimation sample starts in the first quarter of the year indicated in the corresponding panel and recursively ends in the period before the forecast evaluation sample.

"MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

VI. Conclusions

This paper provides real time evidence on the usefulness of the euro area output gap as a leading indicator for inflation and GDP growth. A genuine real-time data set for the euro area is used, including vintages of several alternative gap estimates.

It turns out that, despite some difference across gap estimates and forecast horizons, the results point to a lack of usefulness of real-time output gap estimates for inflation forecasting both in the short term (one-quarter and one-year ahead) and the medium term (two-year and three-year ahead).

By contrast, we find some evidence that a few output gap estimates are useful to forecast real GDP growth, particularly in the short term, and some appear also useful in the medium run. Capacity utilization based measures are particularly promising.

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Appendix I – Results for sub-sample inflation forecasting analysis

Table A – Tests of equal inflation forecast accuracy: one quarter ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 1 (one-quarter ahead)					
CAP-AV	2001:01-2006:04	1.570	1.621	-0.051	*-0.784*	*	*-0.758*	n.s.
	2001:01-2004:04	1.802	1.827	-0.024	*-0.256*	n.s.	*-0.213*	n.s.
	2005:01-2006:04	1.106	1.211	-0.105	*-2.614*	*	*-0.693*	*n.s.*
CAP-TR	2001:01-2006:04	1.570	1.626	-0.056	*-1.072*	*	*-0.828*	n.s.
	2001:01-2004:04	1.802	1.848	-0.046	*-0.622*	n.s.	*-0.396*	n.s.
	2005:01-2006:04	1.106	1.183	-0.077	*-1.538*	*	*-0.521*	*n.s.*
EC - T	1999:01-2006:04	1.342	1.427	-0.085	*-2.555*	*	*-1.910*	*
	1999:01-2002:04	1.191	1.290	-0.099	*-2.153*	*	*-1.223*	*
	2003:01-2006:04	1.492	1.564	-0.072	*-1.163*	*	*-0.734*	*n.s.*
EC - P	2002:04-2006:04	1.447	1.550	-0.103	*-1.334*	*	*-1.132*	*
	2002:04-2005:04	1.318	1.454	-0.136	*-1.339*	*	*-1.212*	*
	2006:01-2006:04	1.864	1.862	**0.002**	*0.017*	*n.s.*	*0.004*	*n.s.*
IMF	1999:01-2006:04	1.342	1.458	-0.116	*-2.465*	*	*-2.545*	*
	1999:01-2002:04	1.191	1.279	-0.088	*-1.729*	*	*-1.104*	*
	2003:01-2006:04	1.492	1.636	-0.144	*-1.637*	*	*-1.404*	*
OECD	1999:01-2006:04	1.342	1.472	-0.130	*-2.977*	*	*-2.834*	*
	1999:01-2002:04	1.191	1.289	-0.098	*-1.410*	*	*-1.214*	*
	2003:01-2006:04	1.492	1.655	-0.163	*-2.550*	*	*-1.575*	*
UC - CC	2002:03-2006:04	1.588	1.784	-0.196	*-2.592*	*	*-1.980*	*
	2002:03-2005:04	1.509	1.766	-0.256	*-2.847*	*	*-2.034*	*
	2006:01-2006:04	1.864	1.849	**0.015**	*0.120*	*n.s.*	*0.032*	*n.s.*
UC - PIC	2002:03-2006:04	1.588	1.834	-0.246	*-3.002*	*	*-2.416*	*
	2002:03-2005:04	1.509	1.775	-0.266	*-2.651*	*	*-2.098*	*
	2006:01-2006:04	1.864	2.041	-0.177	*-1.311*	*	*-0.346*	*n.s.*
UC - BIV	2002:04-2006:04	1.447	1.570	-0.123	*-2.053*	*	*-1.335*	*
	2002:04-2005:04	1.318	1.444	-0.126	*-1.806*	*	*-1.136*	*
	2006:01-2006:04	1.864	1.978	-0.114	*-0.937*	*n.s.*	*-0.230*	*n.s.*
BP	2001:01-2006:04	1.570	1.659	-0.089	*-3.268*	*	*-1.281*	*
	2001:01-2004:04	1.802	1.907	-0.104	*-2.980*	*	*-0.877*	n.s.
	2006:01-2006:04	1.864	1.978	-0.114	*-0.937*	*n.s.*	*-0.230*	*n.s.*
HP	2001:01-2006:04	1.570	1.641	-0.071	*-2.924*	*	*-1.040*	n.s.
	2001:01-2004:04	1.802	1.886	-0.083	*-2.632*	*	*-0.707*	n.s.
	2005:01-2006:04	1.106	1.153	-0.047	*-1.449*	*	*-0.325*	*n.s.*
LIN	2001:01-2006:04	1.570	1.623	-0.053	*-3.332*	*	*-0.782*	n.s.
	2001:01-2004:04	1.802	1.858	-0.056	*-2.894*	*	*-0.483*	n.s.
	2005:01-2006:04	1.106	1.152	-0.046	*-1.671*	*	*-0.321*	*n.s.*
AV-All	2001:01-2006:04	1.570	1.665	-0.095	*-1.425*	*	*-1.371*	*
	2001:01-2004:04	1.802	1.891	-0.089	*-0.921*	*	*-0.750*	n.s.
	2005:01-2006:04	1.106	1.214	-0.108	*-2.083*	*	*-0.713*	*n.s.*
AV-PFA	2001:01-2006:04	1.570	1.726	-0.156	*-2.337*	*	*-2.163*	*
	2001:01-2004:04	1.802	1.965	-0.162	*-1.742*	*	*-1.322*	*
	2005:01-2006:04	1.106	1.247	-0.142	*-1.959*	*	*-0.909*	*
AV-Org	2001:01-2006:04	1.570	1.683	-0.113	*-2.093*	*	*-1.607*	*
	2001:01-2004:04	1.802	1.916	-0.114	*-1.526*	*	*-0.950*	n.s.
	2005:01-2006:04	1.106	1.216	-0.110	*-1.766*	*	*-0.726*	*n.s.*
AV-UC	2001:01-2006:04	1.570	1.688	-0.117	*-1.752*	*	*-1.670*	*
	2001:01-2004:04	1.802	1.933	-0.131	*-1.317*	*	*-1.080*	*
	2005:01-2006:04	1.106	1.197	-0.091	*-2.965*	*	*-0.609*	*n.s.*
AV-Fil	2001:01-2006:04	1.570	1.644	-0.073	*-3.339*	*	*-1.071*	n.s.
	2001:01-2004:04	1.802	1.885	-0.082	*-2.965*	*	*-0.698*	n.s.
	2005:01-2006:04	1.106	1.161	-0.056	*-1.616*	*	*-0.383*	*n.s.*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table B – Tests of equal inflation forecast accuracy: one year ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 4 (one-year ahead)					
CAP-AV	2001:04-2006:04	0.898	0.881	**0.017**	*0.276*	n.s.	*0.415*	n.s.
	2001:04-2004:04	1.162	1.113	**0.049**	*0.507*	n.s.	*0.572*	n.s.
	2005:01-2006:04	0.468	0.502	-0.034	*-0.808*	*n.s.*	*-0.540*	*n.s.*
CAP-TR	2001:04-2006:04	0.898	0.922	-0.024	*-0.528*	n.s.	*-0.555*	n.s.
	2001:04-2004:04	1.162	1.165	-0.003	*-0.037*	n.s.	*-0.029*	n.s.
	2005:01-2006:04	0.468	0.528	-0.060	*-1.312*	*	*-0.906*	*n.s.*
EC - T	1999:04-2006:04	0.798	0.903	-0.105	*-2.144*	*	*-3.378*	*
	1999:04-2002:04	0.856	0.945	-0.089	*-1.575*	*	*-1.223*	*n.s.*
	2003:01-2006:04	0.751	0.869	-0.118	*-1.754*	*	*-2.179*	*n.s.*
EC - P	2003:03-2006:04	0.696	0.872	-0.176	*-2.214*	*	*-2.823*	*
	2003:03-2005:04	0.829	1.050	-0.221	*-2.368*	*	*-2.105*	*n.s.*
	2006:01-2006:04	0.364	0.426	-0.063	*-0.928*	*n.s.*	*-0.588*	*n.s.*
IMF	1999:04-2006:04	0.798	0.965	-0.167	*-2.141*	*	*-5.019*	*
	1999:04-2002:04	0.856	0.976	-0.120	*-1.153*	*	*-1.592*	*n.s.*
	2003:01-2006:04	0.751	0.957	-0.206	*-2.308*	*	*-3.440*	*
OECD	1999:04-2006:04	0.798	0.970	-0.172	*-2.100*	*	*-5.138*	*
	1999:04-2002:04	0.856	0.921	-0.065	*-0.636*	*n.s.*	*-0.920*	*n.s.*
	2003:01-2006:04	0.751	1.010	-0.259	*-4.487*	*	*-4.097*	*
UC - CC	2003:02-2006:04	0.751	0.997	-0.246	*-3.822*	*	*-3.700*	*
	2003:02-2005:04	0.892	1.186	-0.294	*-4.761*	*	*-2.729*	*
	2006:01-2006:04	0.364	0.477	-0.113	*-1.454*	*	*-0.948*	*n.s.*
UC - PIC	2003:02-2006:04	0.751	0.992	-0.241	*-3.567*	*	*-3.647*	*
	2003:02-2005:04	0.892	1.197	-0.305	*-4.785*	*	*-2.799*	*
	2006:01-2006:04	0.364	0.431	-0.067	*-1.347*	*	*-0.626*	*n.s.*
UC - BIV	2003:03-2006:04	0.696	0.803	-0.107	*-2.180*	*	*-1.863*	*n.s.*
	2003:03-2005:04	0.829	0.989	-0.160	*-4.221*	*	*-1.620*	*n.s.*
	2006:01-2006:04	0.364	0.337	**0.027**	*0.616*	*n.s.*	*0.319*	*n.s.*
BP	2001:04-2006:04	0.898	1.009	-0.111	*-2.441*	*	*-2.312*	n.s.
	2001:04-2004:04	1.162	1.329	-0.167	*-4.821*	*	*-1.629*	n.s.
	2005:01-2006:04	0.468	0.489	-0.021	*-2.587*	*	*-0.343*	*n.s.*
HP	2001:04-2006:04	0.898	0.961	-0.063	*-2.768*	*	*-1.380*	n.s.
	2001:04-2004:04	1.162	1.255	-0.093	*-4.543*	*	*-0.959*	n.s.
	2005:01-2006:04	0.468	0.484	-0.015	*-2.483*	*	*-0.254*	*n.s.*
LIN	2001:04-2006:04	0.898	0.961	-0.063	*-2.107*	*	*-1.383*	n.s.
	2001:04-2004:04	1.162	1.255	-0.092	*-2.337*	*	*-0.957*	n.s.
	2005:01-2006:04	0.468	0.484	-0.016	*-1.713*	*	*-0.265*	*n.s.*
AV-All	2001:04-2006:04	0.898	0.951	-0.053	*-0.663*	*	*-1.180*	n.s.
	2001:04-2004:04	1.162	1.221	-0.058	*-0.445*	n.s.	*-0.621*	n.s.
	2005:01-2006:04	0.468	0.514	-0.046	*-1.417*	*	*-0.709*	*n.s.*
AV-PFA	2001:04-2006:04	0.898	1.086	-0.188	*-1.880*	*	*-3.633*	*
	2001:04-2004:04	1.162	1.355	-0.193	*-1.283*	*	*-1.849*	n.s.
	2005:01-2006:04	0.468	0.648	-0.180	*-2.519*	*	*-2.220*	*
AV-Org	2001:04-2006:04	0.898	1.048	-0.150	*-1.889*	*	*-3.009*	*
	2001:04-2004:04	1.162	1.339	-0.177	*-1.403*	*	*-1.717*	n.s.
	2005:01-2006:04	0.468	0.575	-0.107	*-2.092*	*	*-1.485*	*n.s.*
AV-UC	2001:04-2006:04	0.898	1.049	-0.151	*-2.755*	*	*-3.020*	*
	2001:04-2004:04	1.162	1.333	-0.171	*-1.821*	*	*-1.664*	n.s.
	2005:01-2006:04	0.468	0.587	-0.119	*-5.122*	*	*-1.616*	*n.s.*
AV-Fil	2001:04-2006:04	0.898	0.980	-0.082	*-2.461*	*	*-1.753*	n.s.
	2001:04-2004:04	1.162	1.283	-0.120	*-3.254*	*	*-1.217*	n.s.
	2005:01-2006:04	0.468	0.488	-0.020	*-2.295*	*	*-0.321*	*n.s.*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table C – Tests of equal inflation forecast accuracy: two years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 8 (two-years ahead)					
CAP-AV	2002:04-2006:04	1.101	1.028	**0.073**	*2.102*	*	*1.205*	n.s.
	2002:04-2004:04	1.301	1.16	**0.141**	*3.690*	*	*1.092*	n.s.
	2005:01-2006:04	0.876	0.880	-0.003	*-0.079*	*n.s.*	*-0.031*	*n.s.*
CAP-TR	2002:04-2006:04	1.101	1.044	**0.057**	*1.707*	*	*0.93*	n.s.
	2002:04-2004:04	1.301	1.157	**0.145**	*3.577*	*	*1.124*	n.s.
	2005:01-2006:04	0.876	0.917	-0.041	*-0.726*	*n.s.*	*-0.360*	*n.s.*
EC - T	2000:04-2006:04	1.604	1.546	**0.058**	*0.580*	*	*0.930*	*n.s.*
	2000:04-2002:04	2.828	2.520	**0.308**	*2.132*	*	*1.101*	*n.s.*
	2003:01-2006:04	0.915	0.999	-0.084	*-1.734*	*	*-1.338*	*n.s.*
EC - P	2004:03-2006:04	0.933	1.070	-0.137	*-1.751*	*	*-1.278*	*n.s.*
	2004:03-2005:04	1.215	1.427	-0.213	*-1.565*	*	*-0.894*	*n.s.*
	2006:01-2006:04	0.510	0.533	-0.023	*-1.226*	*	*-0.172*	*n.s.*
IMF	2000:04-2006:04	1.604	1.670	-0.067	*-0.767*	*	*-0.996*	*n.s.*
	2000:04-2002:04	2.828	2.867	-0.040	*-0.167*	*n.s.*	*-0.124*	*n.s.*
	2003:01-2006:04	0.915	0.997	-0.082	*-1.518*	*	*-1.312*	*n.s.*
OECD	2000:04-2006:04	1.604	1.750	-0.146	*-1.316*	*	*-2.090*	*n.s.*
	2000:04-2002:04	2.828	2.760	**0.068**	*0.293*	*n.s.*	*0.222*	*n.s.*
	2003:01-2006:04	0.915	1.182	-0.267	*-4.470*	*	*-3.613*	*n.s.*
UC - CC	2004:02-2006:04	1.013	1.299	-0.286	*-5.699*	*	*-2.422*	*n.s.*
	2004:02-2005:04	1.300	1.589	-0.289	*-4.833*	*	*-1.273*	*n.s.*
	2006:01-2006:04	0.510	0.791	-0.281	*-3.131*	*	*-1.420*	*n.s.*
UC - PIC	2004:02-2006:04	1.013	1.154	-0.141	*-4.739*	*	*-1.346*	*n.s.*
	2004:02-2005:04	1.300	1.458	-0.158	*-3.543*	*	*-0.759*	*n.s.*
	2006:01-2006:04	0.510	0.622	-0.112	*-3.847*	*	*-0.719*	*n.s.*
UC - BIV	2004:03-2006:04	0.933	1.033	-0.101	*-2.455*	*	*-0.973*	*n.s.*
	2004:03-2005:04	1.215	1.330	-0.116	*-1.682*	*	*-0.522*	*n.s.*
	2006:01-2006:04	0.510	0.588	-0.078	*-2.494*	*	*-0.528*	*n.s.*
BP	2002:04-2006:04	1.101	1.166	-0.065	*-3.860*	*	*-0.949*	n.s.
	2002:04-2004:04	1.301	1.400	-0.099	*-5.439*	*	*-0.635*	n.s.
	2005:01-2006:04	0.876	0.903	-0.027	*-4.133*	*	*-0.241*	*n.s.*
HP	2002:04-2006:04	1.101	1.092	**0.009**	*0.741*	*	*0.147*	n.s.
	2002:04-2004:04	1.301	1.298	**0.004**	*0.179*	n.s.	*0.024*	n.s.
	2005:01-2006:04	0.876	0.860	**0.016**	*1.148*	*	*0.150*	*n.s.*
LIN	2002:04-2006:04	1.101	1.128	-0.027	*-0.677*	*	*-0.406*	n.s.
	2002:04-2004:04	1.301	1.384	-0.083	*-1.817*	*	*-0.538*	n.s.
	2005:01-2006:04	0.876	0.840	**0.036**	*2.257*	*	*0.340*	*n.s.*
AV-All	2002:04-2006:04	1.101	1.032	**0.069**	*1.314*	*	*1.145*	n.s.
	2002:04-2004:04	1.301	1.137	**0.165**	*2.724*	*	*1.303*	n.s.
	2005:01-2006:04	0.876	0.914	-0.037	*-0.675*	*n.s.*	*-0.328*	*n.s.*
AV-PFA	2002:04-2006:04	1.101	1.219	-0.118	*-1.205*	*	*-1.645*	n.s.
	2002:04-2004:04	1.301	1.205	**0.096**	*1.199*	*	*0.716*	n.s.
	2005:01-2006:04	0.876	1.235	-0.358	*-3.698*	*	*-2.323*	*n.s.*
AV-Org	2002:04-2006:04	1.101	1.190	-0.089	*-1.097*	*	*-1.274*	n.s.
	2002:04-2004:04	1.301	1.203	**0.098**	*1.465*	*	*0.733*	n.s.
	2005:01-2006:04	0.876	1.176	-0.300	*-2.277*	*	*-2.040*	*n.s.*
AV-UC	2002:04-2006:04	1.101	1.197	-0.096	*-1.802*	*	*-1.366*	n.s.
	2002:04-2004:04	1.301	1.230	**0.071**	*1.321*	*	*0.523*	n.s.
	2005:01-2006:04	0.876	1.161	-0.285	*-4.490*	*	*-1.963*	*n.s.*
AV-Fil	2002:04-2006:04	1.101	1.127	-0.026	*-0.904*	*	*-0.387*	n.s.
	2002:04-2004:04	1.301	1.367	-0.065	*-2.004*	*	*-0.431*	n.s.
	2005:01-2006:04	0.876	0.857	**0.019**	*1.317*	*	*0.179*	*n.s.*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table D – Tests of equal inflation forecast accuracy: three years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 12 (three-years ahead)					
CAP-AV	2003:04-2006:04	1.028	1.019	**0.010**	*0.162*	n.s.	*0.122*	n.s.
	2003:04-2004:04	1.312	1.134	**0.178**	*2.016*	*	*0.784*	n.s.
	2005:01-2006:04	0.851	0.946	-0.096	*-3.275*	*	*-0.809*	*n.s.*
CAP-TR	2003:04-2006:04	1.028	1.112	-0.084	*-1.422*	*	*-0.977*	n.s.
	2003:04-2004:04	1.312	1.213	**0.099**	*0.961*	*	*0.408*	n.s.
	2005:01-2006:04	0.851	1.048	-0.198	*-5.352*	*	*-1.508*	*n.s.*
EC - T	2001:04-2006:04	2.205	1.971	**0.234**	*1.745*	*	*2.487*	*n.s.*
	2001:04-2002:04	6.221	5.572	**0.649**	*5.188*	*	*0.583*	*n.s.*
	2003:01-2006:04	0.950	0.846	**0.104**	*1.034*	*	*1.959*	*n.s.*
EC - P	2005:03-2006:04	0.853	1.099	-0.247	*-3.470*	*	*-1.346*	*n.s.*
	2005:03-2005:04	0.648	0.470	**0.178**	*3.645*	*	*0.756*	*n.s.*
	2006:01-2006:04	0.955	1.414	-0.459	*-3.803*	*	*-1.298*	*n.s.*
IMF	2001:04-2006:04	2.205	2.239	-0.034	*-0.367*	*n.s.*	*-0.317*	*n.s.*
	2001:04-2002:04	6.221	6.712	-0.491	*-2.509*	*	*-0.366*	*n.s.*
	2003:01-2006:04	0.950	0.841	**0.109**	*1.326*	*	*2.078*	*n.s.*
OECD	2001:04-2006:04	2.205	2.353	-0.148	*-1.620*	*	*-1.324*	*n.s.*
	2001:04-2002:04	6.221	6.622	-0.401	*-2.713*	*	*-0.303*	*n.s.*
	2003:01-2006:04	0.950	1.019	-0.069	*-0.523*	*n.s.*	*-1.090*	*n.s.*
UC - CC	2005:02-2006:04	0.947	1.463	-0.516	*-9.151*	*	*-2.468*	*n.s.*
	2005:02-2005:04	0.937	1.324	-0.387	*-3.484*	*	*-0.878*	*n.s.*
	2006:01-2006:04	0.955	1.567	-0.612	*-12.187*	*	*-1.563*	*
UC - PIC	2005:02-2006:04	0.947	1.105	-0.158	*-8.771*	*	*-1.003*	*n.s.*
	2005:02-2005:04	0.937	1.013	-0.076	*-2.492*	*	*-0.226*	*n.s.*
	2006:01-2006:04	0.955	1.175	-0.220	*-6.679*	*	*-0.748*	*n.s.*
UC - BIV	2005:03-2006:04	0.853	1.102	-0.249	*-4.774*	*	*-1.357*	*n.s.*
	2005:03-2005:04	0.648	0.516	**0.131**	*2.964*	*	*0.509*	*n.s.*
	2006:01-2006:04	0.955	1.395	-0.439	*-5.716*	*	*-1.260*	*n.s.*
BP	2003:04-2006:04	1.028	1.025	**0.003**	*0.433*	n.s.	*0.034*	n.s.
	2003:04-2004:04	1.312	1.298	**0.014**	*5.128*	*	*0.055*	n.s.
	2005:01-2006:04	0.851	0.855	-0.005	*-0.647*	*n.s.*	*-0.043*	*n.s.*
HP	2003:04-2006:04	1.028	1.005	**0.023**	*2.819*	*	*0.298*	n.s.
	2003:04-2004:04	1.312	1.313	-0.001	*-0.119*	n.s.	*-0.004*	n.s.
	2005:01-2006:04	0.851	0.813	**0.038**	*3.839*	*	*0.376*	*n.s.*
LIN	2003:04-2006:04	1.028	1.041	-0.013	*-0.371*	n.s.	*-0.160*	n.s.
	2003:04-2004:04	1.312	1.465	-0.153	*-7.805*	*	*-0.522*	n.s.
	2005:01-2006:04	0.851	0.776	**0.075**	*4.839*	*	*0.771*	*n.s.*
AV-All	2003:04-2006:04	1.028	0.982	**0.047**	*0.786*	*	*0.616*	n.s.
	2003:04-2004:04	1.312	1.070	**0.242**	*2.944*	*	*1.132*	n.s.
	2005:01-2006:04	0.851	0.927	-0.076	*-3.629*	*	*-0.654*	*n.s.*
AV-PFA	2003:04-2006:04	1.028	1.124	-0.096	*-0.963*	*	*-1.110*	n.s.
	2003:04-2004:04	1.312	1.063	**0.249**	*4.205*	*	*1.171*	n.s.
	2005:01-2006:04	0.851	1.162	-0.311	*-7.398*	*	*-2.144*	*n.s.*
AV-Org	2003:04-2006:04	1.028	1.059	-0.031	*-0.355*	n.s.	*-0.375*	n.s.
	2003:04-2004:04	1.312	1.047	**0.264**	*5.499*	*	*1.263*	n.s.
	2005:01-2006:04	0.851	1.066	-0.215	*-4.105*	*	*-1.613*	*n.s.*
AV-UC	2003:04-2006:04	1.028	1.206	-0.177	*-2.792*	*	*-1.913*	n.s.
	2003:04-2004:04	1.312	1.380	-0.068	*-0.711*	n.s.	*-0.246*	n.s.
	2005:01-2006:04	0.851	1.097	-0.246	*-3.657*	*	*-1.793*	*n.s.*
AV-Fil	2003:04-2006:04	1.028	1.025	**0.003**	*0.170*	n.s.	*0.040*	n.s.
	2003:04-2004:04	1.312	1.386	-0.074	*-5.751*	*	*-0.266*	n.s.
	2005:01-2006:04	0.851	0.800	**0.051**	*5.011*	*	*0.512*	*n.s.*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Appendix II –Inflation forecasting analysis: real time versus pseudo real time vintages

Table – Tests of equal inflation forecast accuracy: real time versus pseudo real time vintages

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
		forecast horizon h = 1 (one-quarter ahead)				
BP	2001:01-2006:04	1.570	1.659	-0.089	*-3.268* *	*-1.281* *
HP	2001:01-2006:04	1.570	1.641	-0.071	*-2.924* *	*-1.040 n.s.*
LIN	2001:01-2006:04	1.570	1.623	-0.053	*-3.332* *	*-0.782 n.s.*
BP pseudo	2001:01-2006:04	1.698	1.750	-0.052	*-2.723* *	*-0.716 n.s.*
HP pseudo	2001:01-2006:04	1.698	1.719	-0.021	*-2.145* *	*-0.299 n.s.*
LIN pseudo	2001:01-2006:04	1.698	1.710	-0.012	*-1.280* *	*-0.166 n.s.*
Output gap model		**MSE (AR)**	**MSE (OG)**	**diff**	**MSE-t (conv)**	**MSE-F**
		forecast horizon h = 4 (one-year ahead)				
BP	2001:04-2006:04	0.898	1.009	-0.111	*-2.441* *	*-2.312 n.s.*
HP	2001:04-2006:04	0.898	0.961	-0.063	*-2.768* *	*-1.380 n.s.*
LIN	2001:04-2006:04	0.898	0.961	-0.063	*-2.107* *	*-1.383 n.s.*
BP pseudo	2001:04-2006:04	1.021	1.109	-0.088	*-2.964* *	*-1.669 n.s.*
HP pseudo	2001:04-2006:04	1.021	1.035	-0.014	*-1.397* *	*-0.289 n.s.*
LIN pseudo	2001:04-2006:04	1.021	1.034	-0.013	*-0.619* n.s.	*-0.255 n.s.*
Output gap model		**MSE (AR)**	**MSE (OG)**	**diff**	**MSE-t (conv)**	**MSE-F**
		forecast horizon h = 8 (two-years ahead)				
BP	2002:04-2006:04	1.101	1.166	-0.065	*-3.860* *	*-0.949 n.s.*
HP	2002:04-2006:04	1.101	1.092	**0.009**	*0.741* *	*0.147 n.s.*
LIN	2002:04-2006:04	1.101	1.128	-0.027	*-0.677* *	*-0.406 n.s.*
BP pseudo	2002:04-2006:04	1.178	1.239	-0.061	*-5.116* *	*-0.836 n.s.*
HP pseudo	2002:04-2006:04	1.178	1.137	**0.041**	*5.768* *	*0.619 n.s.*
LIN pseudo	2002:04-2006:04	1.178	1.133	0.045	*1.512* *	*0.680 n.s.*
Output gap model		**MSE (AR)**	**MSE (OG)**	**diff**	**MSE-t (conv)**	**MSE-F**
		forecast horizon h = 12 (three-years ahead)				
BP	2003:04-2006:04	1.028	1.025	**0.003**	*0.433 n.s.*	*0.034 n.s.*
HP	2003:04-2006:04	1.028	1.005	**0.023**	*2.819* *	*0.298 n.s.*
LIN	2003:04-2006:04	1.028	1.041	-0.013	*-0.371 n.s.*	*-0.160 n.s.*
BP pseudo	2003:04-2006:04	1.039	1.066	-0.028	*-2.067* *	*-0.337 n.s.*
HP pseudo	2003:04-2006:04	1.039	0.993	**0.046**	*3.924* *	*0.599 n.s.*
LIN pseudo	2003:04-2006:04	1.039	0.956	0.083	*2.707* *	*1.124 n.s.*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Appendix III –Inflation forecasting analysis: extended Phillips curve

Table A – Inflation forecast accuracy with extended Phillips curve: 1-quarter ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
	forecast horizon h = 1 (one-quarter ahead)					
CAP-AV	2001:01-2006:04	1.412	1.502	-0.090	*-1.182* *	*-1.442* *
CAP-TR	2001:01-2006:04	1.412	1.513	-0.101	*-1.651* *	*-1.607* *
EC - T	1999:01-2006:04	1.252	1.331	-0.080	*-1.906* *	*-1.918* *
EC - P	2002:04-2006:04	1.317	1.428	-0.111	*-1.309* *	*-1.317* *
IMF	1999:01-2006:04	1.252	1.356	-0.104	*-1.915* *	*-2.460* *
OECD	1999:01-2006:04	1.252	1.386	-0.135	*-2.646* *	*-3.109* *
UC - CC	2002:03-2006:04	1.411	1.632	-0.220	*-2.909* *	*-2.430* *
UC - PIC	2002:03-2006:04	1.411	1.661	-0.250	*-3.289* *	*-2.707* *
UC - BIV	2002:04-2006:04	1.317	1.425	-0.108	*-1.932* *	*-1.286* *
BP	2001:01-2006:04	1.412	1.502	-0.090	*-3.759* *	*-1.437* *
HP	2001:01-2006:04	1.412	1.471	-0.060	*-2.531* *	*-0.971 n.s.*
LIN	2001:01-2006:04	1.412	1.456	-0.044	*-2.638* *	*-0.723 n.s.*
AV-All	2001:01-2006:04	1.412	1.509	-0.097	*-1.421* *	*-1.544* *
AV-PFA	2001:01-2006:04	1.412	1.559	-0.147	*-2.075* *	*-2.261* *
AV-Org	2001:01-2006:04	1.412	1.518	-0.107	*-1.715* *	*-1.684* *
AV-UC	2001:01-2006:04	1.412	1.517	-0.105	*-1.678* *	*-1.659* *
AV-Fil	2001:01-2006:04	1.412	1.474	-0.062	*-3.002* *	*-1.672* *

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table B – Inflation forecast accuracy with extended Phillips curve: 4-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
	forecast horizon h = 4 (one-year ahead)					
CAP-AV	2001:04-2006:04	0.713	0.752	-0.039	*-0.685* *	*-1.102* n.s.
CAP-TR	2001:04-2006:04	0.713	0.796	-0.083	*-2.056* *	*-2.198* n.s.
EC - T	1999:04-2006:04	0.654	0.749	-0.095	*-1.820* *	*-3.663* *
EC - P	2003:03-2006:04	0.525	0.698	-0.173	*-2.304* *	*-3.463* *
IMF	1999:04-2006:04	0.654	0.797	-0.143	*-1.901* *	*-5.201* *
OECD	1999:04-2006:04	0.654	0.815	-0.161	*-1.883* *	*-5.727* *
UC - CC	2003:02-2006:04	0.548	0.810	-0.262	*-3.747* *	*-4.852* *
UC - PIC	2003:02-2006:04	0.548	0.719	-0.172	*-3.968* *	*-3.578* *
UC - BIV	2003:03-2006:04	0.525	0.598	-0.073	*-1.843* *	*-1.714 n.s.*
BP	2001:04-2006:04	0.713	0.823	-0.110	*-2.550* *	*-2.816* *
HP	2001:04-2006:04	0.713	0.739	-0.026	*-0.644* *	*-0.751 n.s.*
LIN	2001:04-2006:04	0.713	0.748	-0.035	*-0.743* *	*-0.987 n.s.*
AV-All	2001:04-2006:04	0.713	0.758	-0.045	*-0.642* n.s.	*-1.259* n.s.
AV-PFA	2001:04-2006:04	0.713	0.861	-0.148	*-1.575* *	*-3.618* *
AV-Org	2001:04-2006:04	0.713	0.842	-0.129	*-1.609* *	*-3.211* *
AV-UC	2001:04-2006:04	0.713	0.835	-0.122	*-2.851* *	*-3.067* *
AV-Fil	2001:04-2006:04	0.713	0.763	-0.050	*-1.131* *	*-1.388* n.s.

Note: See Table A.

Table C – Inflation forecast accuracy with extended Phillips curve: 8-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
forecast horizon h = 8 (two-years ahead)								
CAP-AV	2002:04-2006:04	0.833	0.815	**0.017**	0.515	n.s.	*0.364*	n.s.
CAP-TR	2002:04-2006:04	0.833	0.835	-0.002	-0.064	n.s.	*-0.041*	n.s.
EC - T	2000:04-2006:04	1.392	1.329	**0.062**	*0.620*	*	*1.174*	*n.s.*
EC - P	2004:03-2006:04	0.653	0.813	-0.161	*-2.108*	*	*-1.978*	*n.s.*
IMF	2000:04-2006:04	1.392	1.442	-0.051	*-0.565*	*	*-0.877*	*n.s.*
OECD	2000:04-2006:04	1.392	1.523	-0.131	*-1.120*	*	*-2.156*	*n.s.*
UC - CC	2004:02-2006:04	0.697	1.040	-0.343	*-7.128*	*	*-3.625*	*
UC - PIC	2004:02-2006:04	0.697	0.700	-0.003	*-0.063*	*n.s.*	*-0.041*	*n.s.*
UC - BIV	2004:03-2006:04	0.653	0.685	-0.033	*-0.550*	*n.s.*	*-0.478*	*n.s.*
BP	2002:04-2006:04	0.833	0.925	-0.092	*-7.926*	*	*-1.693*	*n.s.*
HP	2002:04-2006:04	0.833	0.764	**0.068**	*1.742*	*	*1.521*	*n.s.*
LIN	2002:04-2006:04	0.833	0.792	**0.041**	*0.756*	*	*0.875*	*n.s.*
AV-All	2002:04-2006:04	0.833	0.747	**0.086**	1.685	*	*1.950*	n.s.
AV-PFA	2002:04-2006:04	0.833	0.901	-0.068	-0.704	*	*-1.290*	n.s.
AV-Org	2002:04-2006:04	0.833	0.905	-0.072	-0.815	*	*-1.352*	n.s.
AV-UC	2002:04-2006:04	0.833	0.848	-0.015	-0.265	n.s.	*-0.298*	n.s.
AV-Fil	2002:04-2006:04	0.833	0.803	**0.030**	0.780	*	*0.641*	n.s.

Note: See Table A.

Table D – Inflation forecast accuracy with extended Phillips curve: 12-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
forecast horizon h = 12 (three-years ahead)								
CAP-AV	2003:04-2006:04	0.712	0.834	-0.121	*-2.418*	*	*-1.893*	*n.s.*
CAP-TR	2003:04-2006:04	0.712	0.964	-0.252	*-4.160*	*	*-3.396*	*n.s.*
EC - T	2001:04-2006:04	1.938	1.766	**0.173**	*1.416*	*	*2.057*	*n.s.*
EC - P	2005:03-2006:04	0.467	0.788	-0.320	*-4.495*	*	*-2.439*	*n.s.*
IMF	2001:04-2006:04	1.938	2.021	-0.083	*-0.722*	*	*-0.862*	*n.s.*
OECD	2001:04-2006:04	1.938	2.113	-0.174	*-1.707*	*	*-1.733*	*n.s.*
UC - CC	2005:02-2006:04	0.508	0.989	-0.481	*-12.266*	*	*-3.404*	*
UC - PIC	2005:02-2006:04	0.508	0.504	**0.004**	*0.143*	*n.s.*	*0.057*	*n.s.*
UC - BIV	2005:03-2006:04	0.467	0.693	-0.225	*-3.702*	*	*-1.953*	*n.s.*
BP	2003:04-2006:04	0.712	0.736	-0.024	*-2.247*	*	*-0.415*	*n.s.*
HP	2003:04-2006:04	0.712	0.706	**0.006**	*0.130*	*n.s.*	*0.114*	*n.s.*
LIN	2003:04-2006:04	0.712	0.713	-0.001	*-0.011*	*n.s.*	*-0.015*	*n.s.*
AV-All	2003:04-2006:04	0.712	0.691	**0.021**	*0.449*	n.s.	*0.398*	*n.s.*
AV-PFA	2003:04-2006:04	0.712	0.763	-0.051	*-0.611*	n.s.	*-0.865*	*n.s.*
AV-Org	2003:04-2006:04	0.712	0.764	-0.052	*-0.584*	n.s.	*-0.881*	*n.s.*
AV-UC	2003:04-2006:04	0.712	0.919	-0.207	*-2.712*	*	*-2.928*	*n.s.*
AV-Fil	2003:04-2006:04	0.712	0.711	**0.001**	*0.026*	n.s.	*0.024*	*n.s.*

Note: See Table A.

Appendix IV –Inflation forecasting analysis: alternative reference series

Table A – Inflation forecast accuracy with alternative reference series: 1-quarter ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
		forecast horizon h = 1 (one-quarter ahead)				
CAP-AV	2001:01-2006:04	1.709	1.743	-0.034	*-0.518 n.s.*	*-0.468 n.s.*
CAP-TR	2001:01-2006:04	1.709	1.755	-0.045	*-0.790 **	*-0.620 n.s.*
EC - T	1999:01-2006:04	1.528	1.606	-0.077	*-1.828 **	*-1.540 **
EC - P	2002:04-2006:04	1.292	1.489	-0.197	*-2.912 **	*-2.253 **
IMF	1999:01-2006:04	1.528	1.627	-0.099	*-1.599 **	*-1.945 **
OECD	1999:01-2006:04	1.528	1.662	-0.133	*-2.425 **	*-2.567 **
UC - CC	2002:03-2006:04	1.357	1.562	-0.205	*-3.023 **	*-2.362 **
UC - PIC	2002:03-2006:04	1.357	1.651	-0.294	*-3.812 **	*-3.204 **
UC - BIV	2002:04-2006:04	1.292	1.453	-0.161	*-2.970 **	*-1.880 **
BP	2001:01-2006:04	1.709	1.784	-0.075	*-2.687 **	*-1.009 n.s.*
HP	2001:01-2006:04	1.709	1.769	-0.060	*-2.499 **	*-0.817 n.s.*
LIN	2001:01-2006:04	1.709	1.759	-0.050	*-2.249 **	*-0.677 n.s.*
AV-All	2001:01-2006:04	1.709	1.819	-0.110	*-1.546 **	*-1.454 **
AV-PFA	2001:01-2006:04	1.709	1.892	-0.183	*-2.442 **	*-2.320 **
AV-Org	2001:01-2006:04	1.709	1.853	-0.144	*-2.246 **	*-1.862 **
AV-UC	2001:01-2006:04	1.709	1.838	-0.129	*-2.245 **	*-1.679 **
AV-Fil	2001:01-2006:04	1.709	1.775	-0.065	*-2.535 **	*-1.155 n.s.*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table B – Inflation forecast accuracy with alternative reference series: 4-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
		forecast horizon h = 4 (one-year ahead)				
CAP-AV	2001:04-2006:04	0.940	0.969	-0.030	*-0.845 **	*-0.646 n.s.*
CAP-TR	2001:04-2006:04	0.940	0.967	-0.028	*-0.673 **	*-0.604 n.s.*
EC - T	1999:04-2006:04	0.786	0.910	-0.123	*-2.081 **	*-3.935 **
EC - P	2003:03-2006:04	0.340	0.507	-0.167	*-2.118 **	*-4.610 **
IMF	1999:04-2006:04	0.786	0.928	-0.142	*-1.779 **	*-4.422 **
OECD	1999:04-2006:04	0.786	0.976	-0.190	*-2.494 **	*-5.636 **
UC - CC	2003:02-2006:04	0.481	0.697	-0.216	*-2.411 **	*-4.651 **
UC - PIC	2003:02-2006:04	0.481	0.722	-0.242	*-2.183 **	*-5.018 **
UC - BIV	2003:03-2006:04	0.340	0.436	-0.096	*-1.616 **	*-3.085 **
BP	2001:04-2006:04	0.940	1.069	-0.129	*-2.100 **	*-2.541 n.s.*
HP	2001:04-2006:04	0.940	1.016	-0.077	*-2.541 **	*-1.585 n.s.*
LIN	2001:04-2006:04	0.940	1.013	-0.074	*-2.310 **	*-1.526 n.s.*
AV-All	2001:04-2006:04	0.940	1.063	-0.123	*-1.847 **	*-2.431 **
AV-PFA	2001:04-2006:04	0.940	1.151	-0.212	*-2.186 **	*-3.862 **
AV-Org	2001:04-2006:04	0.940	1.121	-0.181	*-2.104 **	*-3.398 **
AV-UC	2001:04-2006:04	0.940	1.144	-0.204	*-5.301 **	*-3.745 **
AV-Fil	2001:04-2006:04	0.940	1.035	-0.096	*-2.384 **	*-1.943 n.s.*

Note: See Table A.

Table C – Inflation forecast accuracy with alternative reference series: 8-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 8 (two-years ahead)					
CAP-AV	2002:04-2006:04	0.951	0.894	**0.057**	*2.370*	*	*1.090*	*n.s.*
CAP-TR	2002:04-2006:04	0.951	0.907	**0.044**	*1.343*	*	*0.822*	*n.s.*
EC - T	2000:04-2006:04	1.162	1.080	**0.082**	*1.538*	*	*1.892*	*n.s.*
EC - P	2004:03-2006:04	0.496	0.555	-0.059	*-1.410*	*	*-1.070*	*n.s.*
IMF	2000:04-2006:04	1.162	1.159	**0.003**	*0.044*	*n.s.*	*0.063*	*n.s.*
OECD	2000:04-2006:04	1.162	1.257	-0.095	*-1.375*	*	*-1.895*	*n.s.*
UC - CC	2004:02-2006:04	0.555	0.809	-0.254	*-4.927*	*	*-3.455*	*
UC - PIC	2004:02-2006:04	0.555	0.657	-0.102	*-4.119*	*	*-1.711*	*n.s.*
UC - BIV	2004:03-2006:04	0.496	0.549	-0.053	*-2.106*	*	*-0.966*	*n.s.*
BP	2002:04-2006:04	0.951	1.022	-0.070	*-2.802*	*	*-1.172*	*n.s.*
HP	2002:04-2006:04	0.951	0.934	**0.018**	*1.579*	*	*0.324*	*n.s.*
LIN	2002:04-2006:04	0.951	0.969	-0.018	*-0.649*	*	*-0.315*	*n.s.*
AV-All	2002:04-2006:04	0.951	0.872	**0.079**	*2.267*	*	*1.545*	*n.s.*
AV-PFA	2002:04-2006:04	0.951	1.006	-0.054	*-0.794*	*	*-0.917*	*n.s.*
AV-Org	2002:04-2006:04	0.951	0.965	-0.014	*-0.306*	*n.s.*	*-0.245*	*n.s.*
AV-UC	2002:04-2006:04	0.951	1.045	-0.093	*-2.541*	*	*-1.518*	*n.s.*
AV-Fil	2002:04-2006:04	0.951	0.970	-0.018	*-0.931*	*	*-0.321*	*n.s.*

Note: See Table A.

Table D – Inflation forecast accuracy with alternative reference series: 12-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 12 (three-years ahead)					
CAP-AV	2003:04-2006:04	1.430	1.397	**0.033**	*0.496*	*n.s.*	*0.303*	*n.s.*
CAP-TR	2003:04-2006:04	1.430	1.459	-0.030	*-0.375*	*n.s.*	*-0.264*	*n.s.*
EC - T	2001:04-2006:04	1.921	1.649	**0.272**	*2.273*	*	*3.461*	*n.s.*
EC - P	2005:03-2006:04	1.101	1.348	-0.247	*-2.939*	*	*-1.101*	*n.s.*
IMF	2001:04-2006:04	1.921	1.857	**0.065**	*0.775*	*	*0.732*	*n.s.*
OECD	2001:04-2006:04	1.921	1.943	-0.022	*-0.237*	*n.s.*	*-0.237*	*n.s.*
UC - CC	2005:02-2006:04	1.056	1.539	-0.483	*-8.621*	*	*-2.198*	*n.s.*
UC - PIC	2005:02-2006:04	1.056	1.199	-0.143	*-6.228*	*	*-0.835*	*n.s.*
UC - BIV	2005:03-2006:04	1.101	1.346	-0.245	*-3.851*	*	*-1.091*	*n.s.*
BP	2003:04-2006:04	1.430	1.432	-0.002	*-0.346*	*n.s.*	*-0.017*	*n.s.*
HP	2003:04-2006:04	1.430	1.380	**0.049**	*4.591*	*	*0.465*	*n.s.*
LIN	2003:04-2006:04	1.430	1.425	**0.005**	*0.163*	*n.s.*	*0.046*	*n.s.*
AV-All	2003:04-2006:04	1.430	1.322	**0.108**	*1.486*	*	*1.062*	*n.s.*
AV-PFA	2003:04-2006:04	1.430	1.418	**0.012**	*0.103*	*n.s.*	*0.108*	*n.s.*
AV-Org	2003:04-2006:04	1.430	1.364	**0.066**	*0.657*	*	*0.630*	*n.s.*
AV-UC	2003:04-2006:04	1.430	1.641	-0.211	*-3.103*	*	*-1.675*	*n.s.*
AV-Fil	2003:04-2006:04	1.430	1.411	**0.019**	*1.104*	*	*0.173*	*n.s.*

Note: See Table A.

Appendix V –Real GDP growth forecasting analysis: real time versus pseudo real time vintages

Table – Tests of equal real GDP growth forecast accuracy: real time versus pseudo real time vintages

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
forecast horizon h = 1 (one-quarter ahead)								
BP	2001:01-2006:04	1.574	3.291	-1.717	*-1.980*	*	*-12.520*	*
HP	2001:01-2006:04	1.574	7.195	-5.621	*-3.981*	*	*-18.749*	*
LIN	2001:01-2006:04	1.574	1.517	**0.058**	*0.866*	*	*0.910*	*n.s.*
BP pseudo	2001:01-2006:04	1.476	3.254	-1.778	*-2.146*	*	*-13.110*	*
HP pseudo	2001:01-2006:04	1.476	4.770	-3.293	*-3.049*	*	*-16.571*	*
LIN pseudo	2001:01-2006:04	1.476	1.394	**0.082**	*0.129*	n.s.	*1.415*	*n.s.*
forecast horizon h = 4 (one-year ahead)								
BP	2001:04-2006:04	0.838	0.842	-0.003	*-0.024*	*n.s.*	*-0.085*	*n.s.*
HP	2001:04-2006:04	0.838	7.750	-6.912	*-3.784*	*	*-18.729*	*
LIN	2001:04-2006:04	0.838	0.753	**0.085**	*1.622*	*	*2.375*	*n.s.*
BP pseudo	2001:04-2006:04	0.892	0.931	-0.039	*-0.230*	n.s.	*-0.882*	*n.s.*
HP pseudo	2001:04-2006:04	0.892	2.964	-2.073	*-1.200*	*	*-14.684*	*
LIN pseudo	2001:04-2006:04	0.892	1.043	-0.151	*-0.493*	n.s.	*-3.048*	*n.s.*
forecast horizon h = 8 (two-years ahead)								
BP	2002:04-2006:04	0.707	0.598	**0.108**	*0.986*	*	*3.077*	*n.s.*
HP	2002:04-2006:04	0.707	4.109	-3.402	*-2.639*	*	*-14.077*	*
LIN	2002:04-2006:04	0.707	0.599	**0.107**	*4.123*	*	*3.047*	*n.s.*
BP pseudo	2002:04-2006:04	0.933	0.678	**0.255**	*2.536*	*	*6.400*	*n.s.*
HP pseudo	2002:04-2006:04	0.933	0.815	**0.118**	*0.293*	n.s.	*2.464*	*n.s.*
LIN pseudo	2002:04-2006:04	0.933	2.531	-1.598	*-9.390*	*	*-10.734*	*
forecast horizon h = 12 (three-years ahead)								
BP	2003:04-2006:04	0.626	0.574	**0.052**	*0.469*	*n.s.*	*1.187*	*n.s.*
HP	2003:04-2006:04	0.626	1.363	-0.736	*-1.421*	*	*-7.025*	*n.s.*
LIN	2003:04-2006:04	0.626	0.579	**0.047**	*1.052*	*	*1.059*	*n.s.*
BP pseudo	2003:04-2006:04	0.820	0.646	**0.174**	*1.737*	*	*3.500*	*n.s.*
HP pseudo	2003:04-2006:04	0.820	0.539	**0.281**	*2.415*	*	*6.794*	*n.s.*
LIN pseudo	2003:04-2006:04	0.820	1.644	-0.824	*-7.558*	*	*-6.516*	*n.s.*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Appendix VI –Real GDP forecasting analysis: alternative reference series

Table A – Real GDP growth forecast accuracy with alternative reference series: 1-quarter ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 1 (one-quarter ahead)					
CAP-AV	2001:01-2006:04	1.454	1.457	-0.003	*-0.008*	*n.s.*	*-0.046*	*n.s.*
CAP-TR	2001:01-2006:04	1.454	1.495	-0.041	*-0.105*	*n.s.*	*-0.662*	*n.s.*
EC - T	2001:01-2006:04	1.454	2.014	-0.560	*-1.334*	*	*-6.673*	*
EC - P	2002:04-2006:04	1.226	1.278	-0.052	*-0.121*	*n.s.*	*-0.686*	*n.s.*
IMF	2001:01-2006:04	1.454	1.990	-0.536	*-1.253*	*	*-6.461*	*
OECD	2001:01-2006:04	1.454	1.745	-0.291	*-0.818*	*	*-4.002*	*
UC - CC	2002:03-2006:04	1.162	2.346	-1.184	*-1.816*	*	*-9.082*	*
UC - PIC	2002:03-2006:04	1.162	9.627	-8.465	*-2.429*	*	*-15.827*	*
UC - BIV	2002:04-2006:04	1.226	4.887	-3.661	*-2.785*	*	*-12.734*	*
BP	2001:01-2006:04	1.454	3.626	-2.172	*-2.519*	*	*-14.377*	*
HP	2001:01-2006:04	1.454	6.258	-4.804	*-3.538*	*	*-18.423*	*
LIN	2001:01-2006:04	1.454	1.384	**0.070**	*1.183*	*	*1.209*	*n.s.*
AV-All	2001:01-2006:04	1.454	4.286	-2.832	*-3.219*	*	*-15.858*	*
AV-PFA	2001:01-2006:04	1.454	2.492	-1.038	*-1.987*	*	*-9.995*	*
AV-Org	2001:01-2006:04	1.454	1.869	-0.415	*-1.068*	*	*-5.331*	*
AV-UC	2001:01-2006:04	1.454	1.652	-0.198	*-0.476*	*n.s.*	*-2.880*	*
AV-Fil	2001:01-2006:04	1.454	13.262	-11.808	*-4.794*	*	*-1.355*	*

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table B – Real GDP growth forecast accuracy with alternative reference series:4-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 4 (one-year ahead)					
CAP-AV	2001:04-2006:04	1.085	0.816	**0.270**	*1.023*	*	**6.947**	*
CAP-TR	2001:04-2006:04	1.085	1.063	**0.022**	*0.265*	*n.s.*	*0.444*	*n.s.*
EC - T	2001:04-2006:04	1.085	1.785	-0.699	*-2.222*	*	*-8.229*	*
EC - P	2003:03-2006:04	0.671	1.085	-0.414	*-1.225*	*	*-5.342*	*
IMF	2001:04-2006:04	1.085	1.849	-0.763	*-2.277*	*	*-8.671*	*
OECD	2001:04-2006:04	1.085	1.319	-0.234	*-1.268*	*	*-3.721*	*
UC - CC	2003:02-2006:04	0.795	0.848	-0.053	*-0.493*	*n.s.*	*-0.932*	*n.s.*
UC - PIC	2003:02-2006:04	0.795	4.201	-3.406	*-1.974*	*	*-12.161*	*
UC - BIV	2003:03-2006:04	0.671	0.704	-0.033	*-0.284*	*n.s.*	*-0.665*	*n.s.*
BP	2001:04-2006:04	1.085	1.060	**0.026**	*0.146*	*n.s.*	**0.511**	*n.s.*
HP	2001:04-2006:04	1.085	7.155	-6.070	*-2.951*	*	*-17.815*	*
LIN	2001:04-2006:04	1.085	0.987	**0.098**	*1.497*	*	**2.084**	*n.s.*
AV-All	2001:04-2006:04	1.085	0.896	**0.189**	*1.070*	*	**4.426**	*
AV-PFA	2001:04-2006:04	1.085	1.431	-0.345	*-1.648*	*	*-5.070*	*
AV-Org	2001:04-2006:04	1.085	1.583	-0.497	*-1.955*	*	*-6.600*	*
AV-UC	2001:04-2006:04	1.085	0.579	**0.507**	*1.052*	*	**18.385**	*
AV-Fil	2001:04-2006:04	1.085	1.604	-0.519	*-0.567*	*n.s.*	*-6.792*	*

Note: See Table A.

Table C – Real GDP growth forecast accuracy with alternative reference series:

8-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 8 (two-years ahead)					
CAP-AV	2002:04-2006:04	0.909	0.321	**0.588**	*1.998*	*	**31.148**	*
CAP-TR	2002:04-2006:04	0.909	0.84	**0.069**	*1.06*	*	*1.398*	*n.s.*
EC - T	2002:04-2006:04	0.909	1.134	-0.225	*-5.476*	*	*-3.370*	*n.s.*
EC - P	2004:03-2006:04	0.280	0.803	-0.523	*-7.737*	*	*-6.514*	*n.s.*
IMF	2002:04-2006:04	0.909	1.732	-0.823	*-2.960*	*	*-8.075*	*n.s.*
OECD	2002:04-2006:04	0.909	0.844	**0.065**	*0.400*	*n.s.*	*1.318*	*n.s.*
UC - CC	2004:02-2006:04	0.323	0.281	**0.042**	*0.724*	*n.s.*	*1.662*	*n.s.*
UC - PIC	2004:02-2006:04	0.323	2.105	-1.782	*-1.979*	*	*-9.312*	*
UC - BIV	2004:03-2006:04	0.280	0.726	-0.446	*-1.478*	*	*-6.143*	*n.s.*
BP	2002:04-2006:04	0.909	0.684	**0.225**	*1.602*	*	*5.598*	*n.s.*
HP	2002:04-2006:04	0.909	3.781	-2.872	*-2.009*	*	*-12.912*	*
LIN	2002:04-2006:04	0.909	0.780	**0.129**	*3.665*	*	*2.821*	*n.s.*
AV-All	2002:04-2006:04	0.909	0.425	**0.484**	*1.763*	*	**19.363**	*
AV-PFA	2002:04-2006:04	0.909	0.886	**0.024**	*0.162*	*n.s.*	*0.451*	*n.s.*
AV-Org	2002:04-2006:04	0.909	1.126	-0.217	*-1.529*	*	*-3.273*	*n.s.*
AV-UC	2002:04-2006:04	0.909	0.793	**0.116**	*0.326*	*n.s.*	**2.497**	*n.s.*
AV-Fil	2002:04-2006:04	0.909	2.693	-1.784	*-1.622*	*	*-11.260*	*n.s.*

Note: See Table A.

Table D – Real GDP growth forecast accuracy with alternative reference series:

12-quarters ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
			forecast horizon h = 12 (three-years ahead)					
CAP-AV	2003:04-2006:04	0.774	0.180	**0.594**	*3.198*	*	**42.940**	*
CAP-TR	2003:04-2006:04	0.774	0.715	**0.060**	*0.917*	*	*1.086*	*n.s.*
EC - T	2003:04-2006:04	0.774	1.007	-0.233	*-4.785*	*	*-3.007*	*n.s.*
EC - P	2005:03-2006:04	0.243	0.610	-0.367	*-9.982*	*	*-3.606*	*n.s.*
IMF	2003:04-2006:04	0.774	1.329	-0.555	*-4.268*	*	*-5.427*	*n.s.*
OECD	2003:04-2006:04	0.774	0.499	**0.275**	*2.472*	*	*7.164*	*n.s.*
UC - CC	2005:02-2006:04	0.318	0.307	**0.011**	*0.562*	*n.s.*	*0.251*	*n.s.*
UC - PIC	2005:02-2006:04	0.318	0.713	-0.394	*-3.318*	*	*-3.873*	*n.s.*
UC - BIV	2005:03-2006:04	0.243	0.647	-0.404	*-2.331*	*	*-3.743*	*n.s.*
BP	2003:04-2006:04	0.774	0.691	**0.084**	*0.762*	*	*1.576*	*n.s.*
HP	2003:04-2006:04	0.774	1.262	-0.488	*-0.864*	*	*-5.026*	*n.s.*
LIN	2003:04-2006:04	0.774	0.731	**0.043**	*0.834*	*	*0.763*	*n.s.*
AV-All	2003:04-2006:04	0.774	0.338	**0.436**	*2.554*	*	**16.756**	*
AV-PFA	2003:04-2006:04	0.774	0.647	**0.127**	*1.840*	*	*2.558*	*n.s.*
AV-Org	2003:04-2006:04	0.774	0.866	-0.091	*-1.442*	*	*-1.372*	*n.s.*
AV-UC	2003:04-2006:04	0.774	0.479	**0.295**	*1.055*	*	*8.018*	*n.s.*
AV-Fil	2003:04-2006:04	0.774	1.314	-0.540	*-0.933*	*	*-5.340*	*n.s.*

Note: See Table A.

Appendix VII – Results for sub-sample real GDP forecasting analysis

Table A – Tests of equal real GDP growth forecast accuracy: one quarter ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
			forecast horizon h = 1 (one-quarter ahead)			
CAP-AV	2001:01-2006:04	1.574	1.346	**0.228**	*0.617* n.s.	*4.061* *
	2001:01-2003:04	1.593	1.525	**0.068**	*0.138* n.s.	*0.539* n.s.
	2004:01-2006:04	1.555	1.168	**0.387**	*0.724 n.s.*	*3.976* *
CAP-TR	2001:01-2006:04	1.574	1.324	**0.250**	*0.594* n.s.	*4.539* *
	2001:01-2003:04	1.593	1.622	-0.029	*-0.054* n.s.	*-0.217* n.s.
	2004:01-2006:04	1.555	1.025	**0.530**	*0.857 n.s.*	*6.203* *
EC - T	2001:01-2006:04	1.574	1.879	-0.305	*-0.615 n.s.*	*-3.893* *
	2001:01-2003:04	1.593	2.567	-0.974	*-2.646* *	*-4.554* *
	2004:01-2006:04	1.555	1.191	**0.365**	*0.467 n.s.*	**3.674** *
EC - P	2002:04-2006:04	1.556	1.388	**0.167**	*0.324 n.s.*	**2.048** *
	2002:04-2005:04	1.062	1.459	-0.397	*-0.927* *	*-3.537* *
	2006:01-2006:04	3.161	1.160	**2.001**	*4.063* *	**6.901** *
IMF	2001:01-2006:04	1.574	1.853	-0.278	*-0.550 n.s.*	*-3.607* *
	2001:01-2003:04	1.593	2.501	-0.908	*-2.063* *	*-4.356* *
	2004:01-2006:04	1.555	1.205	**0.351**	*0.449 n.s.*	**3.494** *
OECD	2001:01-2006:04	1.574	1.643	-0.069	*-0.173 n.s.*	*-1.005 n.s.*
	2001:01-2003:04	1.593	2.371	-0.778	*-2.239* *	*-3.938* *
	2004:01-2006:04	1.555	0.915	**0.641**	*1.287* *	**8.402** *
UC - CC	2002:03-2006:04	1.469	2.244	-0.775	*-1.099* *	*-6.214* *
	2002:03-2005:04	0.986	2.512	-1.526	*-2.638* *	*-8.504* *
	2006:01-2006:04	3.161	1.307	**1.854**	*2.689* *	**5.671** *
UC - PIC	2002:03-2006:04	1.469	10.244	-8.775	*-2.524* *	*-15.418* *
	2002:03-2005:04	0.986	9.156	-8.170	*-1.872* *	*-12.492* *
	2006:01-2006:04	3.161	14.055	-10.894	*-7.099* *	*-3.100* *
UC - BIV	2002:04-2006:04	1.556	5.339	-3.783	*-2.719* *	*-12.046* *
	2002:04-2005:04	1.062	3.234	-2.173	*-2.591* *	*-8.732* *
	2006:01-2006:04	3.161	12.179	-9.018	*-8.414* *	*-2.962* *
BP	2001:01-2006:04	1.574	3.291	-1.717	*-1.980* *	*-12.520* *
	2001:01-2003:04	1.593	5.110	-3.517	*-4.616* *	*-8.259* *
	2006:01-2006:04	1.864	1.978	-0.114	*-0.937 n.s.*	*-0.230 n.s.*
HP	2001:01-2006:04	1.574	7.195	-5.621	*-3.981* *	*-18.749* *
	2001:01-2003:04	1.593	4.798	-3.205	*-2.067* *	*-8.016* *
	2004:01-2006:04	1.555	9.593	-8.037	*-5.463* *	*-10.054* *
LIN	2001:01-2006:04	1.574	1.517	**0.058**	*0.866* *	*0.910* n.s.
	2001:01-2003:04	1.593	1.496	**0.097**	*1.382* *	*0.777* n.s.
	2004:01-2006:04	1.555	1.537	**0.018**	*0.197 n.s.*	*0.142 n.s.*
AV-All	2001:01-2006:04	1.574	3.756	-2.182	*-2.235* *	*-13.941* *
	2001:01-2003:04	1.593	4.791	-3.198	*-3.237* *	*-8.010* *
	2004:01-2006:04	1.555	2.720	-1.165	*-0.776 n.s.*	*-5.139* *
AV-PFA	2001:01-2006:04	1.574	2.265	-0.691	*-1.119* *	*-7.323* *
	2001:01-2003:04	1.593	3.121	-1.528	*-2.740* *	*-5.875* *
	2004:01-2006:04	1.555	1.410	**0.146**	*0.158 n.s.*	*1.240 n.s.*
AV-Org	2001:01-2006:04	1.574	1.745	-0.171	*-0.373* n.s.	*-2.352* *
	2001:01-2003:04	1.593	2.414	-0.821	*-2.334* *	*-4.082* *
	2004:01-2006:04	1.555	1.076	**0.479**	*0.684 n.s.*	**5.345** *
AV-UC	2001:01-2006:04	1.574	1.527	**0.047**	*0.104* n.s.	*0.746* n.s.
	2001:01-2003:04	1.593	2.004	-0.411	*-0.614* n.s.	*-2.461* *
	2004:01-2006:04	1.555	1.049	**0.506**	*0.963* *	**5.786** *
AV-Fil	2001:01-2006:04	1.574	12.289	-10.715	*-4.221* *	*-20.926* *
	2001:01-2003:04	1.593	17.402	-15.809	*-7.348* *	*-10.902* *
	2004:01-2006:04	1.555	7.176	-5.621	*-2.026* *	*-9.399* *

Note: See Table B.

Table B – Tests of equal real GDP growth forecast accuracy: one year ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
		forecast horizon h = 4 (one-year ahead)				
CAP-AV	2001:04-2006:04	0.838	0.635	**0.203**	*0.878* *	**6.716** *
	2001:04-2003:04	1.313	0.614	**0.699**	*6.639* *	**10.255** *
	2004:01-2006:04	0.482	0.651	-0.169	*-4.539* *	*-3.116* *
CAP-TR	2001:04-2006:04	0.838	0.789	**0.049**	*0.675* *	*1.299* n.s.
	2001:04-2003:04	1.313	1.258	**0.055**	*0.477* n.s.	*0.395* n.s.
	2004:01-2006:04	0.482	0.438	**0.044**	*0.613 n.s.*	**1.207** *
EC - T	2001:04-2006:04	0.838	1.410	-0.572	*-1.921* *	*-8.520* *
	2001:04-2003:04	1.313	2.419	-1.106	*-8.319* *	*-4.114* *
	2004:01-2006:04	0.482	0.654	-0.172	*-0.456 n.s.*	*-3.158 n.s.*
EC - P	2003:03-2006:04	0.560	0.879	-0.319	*-0.938* *	*-5.080* *
	2003:03-2005:04	0.281	1.121	-0.839	*-5.545* *	*-7.490* *
	2006:01-2006:04	1.257	0.275	**0.982**	*8.772* *	**14.298** *
IMF	2001:04-2006:04	0.838	1.468	-0.629	*-1.922* *	*-9.007* *
	2001:04-2003:04	1.313	2.151	-0.838	*-3.446* *	*-3.505* *
	2004:01-2006:04	0.482	0.955	-0.473	*-0.943* *	*-5.946* *
OECD	2001:04-2006:04	0.838	1.001	-0.163	*-0.927* *	*-3.411* *
	2001:04-2003:04	1.313	1.778	-0.465	*-4.027* *	*-2.354* *
	2004:01-2006:04	0.482	0.418	**0.064**	*0.291 n.s.*	*1.851 n.s.*
UC - CC	2003:02-2006:04	0.638	0.665	-0.027	*-0.272 n.s.*	*-0.611 n.s.*
	2003:02-2005:04	0.413	0.559	-0.146	*-1.649* *	*-2.868* *
	2006:01-2006:04	1.257	0.958	**0.299**	*2.155* *	**1.248** *
UC - PIC	2003:02-2006:04	0.638	4.859	-4.221	*-1.861* *	*-13.030* *
	2003:02-2005:04	0.413	5.187	-4.774	*-1.649* *	*-10.124* *
	2006:01-2006:04	1.257	3.957	-2.700	*-19.278* *	*-2.729* *
UC - BIV	2003:03-2006:04	0.560	0.852	-0.292	*-2.071* *	*-4.797* *
	2003:03-2005:04	0.281	0.536	-0.255	*-1.235* *	*-4.756* *
	2006:01-2006:04	1.257	1.641	-0.384	*-5.315* *	*-0.936 n.s.*
BP	2001:04-2006:04	0.838	0.842	-0.003	*-0.024* n.s.	*-0.085* n.s.
	2001:04-2003:04	1.313	1.073	0.240	*0.949* *	*2.017* n.s.
	2004:01-2006:04	0.482	0.668	-0.186	*-6.452* *	*-3.344 n.s.*
HP	2001:04-2006:04	0.838	7.750	-6.912	*-3.784* *	*-18.729* *
	2001:04-2003:04	1.313	4.274	-2.961	*-8.839* *	*-6.235* *
	2004:01-2006:04	0.482	10.357	-9.875	*-7.166* *	*-11.442* *
LIN	2001:04-2006:04	0.838	0.753	**0.085**	*1.622* *	*2.375* n.s.
	2001:04-2003:04	1.313	1.127	**0.186**	*2.567* *	*1.485* n.s.
	2004:01-2006:04	0.482	0.472	**0.010**	*0.220 n.s.*	*0.242 n.s.*
AV-All	2001:04-2006:04	0.838	0.651	**0.187**	*1.270* *	**6.019** *
	2001:04-2003:04	1.313	0.969	**0.344**	*2.080* *	**3.195** *
	2004:01-2006:04	0.482	0.413	**0.069**	*0.494 n.s.*	*1.997 n.s.*
AV-PFA	2001:04-2006:04	0.838	1.095	-0.257	*-1.239* *	*-4.926* *
	2001:04-2003:04	1.313	1.757	-0.444	*-4.561* *	*-2.274* n.s.
	2004:01-2006:04	0.482	0.598	-0.117	*-0.350 n.s.*	*-2.336 n.s.*
AV-Org	2001:04-2006:04	0.838	1.232	-0.394	*-1.591* *	*-6.710* *
	2001:04-2003:04	1.313	2.031	-0.718	*-4.607* *	*-3.181* *
	2004:01-2006:04	0.482	0.632	-0.150	*-0.417 n.s.*	*-2.855 n.s.*
AV-UC	2001:04-2006:04	0.838	0.537	**0.301**	*0.854* *	**11.769** *
	2001:04-2003:04	1.313	0.214	**1.099**	*7.391* *	**46.201** *
	2004:01-2006:04	0.482	0.779	-0.297	*-2.002* *	*-4.580 n.s.*
AV-Fil	2001:04-2006:04	0.838	1.708	-0.870	*-1.075* *	*-10.693* *
	2001:04-2003:04	1.313	0.345	**0.968**	*3.916* *	**25.237** *
	2004:01-2006:04	0.482	2.730	-2.248	*-4.483* *	*-9.881* *

Note: Estimation sample starts in 1985Q1 and recursively ends in the period before the forecast evaluation sample. "MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table C – Tests of equal real GDP growth forecast accuracy: two years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
		forecast horizon h = 8 (two-years ahead)				
CAP-AV	2002:04-2006:04	0.707	0.234	**0.472**	*1.877* *	**34.319** *
	2002:04-2003:04	1.758	0.458	**1.300**	*17.567* *	**14.197** *
	2004:01-2006:04	0.269	0.141	**0.128**	*1.486* *	**10.885** *
CAP-TR	2002:04-2006:04	0.707	0.645	**0.062**	*1.092* *	*1.631* n.s.
	2002:04-2003:04	1.758	1.494	**0.264**	*6.679* *	*0.882* n.s.
	2004:01-2006:04	0.269	0.291	-0.022	*-0.933* *	*-0.918* *n.s.*
EC - T	2002:04-2006:04	0.707	0.907	-0.200	*-5.018* *	*-3.753* *n.s.*
	2002:04-2003:04	1.758	1.929	-0.171	*-1.909* *	*-0.443* *n.s.*
	2004:01-2006:04	0.269	0.481	-0.212	*-4.587* *	*-5.300* *n.s.*
EC - P	2004:03-2006:04	0.240	0.715	-0.475	*-6.873* *	*-6.641* *n.s.*
	2004:03-2005:04	0.314	0.887	-0.573	*-22.091* *	*-3.874* *n.s.*
	2006:01-2006:04	0.129	0.457	-0.328	*-3.166* *	*-2.871* *n.s.*
IMF	2002:04-2006:04	0.707	1.477	-0.770	*-2.958* *	*-8.867* *
	2002:04-2003:04	1.758	1.693	**0.065**	*3.037* *	*0.191* *n.s.*
	2004:01-2006:04	0.269	1.387	-1.118	*-8.750* *	*-9.676* *
OECD	2002:04-2006:04	0.707	0.650	**0.056**	*0.391* *n.s.*	*1.465* *n.s.*
	2002:04-2003:04	1.758	1.253	**0.505**	*8.022* *	*2.015* *n.s.*
	2004:01-2006:04	0.269	0.400	-0.131	*-2.244* *	*-3.934* *n.s.*
UC - CC	2004:02-2006:04	0.262	0.224	**0.038**	*0.828* *	*1.886* *n.s.*
	2004:02-2005:04	0.339	0.240	**0.098**	*2.284* *	*2.866* *n.s.*
	2006:01-2006:04	0.129	0.195	-0.067	*-2.046* *	*-1.364* *n.s.*
UC - PIC	2004:02-2006:04	0.262	2.282	-2.019	*-1.998* *	*-9.735* *
	2004:02-2005:04	0.339	3.492	-3.153	*-2.965* *	*-6.321* *
	2006:01-2006:04	0.129	0.164	-0.035	*-1.875* *	*-0.856* *n.s.*
UC - BIV	2004:03-2006:04	0.240	0.769	-0.529	*-1.499* *	*-6.877* *n.s.*
	2004:03-2005:04	0.314	1.232	-0.918	*-2.087* *	*-4.469* *n.s.*
	2006:01-2006:04	0.129	0.074	**0.055**	*1.792* *	*2.963* *n.s.*
BP	2002:04-2006:04	0.707	0.598	**0.108**	*0.986* *	*3.077* n.s.
	2002:04-2003:04	1.758	1.439	**0.319**	*2.341* *	*1.109* n.s.
	2004:01-2006:04	0.269	0.248	**0.020**	*0.204* *n.s.*	*0.988* *n.s.*
HP	2002:04-2006:04	0.707	4.109	-3.402	*-2.639* *	*-14.077* *
	2002:04-2003:04	1.758	1.417	**0.340**	*1.795* *	*1.201* n.s.
	2004:01-2006:04	0.269	5.230	-4.962	*-6.967* *	*-11.384* *
LIN	2002:04-2006:04	0.707	0.599	**0.107**	*4.123* *	*3.047* n.s.
	2002:04-2003:04	1.758	1.686	**0.072**	*1.193* *	*0.212* n.s.
	2004:01-2006:04	0.269	0.146	**0.122**	*4.291* *	**10.040** *
AV-All	2002:04-2006:04	0.707	0.314	**0.392**	*1.684* *	**21.240** *
	2002:04-2003:04	1.758	0.577	**1.181**	*10.198* *	**10.229** *
	2004:01-2006:04	0.269	0.205	**0.064**	*0.942* *	*3.757* *n.s.*
AV-PFA	2002:04-2006:04	0.707	0.696	**0.011**	*0.088* n.s.	*0.269* n.s.
	2002:04-2003:04	1.758	1.413	**0.345**	*9.668* *	*1.221* n.s.
	2004:01-2006:04	0.269	0.397	-0.128	*-1.680* *	*-3.877* *n.s.*
AV-Org	2002:04-2006:04	0.707	0.905	-0.198	*-1.566* *	*-3.722* n.s.
	2002:04-2003:04	1.758	1.521	**0.237**	*10.304* *	*0.777* n.s.
	2004:01-2006:04	0.269	0.648	-0.379	*-6.633* *	*-7.025* *
AV-UC	2002:04-2006:04	0.707	0.888	-0.182	*-0.692* *	*-3.479* n.s.
	2002:04-2003:04	1.758	0.855	**0.903**	*7.012* *	*5.283* n.s.
	2004:01-2006:04	0.269	0.902	-0.634	*-6.141* *	*-8.429* *n.s.*
AV-Fil	2002:04-2006:04	0.707	2.964	-2.257	*-2.311* *	*-12.947* *
	2002:04-2003:04	1.758	0.707	**1.051**	*4.426* *	*7.435* n.s.
	2004:01-2006:04	0.269	3.904	-3.636	*-11.241* *	*-11.175* *

Note: See Table B.

Table D – Tests of equal real GDP growth forecast accuracy: three years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
		forecast horizon h = 12 (three-years ahead)				
CAP-AV	2003:04-2006:04	0.626	0.128	**0.498**	*3.207* *	**50.579** *
	2003:04-2003:04	1.342	0.165	**1.178**	*0.000* n.s.	**7.145** *
	2004:01-2006:04	0.567	0.125	**0.442**	*3.123* *	**42.398** *
CAP-TR	2003:04-2006:04	0.626	0.576	**0.05**	*0.883* *	*1.137* n.s.
	2003:04-2003:04	1.342	1.169	**0.173**	*0.000* n.s.	*0.148* n.s.
	2004:01-2006:04	0.567	0.527	**0.040**	*0.707 n.s.*	*0.915 n.s.*
EC - T	2003:04-2006:04	0.626	0.832	-0.206	*-5.025* *	*-3.213 n.s.*
	2003:04-2003:04	1.342	2.276	-0.934	*0.000 n.s.*	*-0.410 n.s.*
	2004:01-2006:04	0.567	0.712	-0.145	*-7.937* *	*-2.445 n.s.*
EC - P	2005:03-2006:04	0.219	0.559	-0.340	*-9.647* *	*-3.647 n.s.*
	2005:03-2005:04	0.541	1.037	-0.496	*-11.677* *	*-0.956 n.s.*
	2006:01-2006:04	0.058	0.320	-0.262	*-9.925* *	*-3.274 n.s.*
IMF	2003:04-2006:04	0.626	1.145	-0.519	*-4.217* *	*-5.891 n.s.*
	2003:04-2003:04	1.342	1.446	-0.103	*0.000 n.s.*	*-0.071 n.s.*
	2004:01-2006:04	0.567	1.120	-0.554	*-4.684* *	*-5.930 n.s.*
OECD	2003:04-2006:04	0.626	0.384	**0.242**	*2.540* *	*8.201 n.s.*
	2003:04-2003:04	1.342	0.764	**0.578**	*0.000 n.s.*	*0.756 n.s.*
	2004:01-2006:04	0.567	0.352	**0.214**	*2.391* *	*7.298 n.s.*
UC - CC	2005:02-2006:04	0.285	0.272	**0.013**	*0.705 n.s.*	*0.335 n.s.*
	2005:02-2005:04	0.588	0.534	**0.054**	*1.722* *	*0.301 n.s.*
	2006:01-2006:04	0.058	0.075	-0.017	*-9.518* *	*-0.922 n.s.*
UC - PIC	2005:02-2006:04	0.285	0.720	-0.435	*-3.338* *	*-4.230 n.s.*
	2005:02-2005:04	0.588	1.501	-0.913	*-6.206* *	*-1.825 n.s.*
	2006:01-2006:04	0.058	0.135	-0.077	*-3.680* *	*-2.278 n.s.*
UC - BIV	2005:03-2006:04	0.219	0.641	-0.421	*-2.454* *	*-3.947 n.s.*
	2005:03-2005:04	0.541	1.886	-1.345	*-5.209* *	*-1.426 n.s.*
	2006:01-2006:04	0.058	0.018	**0.040**	*2.699* *	**9.107** *
BP	2003:04-2006:04	0.626	0.574	**0.052**	*0.469* n.s.	*1.187* n.s.
	2003:04-2003:04	1.342	2.018	-0.676	*0.000* n.s.	*-0.335* n.s.
	2004:01-2006:04	0.567	0.454	**0.113**	*0.857 n.s.*	*2.992 n.s.*
HP	2003:04-2006:04	0.626	1.363	-0.736	*-1.421* *	*-7.025* n.s.
	2003:04-2003:04	1.342	0.168	**1.175**	*0.000* n.s.	*7.013* n.s.
	2004:01-2006:04	0.567	1.462	-0.896	*-1.823* *	*-7.350 n.s.*
LIN	2003:04-2006:04	0.626	0.579	**0.047**	*1.052* *	*1.059* n.s.
	2003:04-2003:04	1.342	1.935	-0.592	*0.000* n.s.	*-0.306* n.s.
	2004:01-2006:04	0.567	0.466	**0.100**	*4.027* *	*2.586 n.s.*
AV-All	2003:04-2006:04	0.626	0.277	**0.350**	*2.583* *	**16.444** *
	2003:04-2003:04	1.342	0.002	**1.340**	*0.000* n.s.	**669.840** *
	2004:01-2006:04	0.567	0.299	**0.267**	*2.553* *	*10.711 n.s.*
AV-PFA	2003:04-2006:04	0.626	0.509	**0.117**	*1.932* *	*2.988* n.s.
	2003:04-2003:04	1.342	1.066	**0.276**	*0.000* n.s.	*0.259* n.s.
	2004:01-2006:04	0.567	0.463	**0.104**	*1.733* *	*2.691 n.s.*
AV-Org	2003:04-2006:04	0.626	0.710	-0.083	*-1.436* *	*-1.523* n.s.
	2003:04-2003:04	1.342	1.408	-0.066	*0.000* n.s.	*-0.047* n.s.
	2004:01-2006:04	0.567	0.651	-0.085	*-1.363* *	*-1.558 n.s.*
AV-UC	2003:04-2006:04	0.626	0.540	**0.086**	*0.392* n.s.	*2.070* n.s.
	2003:04-2003:04	1.342	0.922	**0.421**	*0.000* n.s.	*0.457* n.s.
	2004:01-2006:04	0.567	0.509	**0.058**	*0.256 n.s.*	*1.372 n.s.*
AV-Fil	2003:04-2006:04	0.626	1.399	-0.772	*-1.431* *	*-7.177* n.s.
	2003:04-2003:04	1.342	0.010	**1.333**	*0.000* n.s.	**135.894** *
	2004:01-2006:04	0.567	1.514	-0.948	*-1.870* *	*-7.509 n.s.*

Note: See Table B.

Appendix VIII – Sub-sample inflation forecasting analysis for the US

Table A – Tests of equal inflation forecast accuracy: one quarter ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
forecast horizon h = 1 (one-quarter ahead)						
Estimation sample starting in 1950						
BP	1965:04-2006:04	1.928	1.759	**0.169**	*0.953* *	*15.747* *
	1965:04-1984:04	3.299	2.982	**0.316**	*0.848* *	*8.172* *
	1985:01-2006:04	0.715	0.677	**0.038**	*0.906* *	*4.923* *
HP	1965:04-2006:04	1.928	1.763	**0.165**	*0.686* *	*15.304* *
	1965:04-1984:04	3.299	2.973	**0.325**	*0.641* *	*8.428* *
	1985:01-2006:04	0.715	0.693	**0.022**	*0.535* *	*2.786* *
LIN	1965:04-2006:04	1.928	1.754	**0.174**	*0.726* *	*16.269* *
	1965:04-1984:04	3.299	2.848	**0.451**	*0.903* *	*12.196* *
	1985:01-2006:04	0.715	0.786	-0.071	*-1.139* *	*-7.880* *
AV-Fil	1965:04-2006:04	1.928	1.765	**0.163**	*0.725* *	*15.155* *
	1965:04-1984:04	3.299	2.902	**0.396**	*0.844* *	*10.517* *
	1985:01-2006:04	0.715	0.758	-0.043	*-0.682* *	*-4.979* *
Estimation sample starting in 1985						
BP - 2001	2001:01-2006:04	0.845	0.808	**0.038**	*0.365 n.s.*	*1.074 n.s.*
	2001:01-2004:04	0.928	0.897	**0.031**	*0.208 n.s.*	*0.549 n.s.*
	2005:01-2006:04	0.658	0.604	**0.054**	*2.073* *	*0.621 n.s.*
HP - 2001	2001:01-2006:04	0.845	0.863	-0.018	*-0.102 n.s.*	*-0.473 n.s.*
	2001:01-2004:04	0.928	0.978	-0.051	*-0.203 n.s.*	*-0.826 n.s.*
	2005:01-2006:04	0.658	0.601	**0.057**	*1.829* *	*0.665 n.s.*
LIN - 2001	2001:01-2006:04	0.845	0.890	-0.044	*-0.326 n.s.*	*-1.145 n.s.*
	2001:01-2004:04	0.928	1.015	-0.087	*-0.456 n.s.*	*-1.375 n.s.*
	2005:01-2006:04	0.658	0.604	**0.054**	*0.784 n.s.*	*0.624 n.s.*
AV-Fil - 2001	2001:01-2006:04	0.845	0.867	-0.021	*-0.138* n.s.	*-0.569* n.s.
	2001:01-2004:04	0.928	0.990	-0.062	*-0.283* n.s.	*-1.009* n.s.
	2006:01-2006:04	1.864	1.978	-0.114	*-0.937 n.s.*	*-0.230 n.s.*

Note: Estimation sample starts in the first quarter of the year indicated in the corresponding panel and recursively ends in the period before the forecast evaluation sample.

"MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table B – Tests of equal inflation forecast accuracy: one year ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
	forecast horizon h = 4 (one-year ahead)					
	Estimation sample starting in 1950					
BP	1966:03-2006:04	1.993	1.632	**0.361**	*1.257* *	*35.575* *
	1966:03-1984:04	3.726	2.863	**0.864**	*1.550* *	*22.327* *
	1985:01-2006:04	0.518	0.585	-0.067	*-0.525* *	*-9.990* *
HP	1966:03-2006:04	1.993	1.690	**0.302**	*1.136* *	*28.803* *
	1966:03-1984:04	3.726	2.979	**0.747**	*1.442* *	*18.558* *
	1985:01-2006:04	0.518	0.594	-0.076	*-0.674* *	*-11.109* *
LIN	1966:03-2006:04	1.993	1.802	**0.191**	*0.555* *	*17.056* *
	1966:03-1984:04	3.726	3.017	**0.709**	*1.034* *	*17.384* *
	1985:01-2006:04	0.518	0.768	-0.250	*-1.715* *	*-28.286* *
AV-Fil	1966:03-2006:04	1.993	1.722	**0.271**	*0.787* *	*25.334* *
	1966:03-1984:04	3.726	2.899	**0.828**	*1.212* *	*21.131* *
	1985:01-2006:04	0.518	0.721	-0.203	*-1.708* *	*-24.454* *
	Estimation sample starting in 1985					
BP - 2001	2001:04-2006:04	0.522	0.484	**0.038**	*0.363 n.s.*	*1.568 n.s.*
	2001:04-2004:04	0.736	0.677	**0.059**	*0.389 n.s.*	*1.133 n.s.*
	2005:01-2006:04	0.124	0.125	-0.001	*-0.051 n.s.*	*-0.067 n.s.*
HP - 2001	2001:04-2006:04	0.522	0.647	-0.125	*-0.858* *	*-3.864* *
	2001:04-2004:04	0.736	0.926	-0.191	*-0.891* *	*-2.676* *
	2005:01-2006:04	0.124	0.127	-0.003	*-0.393 n.s.*	*-0.150 n.s.*
LIN - 2001	2001:04-2006:04	0.522	0.724	-0.203	*-1.216* *	*-5.594* *
	2001:04-2004:04	0.736	1.032	-0.296	*-1.183* *	*-3.730* *
	2005:01-2006:04	0.124	0.153	-0.029	*-3.017* *	*-1.326 n.s.*
AV-Fil - 2001	2001:04-2006:04	0.522	0.683	-0.162	*-0.938* *	*-4.728* *
	2001:04-2004:04	0.736	0.980	-0.244	*-0.942* *	*-3.240* n.s.
	2005:01-2006:04	0.124	0.132	-0.008	*-1.443* *	*-0.415 n.s.*

Note: See Table A.

Table C – Tests of equal inflation forecast accuracy: two years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
	forecast horizon h = 8 (two-years ahead)					
	Estimation sample starting in 1950					
BP	1967:03-2006:04	4.776	3.416	**1.360**	*1.621* *	*62.520* *
	1967:03-1984:04	9.473	5.878	**3.595**	*2.456* *	*42.810* *
	1985:01-2006:04	0.997	1.434	-0.438	*-0.958* *	*-26.554* *
HP	1967:03-2006:04	4.776	3.355	**1.421**	*1.781* *	*66.481* *
	1967:03-1984:04	9.473	5.892	**3.581**	*2.580* *	*42.540* *
	1985:01-2006:04	0.997	1.314	-0.317	*-0.952* *	*-21.006* *
LIN	1967:03-2006:04	4.776	3.891	**0.885**	*0.860* *	*35.716* *
	1967:03-1984:04	9.473	6.067	**3.406**	*1.883* *	*39.302* *
	1985:01-2006:04	0.997	2.140	-1.143	*-2.979* *	*-46.483* *
AV-Fil	1967:03-2006:04	4.776	3.415	**1.361**	*1.400* *	*62.555* *
	1967:03-1984:04	9.473	5.581	**3.892**	*2.278* *	*48.817* *
	1985:01-2006:04	0.997	1.673	-0.676	*-1.932* *	*-35.160* *
	Estimation sample starting in 1985					
BP - 2001	2002:04-2006:04	0.891	0.685	**0.206**	*6.044* *	*4.816* *n.s.*
	2002:04-2004:04	1.125	0.870	**0.255**	*3.898* *	*2.635* *n.s.*
	2005:01-2006:04	0.591	0.447	**0.144**	*3.490* *	*2.251* *n.s.*
HP - 2001	2002:04-2006:04	0.891	0.949	-0.058	*-0.923* *	*-0.983* *n.s.*
	2002:04-2004:04	1.125	1.318	-0.193	*-1.721* *	*-1.320* *n.s.*
	2005:01-2006:04	0.591	0.476	**0.115**	*2.666* *	*1.696* *n.s.*
LIN - 2001	2002:04-2006:04	0.891	1.456	-0.565	*-3.279* *	*-6.207* *
	2002:04-2004:04	1.125	1.797	-0.672	*-2.151* *	*-3.366* *n.s.*
	2005:01-2006:04	0.591	1.018	-0.427	*-3.021* *	*-2.937* *n.s.*
AV-Fil - 2001	2002:04-2006:04	0.891	1.146	-0.255	*-2.429* *	*-3.556* n.s.
	2002:04-2004:04	1.125	1.498	-0.373	*-1.955* *	*-2.242* n.s.
	2005:01-2006:04	0.591	0.693	-0.102	*-1.187* *	*-1.034* *n.s.*

Note: See Table A.

Table D – Tests of equal inflation forecast accuracy: three years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)		MSE-F	
forecast horizon h = 12 (three-years ahead)								
Estimation sample starting in 1950								
BP	1968:03-2006:04	7.384	6.977	**0.406**	*0.797*	*	*8.911*	*
	1968:03-1984:04	13.018	12.004	**1.014**	*1.360*	*	*5.576*	*
	1985:01-2006:04	3.110	3.164	-0.055	*-0.111*	*n.s.*	*-1.505*	*n.s.*
HP	1968:03-2006:04	7.384	6.541	**0.842**	*1.559*	*	*19.702*	*
	1968:03-1984:04	13.018	11.160	**1.859**	*2.066*	*	*10.992*	*
	1985:01-2006:04	3.110	3.038	**0.071**	*0.246*	*n.s.*	*2.046*	*n.s.*
LIN	1968:03-2006:04	7.384	6.303	**1.081**	*0.894*	*	*26.236*	*
	1968:03-1984:04	13.018	10.383	**2.635**	*1.675*	*	*16.753*	*
	1985:01-2006:04	3.110	3.208	-0.099	*-0.099*	*n.s.*	*-2.672*	*n.s.*
AV-Fil	1968:03-2006:04	7.384	6.217	**1.167**	*1.415*	*	*28.720*	*
	1968:03-1984:04	13.018	10.561	**2.457**	*2.032*	*	*15.352*	*
	1985:01-2006:04	3.110	2.921	**0.189**	*0.314*	*n.s.*	*5.618*	*
Estimation sample starting in 1985								
BP - 2001	2003:04-2006:04	1.409	1.374	**0.035**	*0.174*	*n.s.*	*0.304*	*n.s.*
	2003:04-2004:04	0.453	1.187	-0.734	*-16.708*	*	*-3.093*	*n.s.*
	2005:01-2006:04	2.092	1.508	**0.584**	*12.854*	*	*2.711*	*n.s.*
HP - 2001	2003:04-2006:04	1.409	1.611	-0.202	*-2.117*	*	*-1.504*	*n.s.*
	2003:04-2004:04	0.453	0.924	-0.471	*-16.232*	*	*-2.549*	*
	2005:01-2006:04	2.092	2.102	-0.010	*-0.106*	*n.s.*	*-0.033*	*n.s.*
LIN - 2001	2003:04-2006:04	1.409	2.332	-0.923	*-8.464*	*	*-4.749*	*n.s.*
	2003:04-2004:04	0.453	1.215	-0.762	*-6.939*	*	*-3.136*	*n.s.*
	2005:01-2006:04	2.092	3.130	-1.038	*-7.523*	*	*-2.322*	*n.s.*
AV-Fil - 2001	2003:04-2006:04	1.409	1.938	-0.529	*-6.124*	*	*-3.275*	n.s.
	2003:04-2004:04	0.453	1.241	-0.788	*-9.849*	*	*-3.175*	n.s.
	2005:01-2006:04	2.092	2.436	-0.344	*-3.633*	*	*-0.988*	*n.s.*

Note: See Table A.

Appendix IX – Sub-sample real GDP forecasting analysis in the US

Table A – Tests of equal real GDP growth forecast accuracy: one quarter ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
forecast horizon h = 1 (one-quarter ahead)						
Estimation sample starting in 1950						
BP	1965:04-2006:04	11.575	13.795	-2.221	*-0.935* *	*-26.402* *
	1965:04-1984:04	20.377	23.560	-3.184	*-0.639* *	*-10.405* *
	1985:01-2006:04	3.784	5.153	-1.369	*-1.802* *	*-23.109* *
HP	1965:04-2006:04	11.575	11.584	-0.010	*-0.010* *	*-0.141* *
	1965:04-1984:04	20.377	19.962	**0.415**	*0.197* *	*1.600* *
	1985:01-2006:04	3.784	4.170	-0.386	*-1.232* *	*-8.050* *
LIN	1965:04-2006:04	11.575	11.638	-0.064	*-0.108* *	*-0.901* *
	1965:04-1984:04	20.377	20.107	**0.270**	*0.224* *	*1.034* *
	1985:01-2006:04	3.784	4.144	-0.359	*-1.097* *	*-7.547* *
AV-Fil	1965:04-2006:04	11.575	13.224	-1.650	*-0.817* *	*-20.458* *
	1965:04-1984:04	20.377	22.160	-1.783	*-0.422* *	*-6.195* *
	1985:01-2006:04	3.784	5.316	-1.532	*-2.189* *	*-25.068* *
Estimation sample starting in 1985						
BP - 2001	2001:01-2006:04	3.320	4.099	-0.779	*-0.430 n.s.*	*-4.373* *
	2001:01-2003:04	5.042	6.174	-1.132	*-0.329 n.s.*	*-2.200* *
	2004:01-2006:04	1.440	1.835	-0.395	*-1.116* *	*-2.367* *
HP - 2001	2001:01-2006:04	3.320	4.004	-0.684	*-0.835* *	*-3.929* *
	2001:01-2003:04	5.042	6.455	-1.413	*-0.975* *	*-2.626* *
	2004:01-2006:04	1.440	1.329	**0.111**	*0.846 n.s.*	*0.921 n.s.*
LIN - 2001	2001:01-2006:04	3.320	3.491	-0.171	*-0.574 n.s.*	*-1.130* *
	2001:01-2003:04	5.042	5.089	-0.047	*-0.084 n.s.*	*-0.111 n.s.*
	2004:01-2006:04	1.440	1.747	-0.307	*-1.453* *	*-1.934* *
AV-Fil - 2001	2001:01-2006:04	3.320	3.752	-0.432	*-0.364* n.s.	*-2.648* *
	2001:01-2003:04	5.042	5.497	-0.454	*-0.200* n.s.	*-0.992* *
	2006:01-2006:04	1.864	1.978	-0.114	*-0.937 n.s.*	*-0.230 n.s.*

Note: Estimation sample starts in the first quarter of the year indicated in the corresponding panel and recursively ends in the period before the forecast evaluation sample.

"MSE(AR)" and "MSE(OG)" stand for Mean Squared Error (MSE) of the Autoregressive (AR) and Phillips curve with Output Gap (OG) models, respectively. "diff" refers to the difference between these two MSE. "MSE-t (conv)"reports (non-adjusted) conventional t-statistics. "MSE-F" reports the statistic proposed by Clark and McCracken (2005). In both cases critical values were computed using a Monte Carlo simulation. * (n.s.) = test statistics indicates (no) rejection of the null of equal accuracy at a significance level of 10% or better.

Table B – Tests of equal real GDP growth forecast accuracy: one year ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
		forecast horizon h = 4 (one-year ahead)				
		Estimation sample starting in 1950				
BP	1966:03-2006:04	5.457	5.613	-0.155	*-0.196* *	*-4.460* *
	1966:03-1984:04	9.888	9.702	**0.185**	*0.109* *	*1.414* *
	1985:01-2006:04	1.689	2.134	-0.445	*-1.556* *	*-18.157* *
HP	1966:03-2006:04	5.457	5.292	**0.165**	*0.274* *	*5.016* *
	1966:03-1984:04	9.888	8.753	**1.134**	*0.944* *	*9.590* *
	1985:01-2006:04	1.689	2.348	-0.660	*-2.505* *	*-24.441* *
LIN	1966:03-2006:04	5.457	6.199	-0.742	*-1.050* *	*-19.260* *
	1966:03-1984:04	9.888	10.092	-0.205	*-0.137* *	*-1.502* *
	1985:01-2006:04	1.689	2.887	-1.198	*-3.071* *	*-36.107* *
AV-Fil	1966:03-2006:04	5.457	6.692	-1.235	*-1.357* *	*-29.712* *
	1966:03-1984:04	9.888	10.260	-0.372	*-0.199* *	*-2.683* *
	1985:01-2006:04	1.689	3.658	-1.969	*-3.635* *	*-46.835* *
		Estimation sample starting in 1985				
BP - 2001	2001:04-2006:04	1.282	1.630	-0.348	*-0.873* *	*-4.272* *n.s.*
	2001:04-2003:04	2.112	3.162	-1.050	*-1.053* *	*-2.988* *n.s.*
	2004:01-2006:04	0.603	0.377	**0.226**	*0.615* *n.s.*	*6.602* *
HP - 2001	2001:04-2006:04	1.282	2.403	-1.121	*-1.364* *	*-9.330* *
	2001:04-2003:04	2.112	5.037	-2.925	*-6.476* *	*-5.226* *n.s.*
	2004:01-2006:04	0.603	0.247	**0.355**	*1.129* *	*15.785* *
LIN - 2001	2001:04-2006:04	1.282	1.314	-0.032	*-0.224* *n.s.*	*-0.490* *n.s.*
	2001:04-2003:04	2.112	2.228	-0.116	*-0.658* *n.s.*	*-0.469* *n.s.*
	2004:01-2006:04	0.603	0.566	**0.036**	*0.116* *n.s.*	*0.708* *n.s.*
AV-Fil - 2001	2001:04-2006:04	1.282	1.722	-0.440	*-1.774* *	*-5.112* n.s.
	2001:04-2003:04	2.112	3.144	-1.032	*-4.981* *	*-2.954* n.s.
	2004:01-2006:04	0.603	0.559	**0.044**	*0.116* *n.s.*	*0.867* *n.s.*

Note: See Table A.

Table C – Tests of equal real GDP growth forecast accuracy: two years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
	forecast horizon h = 8 (two-years ahead)					
	Estimation sample starting in 1950					
BP	1967:03-2006:04	3.471	3.138	**0.333**	*1.071* *	*16.684* *
	1967:03-1984:04	6.116	5.532	**0.585**	*0.905* *	*7.397* *
	1985:01-2006:04	1.343	1.211	**0.131**	*0.642* *	*9.438* *n.s.*
HP	1967:03-2006:04	3.471	3.337	**0.135**	*0.371* *	*6.331* *
	1967:03-1984:04	6.116	5.260	**0.857**	*1.425* *	*11.399* *
	1985:01-2006:04	1.343	1.789	-0.446	*-2.308* *	*-21.703* *
LIN	1967:03-2006:04	3.471	4.810	-1.338	*-2.226* *	*-43.691* *
	1967:03-1984:04	6.116	7.597	-1.481	*-1.145* *	*-13.643* *
	1985:01-2006:04	1.343	2.567	-1.224	*-2.708* *	*-41.487* *
AV-Fil	1967:03-2006:04	3.471	4.583	-1.112	*-1.765* *	*-38.088* *
	1967:03-1984:04	6.116	6.652	-0.535	*-0.450* *	*-5.633* *
	1985:01-2006:04	1.343	2.919	-1.576	*-3.001* *	*-46.971* *
	Estimation sample starting in 1985					
BP - 2001	2002:04-2006:04	0.719	0.886	-0.166	*-1.407* *	*-3.006* *n.s.*
	2002:04-2003:04	1.710	2.009	-0.299	*-2.787* *	*-0.744* *n.s.*
	2004:01-2006:04	0.269	0.375	-0.106	*-0.787* *n.s.*	*-3.114* *n.s.*
HP - 2001	2002:04-2006:04	0.719	1.630	-0.911	*-1.952* *	*-8.942* *n.s.*
	2002:04-2003:04	1.710	3.994	-2.284	*-19.845* *	*-2.859* *n.s.*
	2004:01-2006:04	0.269	0.556	-0.287	*-1.165* *	*-5.682* *n.s.*
LIN - 2001	2002:04-2006:04	0.719	0.752	-0.032	*-0.436* *n.s.*	*-0.689* *n.s.*
	2002:04-2003:04	1.710	1.608	**0.102**	*1.490* *	*0.318* *n.s.*
	2004:01-2006:04	0.269	0.362	-0.094	*-1.201* *	*-2.841* *n.s.*
AV-Fil - 2001	2002:04-2006:04	0.719	1.249	-0.529	*-1.974* *	*-6.784* n.s.
	2002:04-2003:04	1.710	3.195	-1.485	*-13.305* *	*-2.324* n.s.
	2004:01-2006:04	0.269	0.364	-0.095	*-1.402* *	*-2.873* *n.s.*

Note: See Table A.

Table D – Tests of equal real GDP growth forecast accuracy: three years ahead

Output gap model	Evaluation sample	MSE (AR)	MSE (OG)	diff	MSE-t (conv)	MSE-F
forecast horizon h = 12 (three-years ahead)						
Estimation sample starting in 1950						
BP	1968:03-2006:04	2.191	2.277	-0.086	*-0.568* *	*-5.802* *
	1968:03-1984:04	3.942	4.125	-0.184	*-0.533* *	*-2.937* *
	1985:01-2006:04	0.863	0.876	-0.013	*-0.202 n.s.*	*-1.251 n.s.*
HP	1968:03-2006:04	2.191	2.511	-0.320	*-1.227* *	*-19.513* *
	1968:03-1984:04	3.942	3.847	**0.095**	*0.208* *	*1.633* *
	1985:01-2006:04	0.863	1.498	-0.635	*-3.628* *	*-36.894* *
LIN	1968:03-2006:04	2.191	3.726	-1.535	*-3.139* *	*-63.026* *
	1968:03-1984:04	3.942	5.583	-1.641	*-1.622* *	*-19.404* *
	1985:01-2006:04	0.863	2.317	-1.454	*-4.226* *	*-54.595* *
AV-Fil	1968:03-2006:04	2.191	2.995	-0.804	*-1.842* *	*-41.056* *
	1968:03-1984:04	3.942	4.286	-0.344	*-0.423* *	*-5.304* *
	1985:01-2006:04	0.863	2.015	-1.152	*-3.078* *	*-49.737* *
Estimation sample starting in 1985						
BP - 2001	2003:04-2006:04	0.269	0.432	-0.164	*-2.288* *	*-4.541 n.s.*
	2003:04-2003:04	0.952	1.038	-0.086	*0.000 n.s.*	*-0.083 n.s.*
	2004:01-2006:04	0.207	0.377	-0.171	*-2.126* *	*-4.976 n.s.*
HP - 2001	2003:04-2006:04	0.269	1.061	-0.792	*-3.792* *	*-8.961 n.s.*
	2003:04-2003:04	0.952	1.834	-0.882	*0.000 n.s.*	*-0.481 n.s.*
	2004:01-2006:04	0.207	0.991	-0.784	*-3.486* *	*-8.706 n.s.*
LIN - 2001	2003:04-2006:04	0.269	0.385	-0.117	*-3.542* *	*-3.629 n.s.*
	2003:04-2003:04	0.952	0.778	**0.174**	*0.000 n.s.*	*0.223 n.s.*
	2004:01-2006:04	0.207	0.350	-0.143	*-5.455* *	*-4.496 n.s.*
AV-Fil - 2001	2003:04-2006:04	0.269	0.734	-0.465	*-3.201* *	*-7.607* n.s.
	2003:04-2003:04	0.952	2.055	-1.103	*0.000* n.s.	*-0.537* n.s.
	2004:01-2006:04	0.207	0.614	-0.407	*-3.075* *	*-7.298 n.s.*

Note: See Table A.


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