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Some stylised facts on the euro area business cycle

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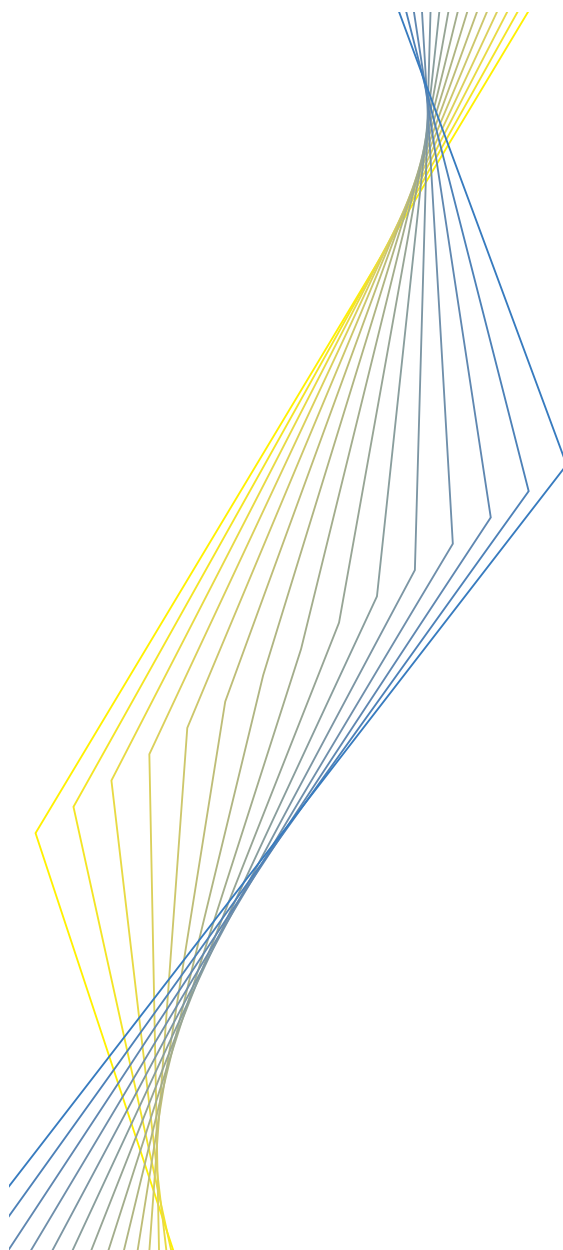
**SOME STYLISTED FACTS
ON THE EURO AREA
BUSINESS CYCLE**

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BENOÎT MOJON**

December 2001

**EUROSYSTEM MONETARY
TRANSMISSION
NETWORK**

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* Directorate General Research, European Central Bank.

¹ This paper is part the Eurosystem Monetary Transmission Network (MTN) project. It reflects the opinion of the authors and not necessarily the view of the European Central Bank or the Eurosystem. We are extremely grateful to Alistair Dieppe and Jérôme Henry for providing us the data from the euro area Area Wide Model, as well as for sharing their procedures to built historical series for the national account variables; and to Don Bredin, Sophocles Brissimis, Raf Wouters and Luis Farinha for providing us quarterly national account data for their own country. We want to thank Frank Smets, Luca Sala, participants in the MTN and especially Anil Kashyap, Catherine Fuss and Ignazio Angeloni for comments on a previous draft of the paper. All remaining errors are ours.

The Eurosystem Monetary Transmission Network

This issue of the ECB Working Paper Series contains research presented at a conference on “Monetary Policy Transmission in the Euro Area” held at the European Central Bank on 18 and 19 December 2001. This research was conducted within the Monetary Transmission Network, a group of economists affiliated with the ECB and the National Central Banks of the Eurosystem chaired by Ignazio Angeloni. Anil Kashyap (University of Chicago) acted as external consultant and Benoît Mojon as secretary to the Network.

The papers presented at the conference examine the euro area monetary transmission process using different data and methodologies: structural and VAR macro-models for the euro area and the national economies, panel micro data analyses of the investment behaviour of non-financial firms and panel micro data analyses of the behaviour of commercial banks.

Editorial support on all papers was provided by Briony Rose and Susana Sommaggio.

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Abstract: This paper presents stylised facts about the business cycle of the euro area. The results suggest that the stylised facts for the euro area economy and the US are very similar. The magnitude of the fluctuations in consumption, investment, prices, inflation, interest rate, monetary aggregates relative to the fluctuations of GDP are very similar in the two monetary unions. There is also high synchronicity of the national cycles and the euro area aggregate cycle. This synchronicity is observed for the main GDP components as well as for interest rates and it is particularly high for the largest countries of the euro area and for countries of the core ERM. These results are not sensitive to a different aggregation method chosen to build euro area aggregates. However, we do find differences between the euro area and the member countries when looking at what variables are predicting inflation or GDP.

JEL Classification: E42, E50

Keywords: Euro area, business cycle, monetary policy

NON-TECHNICAL SUMMARY

This paper compiles a set of stylised facts about the euro area business cycle. We analyse the business cycle properties of up to 20 economic time series for each country, as well as for 24 series of the euro area aggregate. The variables belong to 6 main categories: GDP components and other activity indicators such as industrial production and unemployment, price level indices, money and credit aggregates, market and retail bank interest rates, exchange rate and asset prices.

The first part of the paper analyses the “business cycle component” of the variables. The latter is obtained by band pass filtering the time series, following Baxter and King (1999), to eliminate all frequencies of the data that are higher or lower than business cycle frequencies. In effect, we compute a symmetric moving average of the time series. And the weights of this moving average are chosen so that we keep the variations of periods ranging from 6 to 40 quarters, i.e. periods where the business cycle adjustments take place. We then report the standard deviation of the cross-correlation with respect to GDP of the business cycle component of the variables.

The main finding is that the business cycle of the euro area aggregate is highly comparable to the US business cycle in a number of respects. The phase of the business cycle, the magnitude of consumption and investment fluctuations relative to GDP's, the leading, coincident or lagging correlations of GDP with consumption, investment, prices, inflation, interest rates, and finally the persistence of prices are very similar in the US and in the euro area. These results in our view suggest that the business cycle of the euro area may be studied, to a great approximation, following approaches and models already used for the US economy.

We also find that the business cycle fluctuations of GDP, consumption and investment of most euro area countries were, even before stage three of EMU, highly synchronised with, respectively, the business cycle fluctuations of GDP, consumption and investment of the euro area.

The second part of the paper briefly describes the leading indicator properties with respect to inflation and to GDP of selected macroeconomic time series, both at the euro area level and at the country level. We find that although some variables, such as economic activity indicators and private loans have predictive power with respect to inflation at the euro area level, these same variables usually have the same leading properties at the national level only for a minority of countries. Difference between the euro area and the member countries are also observed when looking at what variables are predicting GDP. The lack of consistency between the countries and their euro area level aggregate calls for further research to understand where these asymmetries may originate.

1. Introduction

Nearly three years into the life of the European Central Bank there is still relatively little known about the economic properties of the euro area. This paper compiles a set of stylised facts about the business cycle based on historically reconstructed data for the entire area. We also report similar statistics for 10 of the 12 countries that now form the euro area¹. As a reference we compare our results to the US, the world's other large currency area. Three conclusions emerge from this exercise. The most striking is that the stylised facts for the euro area economy and the US are extremely comparable. The magnitude of the fluctuations in consumption, investment, prices, inflation, interest rate, monetary aggregates relative to the fluctuations of GDP are very similar in the two monetary unions. And so are the patterns of cross correlation of GDP components, prices and interest rates with respect to GDP.

There is also high synchronicity of the national cycles and the euro area aggregate cycle. This synchronicity is observed for the main GDP components as well as for the short term interest rate and it is particularly high for the largest countries of the euro area and for countries of the core ERM. Finally, we document several consistent patterns about the lead-lag relationships amongst these data (at both the area wide and national level). Interest rates lead the business cycle. The business cycle in turn leads inflation.

The analysis is conducted in five steps, which set the structure of the paper. First, we explain how we filter the data to extract their business cycle frequencies. Second, we briefly review the data we use and describe how the area wide data are constructed. Third, we evaluate the synchronicity of the euro area aggregate cycle with the national cycles and the US cycle. Fourth, we compare the euro area business and US business cycles. Fifth, we briefly describe leading indicator properties with respect to inflation and to GDP of selected macroeconomic time series, both at the euro area level and at the country level. The last section concludes.

2. Our favourite filter for the European macroeconomic time series

To facilitate a comparison with Stock and Watson's (2000) comprehensive study of the US business cycle, we de-trended our data using a band pass filter developed by Baxter and King (1999) (BK). As Stock and Watson note this transformation keeps «...those movements in the series associated with periodicity within a certain range of business cycle duration.»². We deviate in two slight ways from Stock and Watson. First, we allow the upper bound on the length of the business cycle to be 40 quarters (10 years) instead of 32 (8 years). This is because the business cycles in several European countries seems to last more than

¹ There are no quarterly national accounts available for Luxembourg and Irish quarterly national account data are available for a too small sample period.

² See appendix 2 for a brief discussion on recent literature on filtering and a description of the Baxter and King band pass filter.

eight years. Stock and Watson refer to the NBER business cycle reference dates whereby most cycles from trough to trough experienced by the US economy last between 18 months and 8 years. Considering that the euro area only saw three recessions over the last thirty years, we felt it was appropriate to include «frequencies» as low as 10 years into our «business cycle component».

We see several other reasons why this seems reasonable. First, the associate trend we extract is less likely to have a cyclical pattern (Rotemberg, 1999). Similarly the fact that the last two US «cycles» lasted more than eight years suggests that this may be appropriate for the recent US experience as well. So, we also apply this «extended business cycle length» filter to the US macroeconomic time series. Finally, looking at the spectral densities of euro area and US GDP growth quarterly time series (Chart 1) for the last three decades further supports our choice.³ We can see for both the euro area and for the US that the densities are the highest around low frequencies, and not around frequencies that correspond to cycles of 4 to 6 years. Second, the truncation of the band pass filter is done with 8 leads and lags (instead of 12 for Baxter and King and Stock and Watson). As many of the series we consider start only in the 1980's we thought we could not afford a 12 leads and lags truncation because it would mean losing six years of data. As a matter of fact, we applied the chosen filter to the longest available sample for each series. National accounts series, exchange rates and interest rates, start in most of the countries and for the euro area in the early or the mid-seventies⁴, while the monetary and credit aggregates start in the early eighties⁵.

The sensitivity analysis in appendix 1 presents the effects of these two deviations from the Stock and Watson version of the Baxter and King filter and also compares the outcome with the Hodrick-Prescott filter applied to the a number of five different macroeconomic time series. The main conclusion is that the differences across the different filters seem negligible.

3. Data

We analyse the business cycle components of up to 20 economic time series for each country, as well as for 24 series of the euro area aggregate⁶. The variables⁷, belong to 6 main

³ These spectral densities were estimated with a Bartlett window of width 8. We thank Luca Sala for providing these estimates.

⁴ Data are generally available up to 2000q3. However, the starting date differs across countries: 1970q1 for DE, ES, FR and IT; 1975q1 for FI; 1976q for AT and NL; 1980q1 for BE, GR and PT. For the EU-11 aggregate the data are available from 1970q1 to 1998q4.

⁵ For M1 and M3 the starting date is 1980q1. For private loans the starting date for the euro area is 1982q2 and either 1980q1 (DE, ES, FI, FR, and PT) or 1982q2 (AT, IT, NL, BE, GR).

⁶ We are grateful to Jérôme Henry and to Alistair Dieppe, of the Econometric Modelling Division of the ECB for giving us their data for the EU-11 aggregates and for sharing their procedures to built historical series for the national account variables.

⁷ Availability and source are listed in Appendix 2.

categories: GDP components and other activity indicators such as industrial production and unemployment, price level indices, money and credit aggregates, market and retail bank interest rates, exchange rate and asset prices.

Euro area variables are actually EU-11 aggregates (euro area less Greece, which joined EMU in 2001). These variables come from the current version of the Euro Area Wide model (AWM), which has been constructed by the staff of the Econometric Modelling Division of the ECB. The aggregation has been done with fixed weights, based on 1995 PPP GDP⁸. As a robustness check we also report results series for GDP and the GDP deflator that are aggregated using exchange rate based variable weights as in Beyer, Doornik and Henry (2001). All series, except the unemployment rate and interest rates, have been transformed into logarithms before being filtered. The availability and the quality of the data differ from country to country. For instance, a majority of series is available back to 1970, while monetary aggregate series and retail bank interest rates are available only back to 1980. But there are exceptions to these general rules. An exhaustive report of the exact sources and time coverage for each time series is given in the data appendix. Table A2 in appendix 2 provides a concise summary of this information.

4. The business cycle in the euro area

We now address three issues in turn: the historical pattern of the euro area business cycle; the lack of relevance of the aggregation methods used for constructing the aggregate data; and the similarity between the cross-correlations of key macroeconomic time series in the euro area and in the US.

4.1 The historical pattern of the euro area business cycle

Euro area and US growth and business cycle

To start with, we compare the movements in GDP for the euro area with those for the US. The spectral density of the euro area reaches its pick for cycles of five years duration, while for the US, the maximum is reached at zero frequencies (Chart 1). This is at odds with the common wisdom that Europe is less cyclical than the US (Forni and Reichlin, 2001), which is typically based on sample periods that (as shown in Chart 2) do not include the last years of the «New Economy» in the US. Actually, as will be seen in section 4, recent economic

⁸ For euro area variables, a complete description of the methodology and the variables used to construct the AWM data base it is suggested to look at the Annex 2 of Fagan, Henry and Mestre (2001). This represents the current version of the area-wide model for the euro area that has been developed by the ECB staff in the Econometric Modelling Division.

development in the US have been much less cyclical than in the euro area and than they used to be.⁹

The top panel of Chart 3 shows the growth rate of GDP and the lower panel shows its business cycle component as obtained by the Baxter and King band-pass filter (BX-KG (6,40,8)) described in section 2.

In both economies GDP sustained a stable and prolonged period of growth. The average annual GDP growth in the US from 1970 to 1999 is slightly higher (3.3 % against 2.7 %). However, for the same period, the growth of the population has been much larger in the US (34 % in total or nearly 1% per annum) than in the euro area (11 % in total or 0.3 % per annum).

It also appears that, long periods of increases and short periods of declines of output characterise these two economies. There are some similarities in the timing of their cyclical patterns as well. They both fell into recession between 1973 and 1975 and the two US recessions of the early 1980's are mirrored by a slowdown in the euro area. There was some divergence in the 1990's, as the American recession in 1991 during the Gulf war did not coincide with a slowdown in the euro area (which was buoyed by the fiscal stimulus in Germany following reunification). However, 1993 was the most severe recession of the post WWII era for many European countries.

The phases of the two growth cycles are quite similar. The US business fluctuations are more volatile for most of the sample period, but this seems to have changed after 1992. The US cycle tends to lead the euro area cycle. The latter two observations are also quantified in the first panel of Table 1. The standard deviation of the US GDP business cycle fluctuations is 50 % higher than the euro area one. And, the cross-correlation of the two business cycles is the highest between US GDP (t) and euro area GDP (t+2 or t+3) which is consistent with the EU-11 business cycle lagging the US cycle by two to three quarters¹⁰.

Synchronicity of the euro area and EMU countries business cycles

We also briefly review the correlations of each national business cycle with the aggregate euro area cycle. There are already many studies that have addressed this issue with various methodologies, and reviewing them all is beyond the task of this section. But two recent studies are particularly relevant for this exercise.¹¹

⁹ Mac Donnel and Perez-Quiros (2000) have already described this result.

¹⁰ The leads and lags of 2 and 3 quarters are not reported in Table 1 for the sake of tractability and readability. These results are available from the authors upon request.

¹¹ First, empirical studies on optimal currency areas have compiled the country pair-wise cross-correlation of VAR based supply and demand shocks. For a survey of this literature, see Bayoumi and Eichengreen (1996). Second, some studies aim at characterising a European business cycle by weighting countries business cycles. A recent example of this line of research is the paper of Altissimo et al. (2001). The authors, apply dynamic factor models to selected series from six largest euro area countries, and obtain an indicator that tracks the euro area GDP relatively closely. See also Artis et al.

First, Reichlin and Forni (2001) have shown that when the business cycle of European regions is decomposed into a European component, a national component and a regional component. The European component had a larger role than the national ones. The share of the European regions GDP variance that is explained by the common European business cycle range between 40 % and 60 % for most countries of the euro area (Portugal and Greece being the exception) while the share of the national components range between 20 and 35 %. The rest of the variance is driven by the regions' idiosyncratic components.

However, Wynne and Koo (2000) show that the cross correlation between the business cycles (either of GDP, of prices or of employment) of the 12 US Federal Reserve districts are much higher than the cross-correlation of the business cycles of the 15 EU countries¹². Unfortunately we do not have data to carry out this comparison with the Federal Reserve districts before they integrated a formal monetary union in the beginning of the twentieth century. It is likely that monetary union, as conjectured by Bentoglio, Fayolle and Lemoine (2001), will lead to an increase in the synchronicity of the business cycle of countries participating in EMU.¹³

To explore these issues, the top panel of table 1 reports cross-correlations of the country cycles and the aggregate cycle. The contemporaneous correlations are relatively high, between 0.7 and 0.92 for most of the countries. The exceptions, not surprisingly, where the correlation drops to around 0.4, are for the countries in periphery such as Greece, Portugal or Finland. Some specific periods where each country deviated from the rest of the euro area can be seen on Chart 4, which reports the business cycle component of each country GDP together with the business cycle component of the euro area GDP. For example, during the Germany reunification, the German cycle diverged significantly from the European one. In France, the most striking deviation occurred around the fiscal expansion undertaken by the socialist government in 1981. The Spanish business cycle appears to "converges" with the area cycle after 1986, the date when Spain joined the European Community. The Finish financial deregulation of the second part of the 1980's and the trade shock after the collapse of the Soviet Union mark the largest deviations of the Finnish business cycle. Italy, although highly synchronised with the area business cycle throughout the sample period, experienced much larger fluctuations in the 1970s. This is likely due to the heavy Italian reliance on imported oil. The Italian fluctuations subsequently decreased as the share of energy related imports declined (by around 40 %) during the 1980s.

(1999). Third, the literature on international business cycle has produced a number of results on the synchronicity of European business cycles. See for instance the references in Baxter (1995).

¹² This might also explain why in Chart 2, both the growth rate and the Baxter-King based Business Cycle Component of GDP of the Eu11 and USA are not synchronised since 1992.

¹³ Bentoglio, Fayolle and Lemoine show that interest shocks tended to be asymmetric across countries in the period prior to EMU. Mojon and Peersman (2001) also find evidence the monetary policy shocks were asymmetric across countries in the early nineties, around the EMS crisis. Angeloni and Dedola (1999) show that the synchronicity between European countries business cycles has increased over time. Finally, Frankel and Rose (2001) show that monetary unions have a stimulating impact on trade amongst its members.

The second and the third panels in Table 1 report measures of the synchronisation between respectively consumption and investment of each country with respectively consumption and investment of the euro area aggregate. Both consumption and investment of most European countries are highly correlated with euro area consumption or investment. We also notice that the US norm of consumption being less volatile than GDP and investment being more volatile do not hold for all countries. This puzzling finding, which can partly be explained by the fact that private consumption includes durable consumption is, however, not unusual. Baxter (1995) reports consumption fluctuations are larger than GDP fluctuations for Japan and for the UK and nearly as large for France.

Finally, results on the correlation of the cyclical component of each country's GDP, investment and consumption with US GDP is also reported in Table 1. High correlations are present in Germany, Italy, France and in the Netherlands.

4.2 Aggregation

We now show evidence that the aggregation method chosen to build euro area aggregates has only second order implications for the business cycle properties of the euro area GDP. As discussed in section 3, the aggregation of country macroeconomic variables into EU-11 aggregate variable is based on summing national growth rates with weights that are proportional to PPP GDP in 1995. The major drawback of this approach to aggregation is that it may introduce distortions in periods of large changes in "intra euro area" exchange rates. Another aggregation approach, using weights that vary over time with the exchange rates, has been proposed by Beyer, Doornik and Hendry (2001) (BDH aggregation in Table 2).

Table 2 shows the cross-correlation of the band pass filtered euro area GDPs obtained with the two alternative aggregation methods over the sample period from 1980 to 1999 with the benchmark euro area GDP filter for the full sample of the last 30 years. It also reports their respective standard deviations. Both the standard deviation and the cross-correlations of the two measures of EU-11 GDP indicate that the type of weights used in the aggregation have a very small impact on the business cycle fluctuations of the aggregate. This is also reflected in the similarity of the standard deviation and the cross-correlation vis-à-vis GDP of the GDP deflator, aggregated following the two methods. The neutrality of the aggregation method (fixed versus exchange rates based variable rates) comes from the fact that they were no major growth or inflation asymmetries within the euro area at the time of the largest intra-

exchange rate fluctuations. Or at least that these asymmetries did not occur for countries that have a large enough weight in the euro area aggregate¹⁴.

Finally Table 2 also reports evidence of the very high correlation of the euro area GDP aggregate with two other key indicators of economic activity: industrial production and the unemployment rate. It appears that, as is observed for the US by Stock and Watson (1999) industrial production is largely coincident with GDP while the unemployment rate is lightly lagging.

4.3 Business cycle fluctuations for the euro area economy and comparison with the US economy

Similarities with the US business cycle

The business cycle properties of a number of euro area variables (Table 3a) are very similar to those observed in the US economy (Table 3b), both in terms of the magnitude of the fluctuations relative to the ones of GDP and in terms of leading, coincident or lagging correlations with GDP¹⁵.

First, consumption and investment series are pro-cyclical while inventories, which in many countries of the euro area are measured as a residual in the national accounts¹⁶, are slightly lagging aggregate activity (usually by two to three quarters). Consumption is smoother than output while investment is more than twice as volatile as output.¹⁷ Second, the levels of the CPI and GDP deflator are counter-cyclical, while inflation is pro-cyclical. However the correlations with current GDP are hardly significant¹⁸. The cross-correlation of price levels with future GDP are much larger. Higher price levels are followed, two to three quarters later by a decline in GDP. Third, the persistence of the price levels business cycle components is very high.

Fourth, all interest rates (short-term nominal, short term real and long term nominal) are pro-cyclical, while the yield curve (long term rate – short-term rate) is counter cyclical. The cross-correlation reaches a maximum positive value near lag zero or a small negative lag. Fifth, all interest rates lead GDP slowdowns by about a year. Among the three interest rates, the nominal short-term interest rate appears to have the highest negative correlation with

¹⁴ Labhard, Weeken and Westaway (2001) also conclude that alternative aggregation methods Do not seem to matter a lot for econometric analysis.

¹⁵ We check that GDP itself is correlated with two other indicators of aggregate activity: the index of industrial production and the unemployment rate. Industrial production has correlation to GDP of 0.96, while the unemployment rate has a correlation to GDP of - 0.81.

¹⁶ With the exception of Italy, France and the Netherlands where inventory series are also based on surveys.

¹⁷ We do not report statistics for imports and exports vis-à-vis non- euro area countries because they are available only back to the late 1980's.

¹⁸ The standard deviation of the correlation coefficient is about 0,1 for series available back to 1970 and about 0,16 for variables available only since 1980.

future GDP. Finally, a appreciation (depreciation) of the US dollar–DM exchange rate leads economic activity in the euro area (the US) by about 3 quarters.

Differences with the US business cycle

There are also some differences between the two economies. First, the evidence that M1 leads GDP, by about a year, is much stronger in the euro area than in the US. Second, stock prices are leading GDP by 2 quarters in the US but not in the euro area. Third, real estate prices are lagging GDP in the euro area but not in the US

5. Forecasting properties with respect to inflation and GDP of selected variables at the euro area and at the country level

Given its mandate to insure price stability over the medium, it is of primary interest for the ECB to monitor developments in variables that may give early warning with respect to future price developments. Because we find that GDP is among the best leading indicators of inflation, we also describe which variables are leading GDP itself. In spite of the fact that the ECB mandate is defined for the euro area aggregate, it makes sense to investigate whether country level data should play a role in forecasting exercises (Marcellino, Stock and Watson, 2001)¹⁹. Moreover, the euro area level statistics are still much more under development than at the country level.

We restrict the analysis to reporting three very simple statistics on the ability of selected variable to predict inflation or output²⁰. The first one is the cross-correlations between the business cycle component of selected variables with the business cycle component of inflation (GDP) four quarters ahead. The second and the third one are based on regressions of inflation (GDP) on four of its lags and four lags of the selected variable. Using these regressions we compute the p-value of the fisher test of the hypothesis that four lags of the selected variables are not different from zero and the T-statistic of the sum of the four lags of the selected variable.

5.1 Which variables predict inflation in the euro area and in EMU countries?

Based on the three simple statistics just described, Table 4 shows to what extent, 14 macroeconomic time series predict CPI inflation in the euro area, 10 of the euro area countries and the US. The selected variables can be put in four categories. First, we

¹⁹ These authors compare the forecasting performance of the aggregate euro area wide forecasts with aggregating country-specific forecasts. They concluded that pooling country-specific forecasts outperforms directly modelling euro-area aggregates. And consequently that country-specific details matters for forecasting euro area inflation.

²⁰ A number of recent papers investigate leading indicators for euro area inflation and business cycle: Angelini., Henry and Mestre (2001a and 2001b), Nicoletti-Altimari (2000), Cristadoro, Forni and Reichlin (2001), Marcellino, Stock and Watson (2001).

consider indicators of economic activity that may indicate the state of demand (GDP, consumption or investment) or the existence of tensions on the labor market (unemployment). Second, we consider monetary and credit aggregate. Third, we focus on the imported inflation (prices of imports) and some of their determinants: the exchange rate (real effective exchange rate and US dollar exchange rate) and the price of commodities (world price indices with and without oil). Finally, we look at the short-term interest rates, which is controlled by the central bank and at the long-term interest rate and at the yield curve.

The main result is that no macroeconomic time series predicts inflation **both** at the euro area level and for a large majority of countries. Focusing on the euro area, it appears that economic activity indicators, private loans, exchange rates and import prices are leading inflation. In the case of the euro area, at least one of the three statistics reported shows that economic activity, either measured by GDP, its two main components or by unemployment, helps predicting inflation. This is also the case, although to a lesser extent, for most countries, but not for France, Italy and Spain (which together accounting for about half of the euro area GDP). For these three countries, some of the economic activity indicators are positively correlated with future inflation. However, none of the economic activity variables “Granger causes” inflation.

Among the monetary and credit aggregates, only bank loans seem to have some predictive power with respect to inflation²¹. This holds in the euro area but also in Italy and to a lesser extent in France, both countries for which hardly any other variable has predictive power for inflation.

Turning to exchange rates, it is worth underlining that the exchange rate depreciation, with respect to the dollar is followed by a reduction of inflation. This paradoxical results, which we observe also in a majority of countries, seem to be largely spurious as the most striking disinflations of the sample period took place in the first part of the 1980’s, while the dollar was appreciated for most of the early 1980s. By contrast, US inflation appears, as one would expect, to be led by depreciation of the dollar. Finally, we observe that import prices are, as one would expect, helping to forecast CPI inflation both in the euro area and in most of the countries.

5.2 What is predicting GDP in the euro area and in EMU countries?

Having looked at forecasting equations for prices, we now turn to predicting GDP (Table 5). Among the candidate leading indicators are industrial production, asset prices

²¹ Further results with respect to the performance of M1, M3 and loans in predicting euro area inflation at different horizon, can be found in Nicoletti Altamari (2001) and in Trecoci and Vega (2000). Both studies show that monetary and credit aggregates provide significant and independent information for future price development in the euro area, especially at medium run horizon.

(stock prices and real estate prices), interest rates, money (M1 and M3) and credit aggregates, exchange rates (real effective and the nominal dollar) and indicators of world demand (the US GDP and the GDP of the euro area aggregate²²).

The main result is that only a few variables seem to lead GDP both at the euro area level and in at least half of the countries considered. At the euro area level, only M1, and to a lesser extent, short-term interest rates, are “leading” GDP according to each of the three statistics we report. Some other variables, like M3 are correlated with future GDP (GDP (t+4)). It should also be noted that share prices or industrial production seem to have predictive power with respect to euro area GDP. M1 and the short-term interest rate are also leading GDP in several countries. It is also worth underlining that bank loans help predicting GDP in several countries including Italy and Germany.

To summarize, these brief overview on the forecasting inflation or GDP properties of the variables we selected show that what is true at the euro area level is not necessarily true even for a majority of countries. This raises issues as to why we observe these “forecasting” abilities at the aggregate level and not in the parts which compose this aggregate.

6. Conclusion

This paper has put together a set of stylised facts about the euro area economy and how these compare to the US and the individual countries that form the euro area. The main finding is that the business cycle of the euro area aggregate is highly comparable to the US business cycle in a number of respects. The phase of the business cycle, the magnitude of consumption and investment fluctuations relative to GDP's, the leading, coincident or lagging correlations of GDP with consumption, investment, prices, inflation, interest rates, and finally the persistence of prices are very similar in the US and in the euro area.

This suggest the view that the business cycle of the euro area may be studied, to a great approximation, following approaches and models already used for the US Economy. The paper also points to a number of other interesting findings. First, we find that the business cycle fluctuations of GDP, consumption and investment as well as short-term interest rates of most euro area countries were highly synchronised with, respectively, the business cycle fluctuations of GDP, consumption and investment and the short-term interest rate of the euro area. We also find that although some variables, such as economic activity indicators and private loans have predictive power with respect to inflation at the

²² Obviously, this is an imperfect indicator of world demand as the GDP of each country is part of the aggregate. We however find interesting to check whether the GDP of the area helps predicting of the countries conditional on the own lags of national GDPs.

euro area level, these same variables do not always have the same leading properties at the national level. Differences between the euro area and the member countries are also observed when looking at what variables are predicting GDP. These last two results call for further research to understand where these asymmetries may originate.

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Appendix 1: Choice of the filtering method

The band pass filter

There is a long tradition of filtering macroeconomic time series. The usual filters often remove more variation than just the one relevant for business cycle frequencies (Baxter and King, 1999). Removal of linear trends would not remove unit roots from the data. Growth rates over-emphasise high frequencies while they down-weight low frequencies. Hodrick-Prescott filters, which are very popular quadratic trend filters, remove the low frequency and smooth the high frequencies of the time series. These filters have many good properties. They remove the unit root component of the data and their symmetry insures that the filtering does not shift the phase of the time series. But, to be operational, HP filters require that a weighting constant is chosen. This constant depends on the frequency of the time series to be filtered. Canova (1998) argues that using a weighting constant of 1600, as usually done to filter quarterly time series, would be efficient only if the business cycle phenomena lasted between four and six years. Moreover, the Hodrick-Prescott filters are not efficient for the first and the last observations of the sample period.

Baxter and King argue that a good business cycle filter should: remove the unit root, respect the phase and isolate business cycle frequencies without re-weighting past frequencies. Moreover, it should be easy to implement. The band-pass filter is founded on the spectral analysis principle that a time series can be seen as the sum of components with different frequencies. One can use a band pass filter to eliminate all frequencies of the data that are higher or lower than business cycle frequencies. In the case of the US, most business cycle last between 6 and 32 quarters. This suggests that one might opt to remove all cycles that are either shorter than 1.5 years or longer than 8 years. One can define a band pass filter $BPF(6,32 ;K)$ that consists of a weighted moving average of order K . The weights are the Fourier transforms of the frequency domain representation of the time series where frequencies below $(2\pi)/32$ and over $(2\pi)/6$ are set to zero. One also constrains the sum of weights to be zero, which insures that the unit root is removed from the data.

The band pass filter $BPF(6,32 ;K)$ is a symmetric moving average of order K :

$$y_t^* = \sum_{i=-K}^{+K} a_K y_{t+i}$$

such that the weights are defined as follows.

$$a_o = \left(\frac{2\pi}{6} - \frac{2\pi}{32} \right) / \pi - \frac{1}{2K+1} \sum_{h=-K}^{+K} b_h$$

$$a_h = b_h - \frac{1}{2K+1} \sum_{h=-K}^{+K} b_h$$

$$b_h = \sin\left(\frac{2\pi h}{6}\right) - \sin\left(\frac{2\pi h}{32}\right)$$

Ideally, K should be infinite²³. However, the weights decline rapidly to zero. Besides, using US data, Baxter and King show that the gains of increasing the order of the moving average beyond 12 are negligible.

Sensitivity analysis

As explained in section 2 of the paper, we have filtered macroeconomic time series with a Baxter and King filter that keeps periods from 6 to 40 quarters with truncation at 8 leads and lags. We show in Table A1 the standard deviation and the cross correlation of business cycle components of key macro-economic time series with four alternative filters. The traditional Hodrick-Prescott filter, with the weighting constant of 1600, the filter we have used through out this paper and two other Baxter and King band pass filters, one for which the "longest" business cycle period is limited to 8 years (as in Stock and Watson, 1999) and one with a twelve leads and lags truncation. Chart A1 reports the business cycle components of the euro area consumption and of euro area GDP as obtained with the four filters. It appears that the different de-trending methods deliver business cycle components that are very highly correlated to one another. The number of lags used in the truncation has a larger influence on the outcome than the span of frequencies used in the filter. Finally, the standard deviations of the business cycle components are smaller with the HP filter and the order 12 moving average than with the order 8 moving average. One should then be cautious when comparing the "absolute" standard deviations of this paper with the ones obtained with other filters. However, the standard deviations measured relative to the standard deviation in the fluctuations of GDP are still comparable even if different filters have been used.

Table A2 provides further robustness checks that the key finding of the paper does not depend on the filter used. The strong similarity that we found between the euro area and

²³ Christiano and Fitzgerald (1999) propose to optimise the weights of the band pass filter with respect to the mean square error of filtered series relative to the «ideal» band pass filter of the time series considered. One major drawback of their approach is that the «ideal» band pass filtered series is neither feasible nor observable. It is then necessary to make an assumption about the again-unobserved data generating process of the time series to be filtered.

the US business cycles does not depend on the de-trending methodology. Both the relative fluctuation and the cross correlation of consumption, investment and interest rates with GDP appear to be similar in the two big economies for each of the four de-trending methods listed above.

Appendix 2: Description of the data source, availability and transformation

This appendix contains a description of the source, the availability and the transformation of the data series used for this paper. All the series come from a macroeconomic time series database, which was built for the Eurosystem Monetary Transmission Network (MTN) of the Eurosystem. This database assembles a comparable cross-country set of macroeconomic variables for each country of the euro area and for the EU-11 area wide aggregates. In the following we briefly describe in turn the data from quarterly national accounts, monetary and credit aggregates, interest rate and exchange rates and other data including asset prices, consumer prices, unemployment and industrial production.

Quarterly National Accounts

The sources for the national account series were chosen in order to cover as much as possible of the last thirty years. Data used in the paper include GDP, consumption, investment, exports, imports, cumulated change in inventories, GDP deflator.

At the country level, the data come from Quarterly National Accounts database of the OECD²⁴, that gathers national sources, except for BE, GR, IR and PT, for which countries we received data from the respective NCBs within the MTN. Data are generally available up to 2000q3. However, the starting date differs across countries: 1970q1 for DE, ES, FR and IT; 1975q1 for FI; 1976q1 for AT and NL; 1980q1 for BE, GR and PT. In most cases, the QNA database provides data that are already seasonally adjusted. For DE (1970q1-1994q1) FI (1975q1-1998q4) and AT (1976q1-1998q4), we seasonally adjusted with the X-11 method in Eviews.

For the EU-11 aggregate the data come from the database of the ECB Area-Wide model.²⁵ The data are available from 1970q1 to 1998q4.

All data from national accounts are transformed into their logarithm before being filtered or used in a regression. For inventories, we report the logarithm of the cumulated change in

²⁴ For more information about the methodology see OECD "Quarterly National Accounts: Sources and Methods Used by OECD Countries". OECD data are the Eurostat data collected and released the OECD. The use of the OECD database is due to the longer available data range, back to the 1970 for many European countries.

²⁵ ECB Area Wide Model, see Fagan, Henry and Mestre (2001).

inventories. The latter is compiled by giving an arbitrary initial value that is large enough to ensure that the cumulated inventories are never negative.

Monetary and credit aggregates

The monetary and credit aggregates (M1, M3, and private sector loans) come from the database built by the ECB to construct the monetary aggregates historical time series for the euro area. For M1 and M3, the series and the source used for each country are described in the ECB Monthly Bulletin of February 1999²⁶. For private sector loans, the series for the euro area is described in Calza, Gartner and Sousa (2001). The series gives the monthly-end value relative to quarter of interest in national currencies. All series were seasonally adjusted with the X-11 method in Eviews.

For M1 and M3 the starting date is 1980q1. For private loans the starting date for the euro area is 1982q2 and for most countries is 1980q1 (DE, ES, FI, FR, and PT). Starting dates for other countries are given in Table A3.

All monetary and credit aggregates are transformed in logarithms.

Interest rates and exchange rates

The short-term rates are three-month money market rates and long-term rates are interest rates paid on government bonds, as available in the BIS database. The EU-11 aggregates are taken from the AWM-EMD database. After 1998q4, the interest rates were updated with the Euro 10 years and three month benchmarks as published in the ECB monthly bulletin (Table 3.1 and Table 3.2). The starting date for the euro area and for some countries is 1970q1 (DE, FR, IT, PT). Starting dates for other countries are given in Table A3.

Retail bank interest rates have been taken from an ECB database²⁷. The national retail interest rates are defined as those interest rates that are considered to be the main indicators of retail financial market conditions in the Member State concerned. These rates are not harmonised and based statistics constructed and defined by national central banks. The two lending rates are rates on mortgage loans to households (N2 in the ECB database) and on short-term loans to enterprises (N4 in the ECB database except for Finland for which we took N5). The deposit rate is the rate on time deposits (N8 in the ECB database except for Ireland where we took N9). Availability of the data, which differs a lot among the countries, is given in Table A3.

Bilateral exchange rates vis-à-vis DEM have been compiled as the ratio of the spot US-dollar exchange rate vis-à-vis the DEM/US-dollar exchange rate. The real effective exchange rates

²⁶ For further information on the methodology, see also www.ecb.int: Monetary aggregates and loans - historical time series.

²⁷ See the methodological note on the National retail bank rates on www.ecb.int.

are CPI based. All exchange rates were taken from the BIS database. They are all transformed in logarithms.

The starting data for the euro area and for countries is similar to the ones of the national account data availability for each country.

Other data

Additional data on the consumer price index (CPI), asset prices, unemployment rate, industrial production and real estate and US GDP data were gathered from different sources. The CPI and industrial production indices come from the IMF-IFS database. The series give the monthly-average value relative to quarter of interest. Share Prices come either from the IMF-IFS database or from the OECD, Monetary Economic Indicator. The series correspond to the headline stock exchange indices. For the euro area we took the Datastream index for EMU. The series are taken as the three months average value for the quarter of interest. The starting date for the euro area is 1980q1 and for four countries is 1970q1 (DE, ES, FR, IT). Starting dates for other countries are given in Table A3.

Unemployment rates come either from the BIS or from the OECD, Main Economic Indicator databases. The series give the three months average value for the quarter of interest.

The euro area real estate price index is the aggregate of national real estate indices. Data on house prices have been collected from different sources and the quality of the data differs from country to country.

Starting dates for other are given in Table A3.

Except for unemployment, all these other data are transformed in logarithms.

Chart 1: Spectral densities of GDP growth for the period 1970-1999 in the euro area and the US

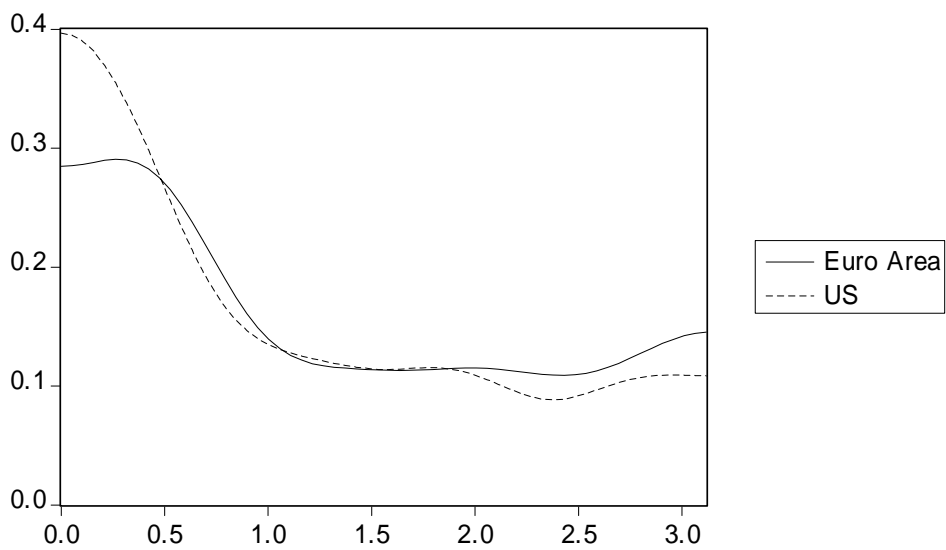


Chart 2: Spectral densities of GDP growth for the period 1970-1995 in the euro area and the US

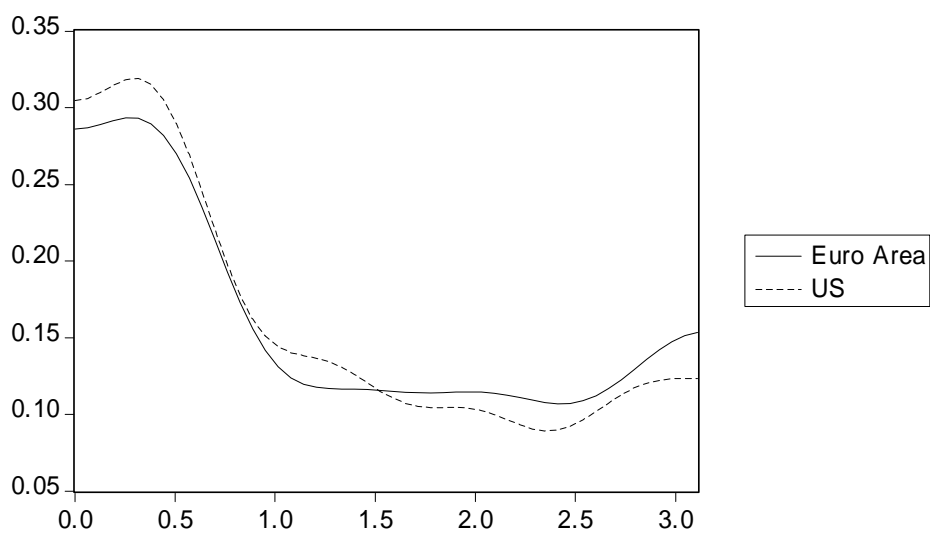


Chart 3: GDP growth (top panel) and business cycle component (low panel) in the euro area (solid line) and in the US (dashed line)

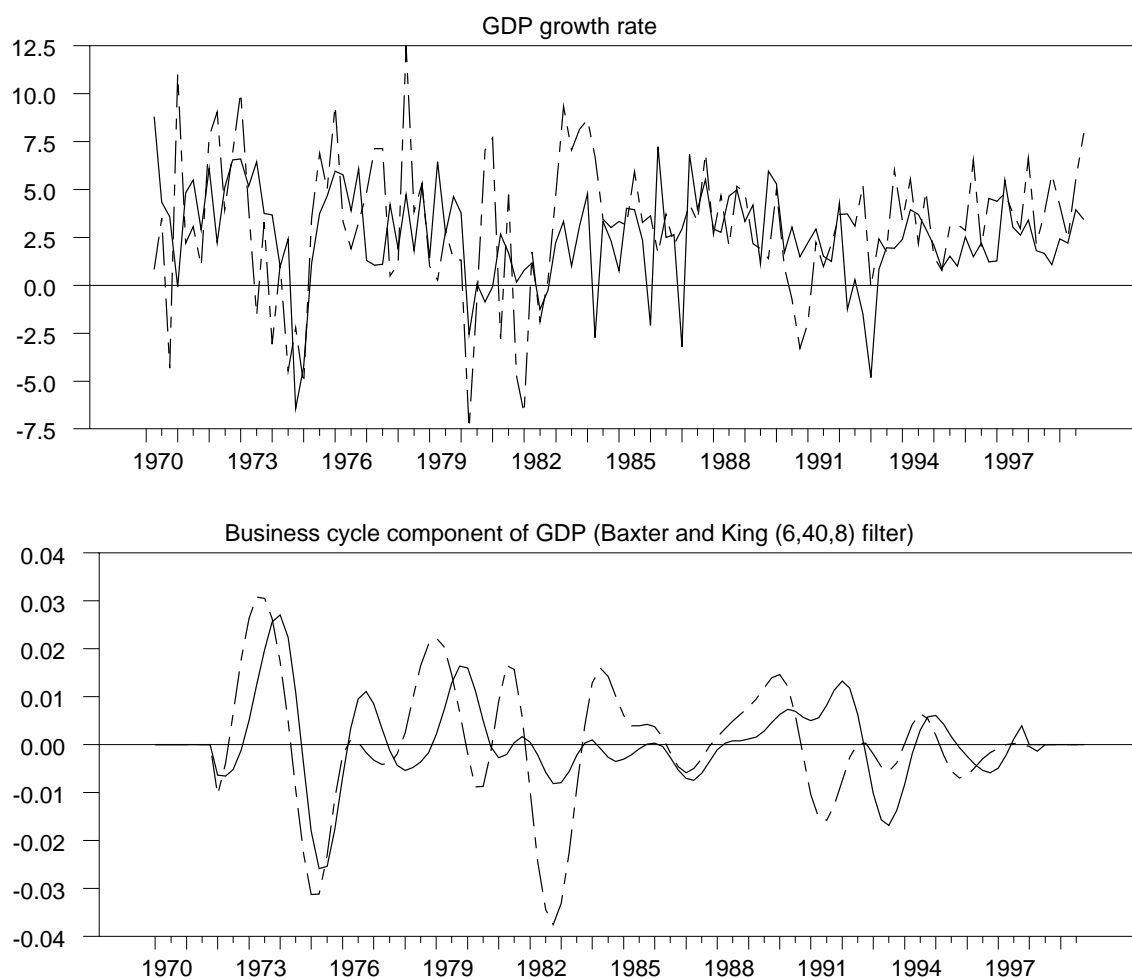


Chart 4: Business cycle component (using a Baxter and King (6,40,8) filter) of GDP for EMU countries (solid line) and the euro area (dashed line)

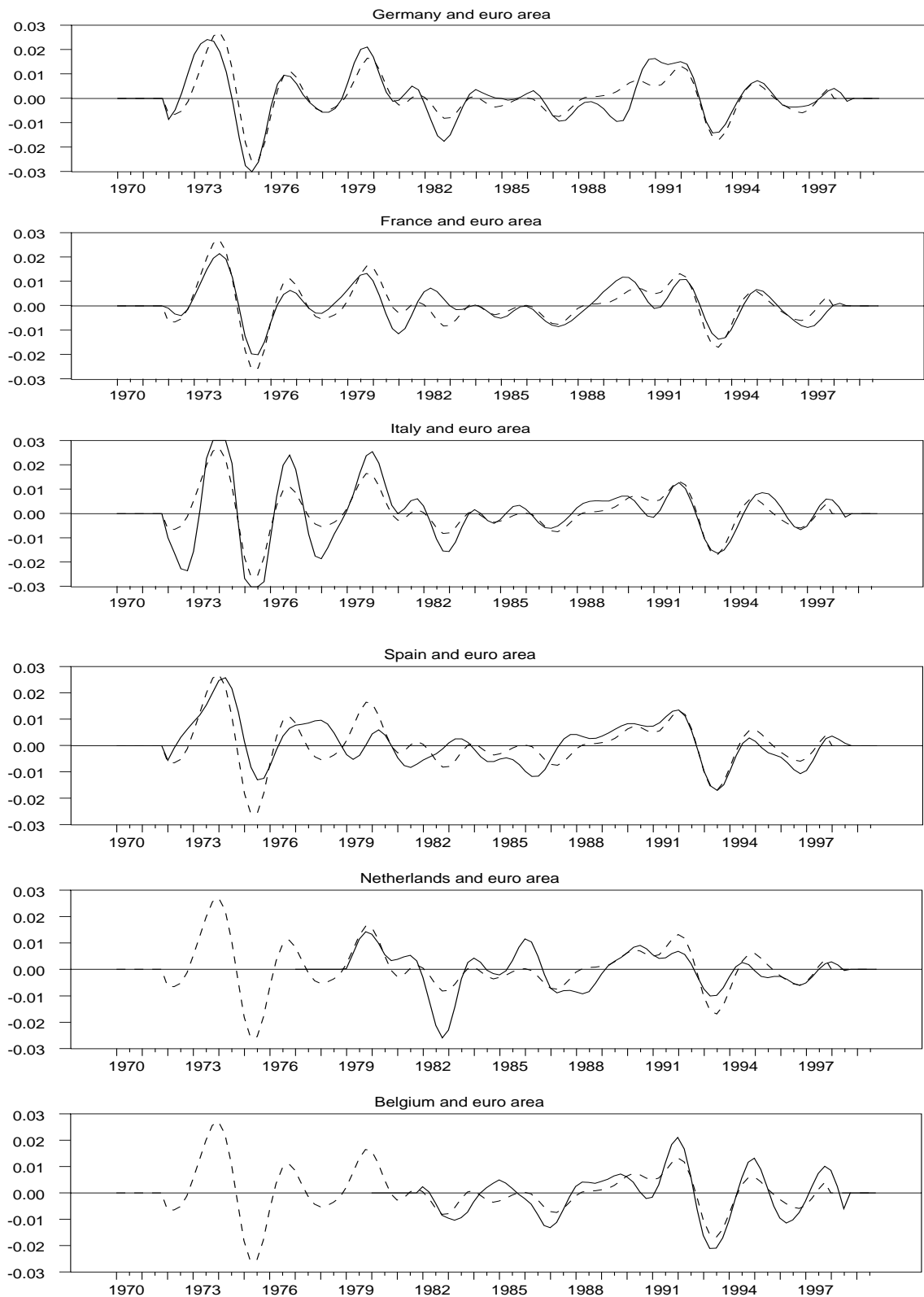


Chart 4 (continued): Business cycle component (using a Baxter and King (6,40,8) filter) of GDP for EMU countries (solid line) and the euro area

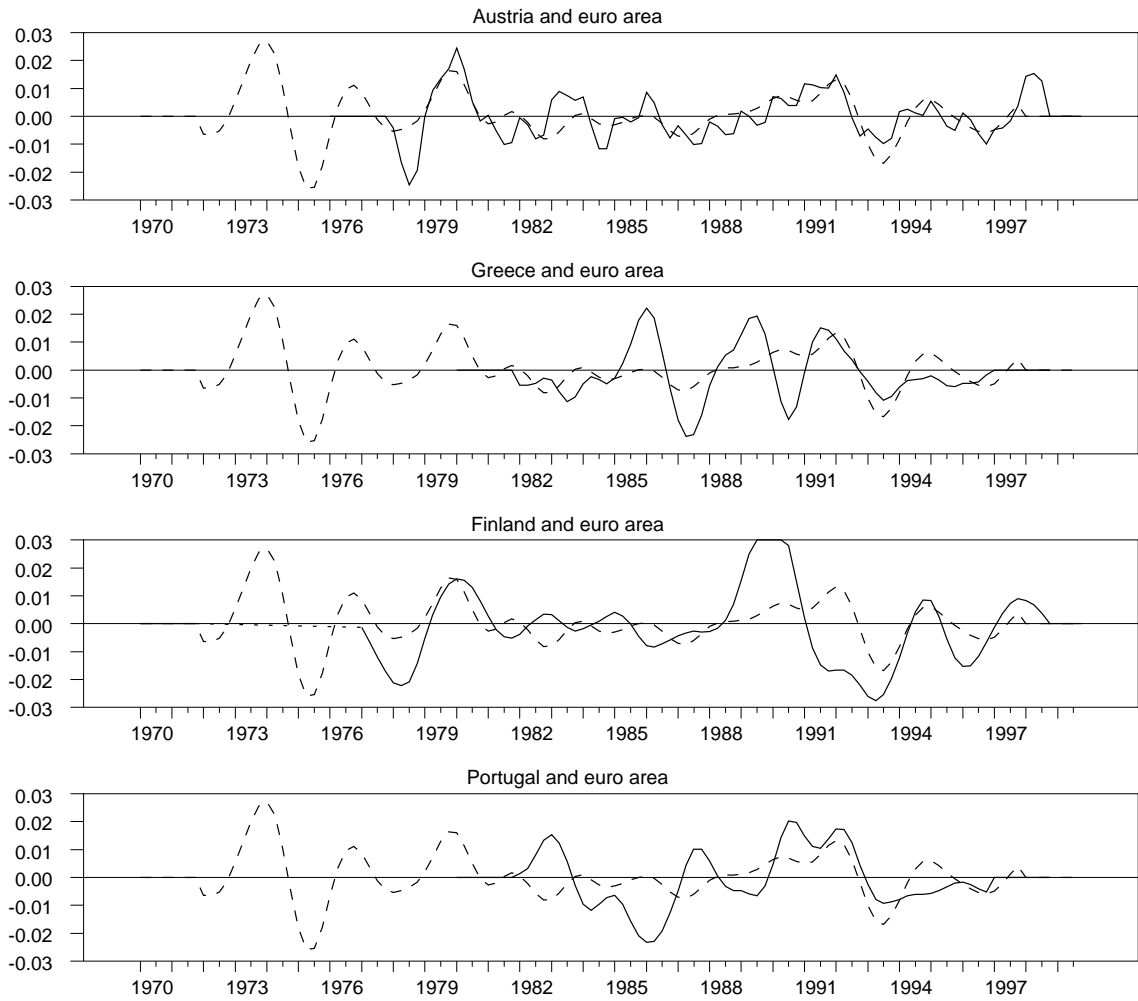


Chart A1: Business cycle component of consumption according to four different filters (HP (1600), BXKG(6,40,8), BXKG(6,32,8), BXKG(6,40,12))

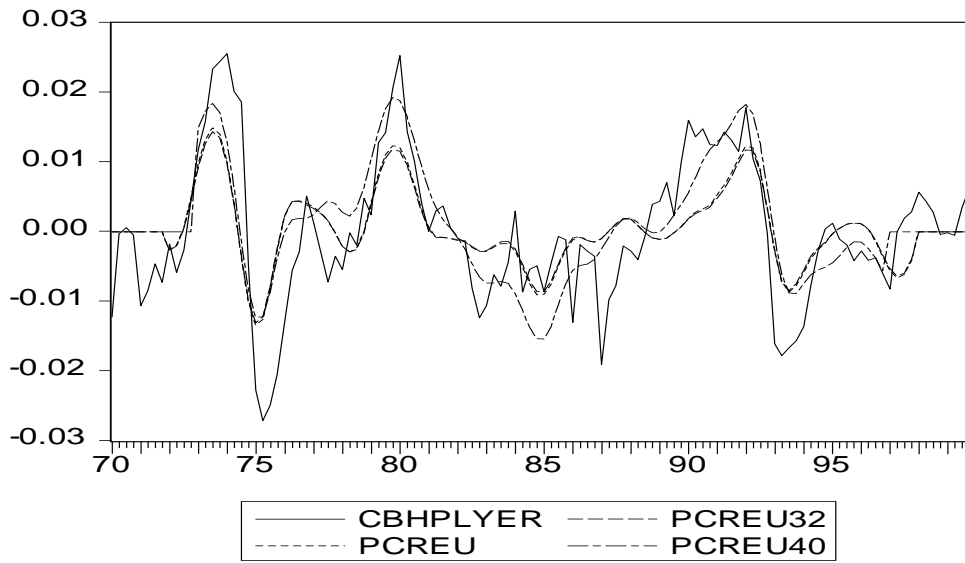


Chart A2: Business cycle component of GDP according to four different filters (HP (1600), BXKG(6,40,8), BXKG(6,32,8), BXKG(6,40,12))

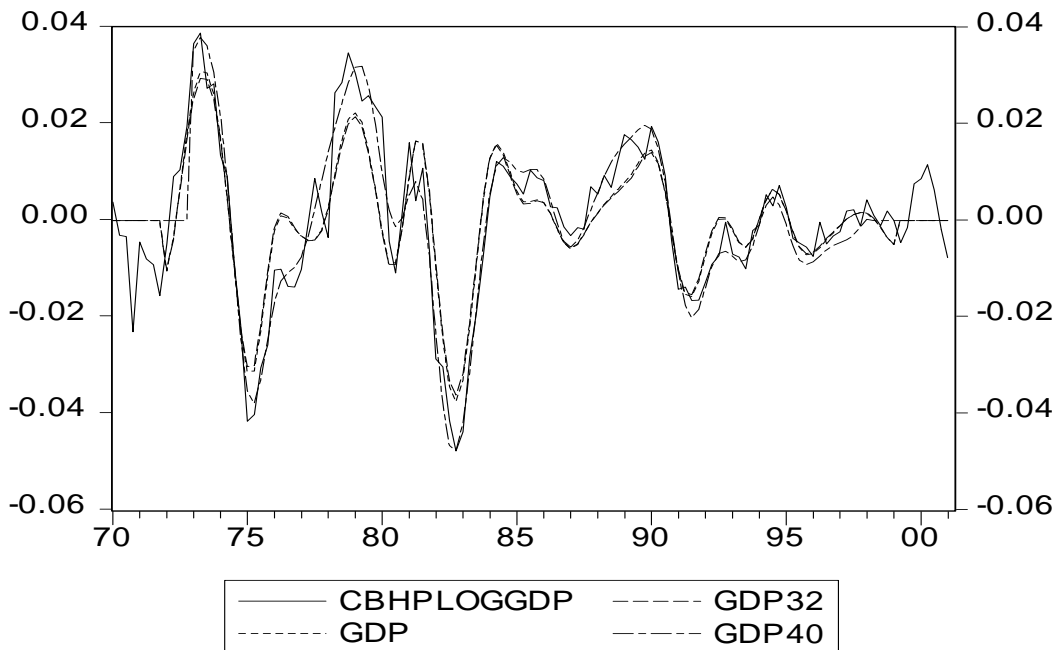


Table 2: Business fluctuations of the euro area economy (1970-2000)

variables (t)	St.Dev absolute	relative/GDP	k	Cross correlation with GDP(t+k)									
				-4	-3	-2	-1	0	1	2	3	4	
Alternative aggregations													
GDP, AWM*, 80:99	0.61	0.7		-0.01	0.30	0.64	0.90	1.00	0.90	0.90	0.63	0.29	-0.01
GDP, BDH**, 80:99	0.62	0.7		-0.04	0.28	0.62	0.88	0.99	0.90	0.90	0.65	0.32	0.03
GDP deflator (level) AWM	0.67	0.5		0.00	-0.16	-0.31	-0.42	-0.48	-0.49	-0.49	-0.46	-0.42	-0.39
GDP deflator (level), BDH	0.45	0.5		0.10	0.05	-0.02	-0.11	-0.21	-0.33	-0.33	-0.44	-0.53	-0.57
Other economic activity indicator													
Industrial production	1.57	1.9		-0.18	0.16	0.52	0.82	0.96	0.89	0.89	0.66	0.35	0.03
Unemployment	4.66	5.6		-0.24	-0.55	-0.79	-0.89	-0.81	-0.58	-0.58	-0.26	0.08	0.34

Note: Standard deviation of and cross correlation between the Business Cycle Component of individual time series (GDP, Consumption, Investment and 3 month interest rate of the countries). The BCC was obtained from a Band Pass filter BPF(6,40,8) a la Baxter and King (1999) as described in Appendix 1.

** AWM refer to the Area Wide Model where the aggregation is based on fixed weights as in Fagan, Henry and Mestre (2001).

** BDH Aggregation based on variable weights as proposed by Beyer, Doornik and Hendry (2001).

Table 3.a: Business fluctuations of the euro area economy (1970-2000)

variables (t)	St.Dev	Cross correlation with GDP(t+k)												
		absolute	relative/GDP	k	-4	-3	-2	-1	0	1	2	3	4	
GDP	1	0.84	1.0		-0.19	0.18	0.58	0.88	1.00					
Consumption	2	0.55	0.7		-0.13	0.09	0.37	0.63	0.79	0.80	0.66	0.40	0.09	
Investment	3	1.85	2.2		0.06	0.34	0.62	0.81	0.86	0.75	0.51	0.21	-0.09	
Cumulated inventories	4	2.40	2.9		0.65	0.83	0.82	0.59	0.22	-0.19	-0.52	-0.70	-0.70	
GDP deflator (level)	5	0.58	0.7		0.29	0.27	0.16	-0.04	-0.30	-0.55	-0.72	-0.76	-0.67	
CPI (level)	6	0.68	0.8		0.28	0.26	0.16	-0.03	-0.26	-0.50	-0.66	-0.72	-0.66	
CPI (inflation)	7	0.31	0.4		0.35	0.34	0.27	0.21	0.20	0.26	0.31	0.30	0.19	
Stock prices	8	12.00	0.1		-0.10	-0.07	-0.01	0.05	0.08	0.06	0.01	-0.03	-0.02	
Real estate prices	9	1.36	1.6		0.53	0.52	0.50	0.45	0.39	0.31	0.20	0.06	-0.08	
Short-term rate nominal	10	1.09	0.0		0.27	0.54	0.73	0.76	0.61	0.30	-0.08	-0.43	-0.67	
Short-term rate real	11	0.76	0.0		0.49	0.65	0.68	0.55	0.26	-0.11	-0.43	-0.61	-0.59	
Long-term rate nominal	12	0.57	0.0		0.22	0.38	0.48	0.47	0.33	0.09	-0.17	-0.37	-0.46	
Yield curve	13	0.83	0.0		-0.20	-0.45	-0.63	-0.68	-0.58	-0.34	-0.01	0.32	0.56	
Real ef. exchange rate	14	3.58	4.3		0.22	0.33	0.36	0.30	0.17	0.01	-0.12	-0.18	-0.18	
DM-USD exchange rate	15	5.23	6.2		0.13	0.36	0.56	0.61	0.48	0.22	-0.08	-0.34	-0.46	
M1	16	1.00	1.2		-0.22	-0.26	-0.20	-0.05	0.16	0.39	0.58	0.68	0.67	
M3	17	0.72	0.9		0.45	0.23	0.01	-0.17	-0.26	-0.27	-0.19	-0.06	0.07	
Total loans	18	0.85	1.0		0.59	0.55	0.48	0.37	0.23	0.10	0.00	-0.06	-0.08	
					Cross correlation with own (t+k)									
CPI (level)	19				0.33	0.55	0.77	0.94	1.00					
GDP deflator	20				0.27	0.50	0.74	0.93	1.00					

Note: Standard deviation of and cross correlation between the Business Cycle Component of individual time series (GDP, Consumption, Investment and 3 month interest rate of the countries). The BCC was obtained from a Band Pass filter BPF(6,40,8) a la Baxter and King (1999) as described in Appendix 1

Table 3.b: Business fluctuations of the US economy (1970-2000)

variables (t)	1	St.Dev		Cross correlation with GDP(t+k)										
		absolute	relative/GDP	k	-4	-3	-2	-1	0	1	2	3	4	
GDP	1	1.34	1.0	k	-0.09	0.24	0.60	0.89	1.00	0.89	0.59	0.23	-0.09	
Consumption	2	1.01	0.8		-0.24	0.03	0.34	0.64	0.84	0.87	0.74	0.51	0.27	
Investment	3	3.26	2.4		0.11	0.44	0.75	0.94	0.95	0.80	0.53	0.20	-0.10	
Cumulated inventories	4	2.35	1.8		0.74	0.89	0.88	0.69	0.35	-0.02	-0.32	-0.48	-0.48	
GDP deflator (level)	5	0.67	0.5	0.0	0.00	-0.16	-0.31	-0.42	-0.48	-0.49	-0.46	-0.42	-0.39	
CPI (level)	6	1.02	0.8	0.8	0.23	0.10	-0.07	-0.24	-0.41	-0.52	-0.56	-0.54	-0.49	
CPI (inflation)	7	1.29			0.48	0.59	0.63	0.56	0.38	0.15	-0.09	-0.25	-0.31	
Stock prices	8	7.92	5.9		-0.50	-0.50	-0.37	-0.12	0.16	0.39	0.47	0.40	0.22	
Real estate prices	9	2.12	1.6		-0.18	-0.21	-0.16	-0.06	0.08	0.21	0.24	0.17	0.03	
Short-term rate nominal	10	1.31	0.0		0.38	0.56	0.68	0.67	0.50	0.21	-0.14	-0.44	-0.62	
Short-term rate real	11	1.11	0.0		-0.11	-0.03	0.07	0.14	0.15	0.07	-0.06	-0.22	-0.36	
Long-term rate nominal	12	0.82	0.0		-0.03	0.14	0.28	0.35	0.30	0.14	-0.07	-0.28	-0.41	
Yield curve	13				-0.51	-0.60	-0.63	-0.56	-0.39	-0.15	0.12	0.33	0.45	
Real ef. exchange rate	14	2.96	2.2		0.08	0.11	0.08	0.00	-0.07	-0.12	-0.12	-0.08	-0.01	
DM-USD exchange rate	15	6.66	5.0		0.19	0.23	0.23	0.23	0.27	0.37	0.45	0.42	0.27	
M1	16	1.78	1.3		-0.22	-0.23	-0.18	-0.08	0.05	0.16	0.22	0.24	0.22	
M3	17	0.87	0.7		0.25	0.37	0.42	0.39	0.28	0.12	-0.03	-0.13	-0.15	
Total loans	18	1.99	1.5		0.75	0.78	0.68	0.48	0.19	-0.11	-0.34	-0.45	-0.45	
CPI (level)	19				0.38	0.61	0.81	0.95	1.00					
GDP deflator	20				0.35	0.58	0.80	0.95	1.00					

Note: Standard deviation of and cross correlation between the Business Cycle Component of individual time series (GDP, Consumption, Investment and 3 month interest rate of the countries). The BCC was obtained from a Band Pass filter BPF(6,40,8) a la Baxter and King (1999) as described in Appendix 1.

Table 4: Leading indicator properties of selected variables relative to inflation

	Euro Area		Austria		Belgium		Finland		France		Germany					
	Corr	P.-val.* T stats**	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	values† stats	Corr	P.-val.* T stats				
GDP	0.33	0.08	0.15	0.01	0.42	0.10	2.14	-0.10	0.05	1.29	0.45	0.75	0.58	0.50	0.01	3.85
Consumption	0.25	0.06	2.87	0.00	0.40	0.12	2.30	0.13	0.21	1.44	-0.07	0.87	0.66	0.66	0.00	4.52
Investment	0.24	0.06	3.01	0.08	0.47	0.02	2.10	-0.13	0.16	1.21	0.47	0.44	0.84	0.08	0.01	3.93
Unemployment	-0.22	0.03	-3.02	0.00	-0.05	0.00	-3.02	0.10	0.00	-1.93	-0.30	0.21	-2.24	-0.31	0.00	-4.16
M1	0.34	0.73	0.98	0.04	-0.54	0.79	-0.02	-0.04	0.35	1.25	-0.17	0.09	-2.65	0.75	0.01	3.74
M3	-0.06	0.23	0.45	-0.03	-0.53	0.56	0.39	0.20	0.34	-0.46	-0.22	0.79	-1.02	0.03	0.03	0.43
Loans	0.11	0.00	2.15	0.22	0.00	0.99	1.63	0.01	0.08	-0.20	0.19	0.11	-1.42	0.48	0.18	0.62
Real ef. exchange rate	0.19	0.00	3.13	-0.13	-0.06	0.02	0.90	-0.18	0.77	0.36	0.11	0.02	2.68	-0.10	0.10	0.34
Exchange rate v USD	-0.36	0.00	-4.59	-0.31	-0.40	0.00	-2.21	0.23	0.16	-1.94	-0.22	0.01	-3.12	-0.19	0.00	-2.96
World pice index	-0.23	0.11	0.90	0.10	0.28	0.17	0.94	0.29	0.60	0.44	-0.19	0.65	-0.46	0.05	0.00	0.32
same without energy	-0.36	0.24	0.97	0.03	0.21	0.57	0.38	0.17	0.35	1.90	-0.42	0.07	0.92	-0.03	0.65	0.25
Import prices	0.00	1.24	0.32	0.32	0.00	2.60	1.15	0.68	1.15	0.08	0.08	1.88	0.08	0.22	1.29	
Long interest rate	-0.06	0.41	-0.41	0.20	0.12	0.68	1.25	-0.59	0.07	-1.93	0.06	0.82	0.07	-0.25	0.48	1.46
Short interest rate	0.37	0.58	0.54	-0.05	0.19	0.20	1.37	-0.66	0.50	-1.59	0.40	0.66	-0.36	0.23	0.05	2.46
Yield curve	0.47	0.39	-1.16	-0.05	0.05	0.26	-0.96	0.13	0.79	1.09	0.30	0.80	0.37	0.40	0.11	-2.28

	Italy		Netherlands		Spain		Greece		Portugal		US					
	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats				
GDP	0.03	0.30	1.58	-0.14	0.09	1.96	1.08	0.33	0.18	1.68	0.44	0.11	1.80	0.25	0.22	1.50
Consumption	0.06	0.58	1.48	0.14	0.17	2.45	1.75	0.17	0.01	2.93	0.32	0.49	1.61	0.18	0.26	1.78
Investment	-0.23	0.15	1.18	0.04	0.23	1.44	1.17	0.33	0.46	-0.17	0.48	0.11	2.53	-0.36	0.55	-0.08
Unemployment	0.32	0.18	-0.33	-0.07	0.23	-2.18	-1.36	-0.28	0.96	-0.14	-0.04	0.00	-1.88	-0.17	0.51	0.87
M1	0.60	0.83	0.25	0.11	0.44	1.02	0.15	0.08	0.01	3.64	0.38	0.03	-1.03	0.09	0.75	1.24
M3	-0.19	0.86	-0.63	0.25	0.87	0.22	-0.88	0.33	0.11	2.61	0.07	0.14	-2.20	0.29	0.79	1.10
Loans	-0.35	0.00	1.60	0.47	0.00	0.05	0.69	0.08	0.04	-1.45	-0.30	0.94	0.58	-0.07	0.06	2.35
Real ef. exchange rate	0.01	0.27	-0.15	0.27	0.00	-0.17	0.75	0.08	0.04	1.45	-0.32	0.42	0.05	-0.07	0.06	2.42
Exchange rate v USD	0.01	0.05	-1.80	-0.31	0.00	-2.51	-1.27	0.40	0.76	0.27	-0.15	0.06	-1.31	-0.03	0.06	2.42
World pice index	-0.27	0.08	2.61	0.28	0.00	2.28	0.17	0.24	0.63	0.79	-0.02	0.82	0.09	0.22	0.20	1.78
same without energy	-0.35	0.13	0.16	0.21	0.50	0.52	0.56	0.32	0.38	-1.36	-0.08	0.05	1.07	0.21	0.01	-2.46
Import prices	0.05	2.27	0.01	0.01	3.81	3.03	0.63	0.42	0.01	3.06	0.01	0.01	3.06	0.27	0.00	-1.52
Long interest rate	-0.45	0.19	0.31	0.34	1.00	0.27	0.56	-0.07	0.00	1.25	-0.09	0.00	-1.89	0.27	0.00	-1.52
Short interest rate	-0.32	0.40	-0.04	0.32	0.16	0.11	0.74	0.01	0.97	0.31	0.01	0.91	-0.72	0.42	0.01	0.57
Yield curve	0.31	0.12	0.42	-0.17	0.14	-0.37	-0.11	0.30	0.00	1.67	0.30	0.00	-0.75	-0.27	0.36	-1.37

Note: Corr. Stand for the cross-correlation of the business cycle component of the variable in line (t) and inflation (t+4). P.-val. And T stat are based on a regression of inflation on four of its lags and four lags of the variable in column. The P.-val. is the probability of the hypothesis that the four lags of the variable in column are nil. T. Stat is the student statistic of the sum of the coefficient on the four lags of the variable in column.

Bold values are at 5 % significance level

Table 5: Leading indicator properties of selected variables relative to GDP

	Euro Area		Austria		Belgium		Finland		France		Germany			
	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats		
Industrial production	-0.16	0.00	0.88	1.35	0.12	0.14	2.35	0.04	0.61	1.40	-0.38	0.09	-0.48	2.31
Share prices	-0.10	0.06	2.45	1.78	-0.15	0.00	1.21	-0.19	0.01	1.59	-0.08	0.36	1.20	-0.33
Real estate price	0.32	0.02	-0.01	0.00	0.42	0.00	-3.67	0.24	0.00	1.94	0.38	0.51	-0.07	0.13
Long interest rate	-0.14	0.17	-1.32	0.74	0.96	0.02	-1.91	-0.02	0.05	-1.58	-0.02	0.32	-1.88	0.05
Short interest rate	-0.43	0.10	-1.56	0.09	1.61	0.04	-1.96	-0.34	0.01	-2.62	-0.48	0.16	-2.42	0.25
M1	0.58	0.00	2.56	0.56	1.51	0.59	0.68	0.89	0.01	1.22	-0.03	0.26	1.06	0.25
M3	0.53	0.52	1.14	0.07	0.19	0.57	0.25	1.56	0.14	0.07	-1.06	0.72	0.01	0.26
Loans	0.24	0.13	-0.03	0.00	2.49	-0.03	0.00	0.59	0.13	0.00	0.09	0.40	1.23	-0.03
Real ef. exchange rate	-0.30	0.47	0.85	0.83	-0.30	-0.22	0.31	-0.47	-0.22	0.49	-0.44	0.41	0.28	-0.21
Exchange rate v USD	-0.30	0.95	0.36	0.39	0.66	-0.94	0.42	0.77	0.42	0.30	0.35	0.44	-0.67	0.25
US GDP	0.29	0.30	2.09	0.18	0.24	1.08	0.14	0.11	0.35	0.49	0.33	0.16	2.55	0.13
Euro Area GDP	-0.20			0.17	0.03	3.40	-0.14	0.00	1.89	-0.17	0.00	-0.18	0.25	-0.29
														0.54
														2.46

	Italy		Netherlands		Spain		Greece		Portugal		US	
	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats	Corr	P.-val.* T stats
Industrial production	-0.43	0.16	-1.00	0.14	0.94	0.52	-0.14	0.64	0.74	0.34	0.41	0.18
Unemployment	-0.48	0.07	2.79	-0.64	0.22	-1.44	-0.41	0.15	0.75	-0.67	0.00	-2.48
Share prices	-0.03	0.20	2.29	-0.22	0.18	1.19	-0.15	0.00	4.01	-0.39	0.00	2.05
Real estate	0.40	0.70	2.79	-0.28	0.58	-1.44	0.48	0.00	0.75	0.55	0.00	-2.48
Long interest rate	-0.42	0.13	-2.34	-0.16	0.82	-0.68	-0.11	0.14	-1.12	0.35	0.00	-0.30
Short interest rate	-0.70	0.03	-3.29	-0.13	0.76	-0.17	-0.05	0.75	-0.22	0.31	0.41	0.40
M1	0.19	0.09	2.13	0.43	0.00	2.43	0.30	0.00	1.30	-0.14	0.11	2.30
M3	-0.08	0.13	1.65	-0.10	0.00	0.49	0.08	0.44	0.32	-0.29	0.82	0.49
Loans	-0.77	0.00	-1.24	-0.04	0.00	0.20	0.07	0.32	0.44	-0.56	0.81	-0.18
Real ef. exchange rate	-0.18	0.26	1.17	-0.57	0.22	-0.28	-0.07	0.69	0.10	-0.24	0.28	-2.03
Exchange rate v USD	0.20	0.65	0.68	0.64	0.62	-0.14	-0.04	0.89	0.22	0.20	0.52	-0.32
US GDP	0.34	0.05	2.36	0.16	0.07	1.86	0.29	0.28	2.15	-0.10	0.02	2.89
Euro area GDP	-0.18	0.06	-2.20	0.03	0.50	0.39	0.13	0.20	-1.52	0.22	0.01	3.57

Note: Corr. Stand for the cross-correlation of the business cycle components of the variable in line (t) and GDP (t+4). P.-val. And Tstats are based on a regression of GDP on four of its lags and four lags of the variable in column. The P.-val. is the probability of the hypothesis that the four lags of the variable in column are nil. T. stats is the student statistic of the sum of the coefficient on the four lags of the variable in column.

Bold values are at 5 % significance level

Table A1: Standard deviation and cross correlation selected filtered series in the euro area (1970:q1-1999:q4) and the US (1970q1-2001:q1), using 4 alternative filters

	St. Deviation	HP Filter*	BXKG**(6,40,8)	BXKG**(6,32,8)	BXKG**(6,40,12)
GDP					
HP Filter*	0.010	1.000	0.891	0.886	0.941
BXKG**(6,40,8)	0.008	0.891	1.000	1.000	0.924
BXKG**(6,32,8)	0.008	0.886	1.000	1.000	0.918
BXKG**(6,40,12)	0.010	0.941	0.924	0.918	1.000
Consumption					
HP Filter*	0.008	1.000	0.851	0.846	0.887
BXKG**(6,40,8)	0.005	0.851	1.000	1.000	0.909
BXKG**(6,32,8)	0.005	0.846	1.000	1.000	0.903
BXKG**(6,40,12)	0.008	0.887	0.909	0.903	1.000
CPI					
HP Filter*	0.011	1.000	0.856	0.852	0.837
BXKG**(6,40,8)	0.007	0.856	1.000	1.000	0.892
BXKG**(6,32,8)	0.006	0.852	1.000	1.000	0.888
BXKG**(6,40,12)	0.011	0.837	0.892	0.888	1.000
Short-term interest rate					
HP Filter*	1.298	1.000	0.899	0.895	0.906
BXKG**(6,40,8)	1.098	0.899	1.000	1.000	0.872
BXKG**(6,32,8)	1.063	0.895	1.000	1.000	0.868
BXKG**(6,40,12)	1.178	0.906	0.872	0.868	1.000
GDP in USA					
HP Filter*	0.016	1.000	0.901	0.896	0.940
BXKG**(6,40,8)	0.012	0.901	1.000	1.000	0.927
BXKG**(6,32,8)	0.012	0.896	1.000	1.000	0.920
BXKG**(6,40,12)	0.016	0.940	0.927	0.920	1.000

Note: * Hodrick-Prescott Filter with constant 1600. ** Baxter and King band pass filters (L,H,K) with L and H the lower and upper bounds on the length of the business cycles fluctuations in quarters and K the truncation lags also in quarters.

Table A2: Business cycle fluctuations of the euro area and the US economy

		Euro area economy (1970-1999)					US economy (1970-2000)										
		BXKG(6,32,8)*					BXKG(6,32,8)*										
		St.Dev		Cross correlation with GDP(t+k)			St.Dev		Cross correlation with GDP(t+k)								
		absolute	relative/GDP	k	-4	-1	0	1	4	absolute	relative/GDP	k	-4	-1	0	1	4
GDP	variables (t)	1	0.01	1.00	-0.22	0.88	1.00			1	0.01	1.00	-0.08	0.90	1.00		
Consumption		2	0.01	0.65	-0.18	0.64	0.80	0.82	0.03	2	0.01	0.77	-0.19	0.68	0.85	0.87	0.18
Investment		3	0.02	2.18	0.04	0.82	0.87	0.75	-0.17	3	0.03	2.53	0.11	0.94	0.95	0.79	-0.18
CPI (level)		4	0.01	0.79	0.30	-0.07	-0.32	-0.54	-0.59	4	0.01	0.79	0.18	-0.35	-0.49	-0.58	-0.39
CPI (inflation)		5	0.01	1.09	0.02	0.69	0.67	0.49	-0.47	5	1.24	0.99	0.31	0.64	0.58	0.41	-0.26
Short-term rate nominal		6	0.01	1.30	0.26	0.78	0.63	0.32	-0.65	6	1.26	1.00	0.38	0.69	0.54	0.26	-0.64
				Cross correlation with own (t+k)					Cross correlation with own (t+k)					Cross correlation with own (t+k)			
CPI (level)		7	0.01	0.79	0.29	0.93	1.00			7	0.01	0.79	0.39	0.95	1.00		
		BXKG(6,40,12)*					BXKG(6,40,12)*										
		St.Dev		Cross correlation with GDP(t+k)			St.Dev		Cross correlation with GDP(t+k)								
		absolute	relative/GDP	k	-4	-1	0	1	4	absolute	relative/GDP	k	-4	-1	0	1	4
GDP	variables (t)	1	0.01	1.00	0.23	0.93	1.00			1	0.02	1.00	0.27	0.94	1.00		
Consumption		2	0.01	0.78	0.33	0.75	0.81	0.80	0.30	2	0.01	0.82	0.07	0.75	0.89	0.93	0.65
Investment		3	0.03	2.57	0.43	0.90	0.91	0.83	0.19	3	0.05	2.78	0.33	0.93	0.96	0.88	0.35
CPI (level)		4	0.01	1.04	-0.06	-0.38	-0.49	-0.59	-0.61	4	0.02	0.96	0.12	-0.37	-0.51	-0.63	-0.76
CPI (inflation)		5			0.36	0.61	0.57	0.43	-0.31	5			0.55	0.65	0.58	0.45	-0.02
Short-term rate nominal		6	0.01	1.13	0.52	0.68	0.53	0.29	-0.47	6	1.82	1.03	0.59	0.49	0.31	0.07	-0.56
				Cross correlation with own (t+k)					Cross correlation with own (t+k)					Cross correlation with own (t+k)			
CPI (level)		7	0.01	1.04	0.60	0.97	1.00			7	0.02	0.96	0.53	0.97	1.00		
		HP filter 1600*					HP filter 1600*										
		St.Dev		Cross correlation with GDP(t+k)			St.Dev		Cross correlation with GDP(t+k)								
		absolute	relative/GDP	k	-4	-1	0	1	4	absolute	relative/GDP	k	-4	-1	0	1	4
GDP	variables (t)	1	0.01	1.00	0.19	0.86	1.00			1	0.02	1.00	0.27	0.87	1.00		
Consumption		2	0.01	0.79	0.26	0.65	0.80	0.74	0.33	2	0.01	0.83	0.07	0.70	0.87	0.90	0.52
Investment		3	0.03	2.59	0.37	0.82	0.89	0.78	0.27	3	0.04	2.72	0.32	0.87	0.95	0.85	0.28
CPI (level)		4	0.01	1.04	0.06	-0.30	-0.45	-0.59	-0.70	4	0.02	0.94	0.10	-0.44	-0.59	-0.72	-0.69
CPI (inflation)		5	0.01	1.41	0.23	0.46	0.39	0.28	-0.25	5	2.00	1.22	0.47	0.50	0.47	0.38	-0.16
Short-term rate nominal		6	0.01	1.24	0.51	0.66	0.52	0.28	-0.46	6	1.80	1.10	0.53	0.49	0.34	0.08	-0.56
				Cross correlation with own (t+k)					Cross correlation with own (t+k)					Cross correlation with own (t+k)			
CPI (level)		7	0.01	1.04	0.55	0.94	1.00			7	0.02	0.94	0.50	0.94	1.00		

Note: Standard deviation of and cross correlation between the Business Cycle Component of individual time series (GDP, Consumption, Investment and 3 month interest rate of the countries). The BCC was obtained from the Band Pass filter BPF(6,40,8), BPF(6,32,8) and BPF(6,40,12) a la Baxter and King (1999) as described in Appendix 1 as well as with the HP filter with a 1600 weight.

Table A3: Summary of data source and availability

DEFINITION	Main SOURCE**	Availability	EU-11	AT	BE	DE	ES	FI	FR	GR	IT	NL	PT	US
National Accounts														
GDP REAL	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Private consumption	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Durables	OECD- QNA	na	na	na	na	na	na	75q1-00q3	70q1-00q3	na	70q1-00q3	na	na	na
Non Durables	OECD- QNA	na	na	na	na	na	na	75q1-00q3	70q1-00q3	na	70q1-00q3	na	na	na
Investment	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Residential	OECD- QNA	na	na	80q1-99q3	91q1-00q3	91q1-00q3	na	75q1-00q3	70q1-00q3	na	na	77q1-00q3	na	70q1-00q3
Non Residential	OECD- QNA	na	na	80q1-99q3	91q1-00q3	91q1-00q3	na	75q1-00q3	70q1-00q3	na	na	77q1-00q3	na	70q1-00q3
Change in inventories	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	na	70q1-00q3	77q1-00q3	na	70q1-00q3
Cumulated Change in inventories	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	na	70q1-00q3	77q1-00q3	na	70q1-00q3
Total (intra and extra euro area) Exports	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	na	70q1-00q3	77q1-00q3	na	na
Total (intra and extra euro area) Imports	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	na	70q1-00q3	77q1-00q3	na	na
Government consumption	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	na	70q1-00q3	77q1-00q3	na	na
GDP deflator	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	na	70q1-00q3	77q1-00q3	na	70q1-00q3
Consumption deflator	OECD- QNA	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	75q1-00q3	70q1-00q3	na	70q1-00q3	77q1-00q3	80q1-98q4	na
Other data														
CPI	IMF	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Industrial production index	IMF	85q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Share prices (IMF)	IMF	80q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Share prices (OECD)	OECD	70q1-99q4	77q1-00q3	85q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	88q1-98q4	na
Unemployment (BIS)	BIS	70q1-99q4	77q1-00q3	85q1-00q3	70q1-98q3	70q1-98q3	70q1-00q3	84q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	83q1-98q4	80q1-00q3
Unemployment (OECD)	OECD	80q1-99q4	76q1-99q4	85q1-99q4	72q1-00q3	72q1-00q3	70q1-00q3	78q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	80q1-00q3
Real estate prices	ECB	70q1-99q4	77q1-00q3	85q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	88q1-98q4	na
Interest rates														
Short-term money market	AWM and ECB	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	77q1-00q3	75q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Long-term bond	AWM and ECB	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	78q1-00q3	75q1-00q3	70q1-00q3	85q1-98q4	70q1-00q3	77q1-00q3	85q1-98q4	70q1-00q3
Retail interest rate on house purchase loans *	ECB	90q1-99q4	95q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	90q1-00q3	80q1-98q4	89q1-00q3	80q1-00q3	90q1-98q4	70q1-00q3
Retail rate on short-term loans to firms *	ECB	90q1-99q4	95q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	84q1-00q3	80q1-98q4	89q1-00q3	80q1-00q3	90q1-98q4	70q1-00q3
Retail rate on Time deposits *	ECB	90q1-99q4	95q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-98q4	89q1-00q3	80q1-00q3	90q1-98q4	70q1-00q3
Monetary aggregates														
Total loans	ECB	82q4-99q4	83q1-00q3	83q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	na	83q1-00q3	83q1-00q3	80q1-98q4	70q1-00q3
M1	ECB	80q1-99q4	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-98q4	80q1-00q3	80q1-00q3	80q1-98q4	70q1-00q3
M3	ECB	80q1-99q4	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-98q4	80q1-00q3	80q1-00q3	80q1-98q4	70q1-00q3
Loans to Firms	NCB's	na	81q1-00q3	80q1-00q3	78q1-00q3	78q1-00q3	83q1-00q3	89q1-00q3	78q1-00q3	80q1-98q4	80q1-00q3	80q1-00q3	80q1-98q4	70q1-00q3
Loans to Households	NCB's	na	81q1-00q3	80q1-00q3	78q1-00q3	78q1-00q3	83q1-00q3	89q1-00q3	78q1-00q3	80q1-98q4	80q1-00q3	80q1-00q3	80q1-98q4	70q1-00q3
Exchange rates														
Real effective exchange rate	BIS	70q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
Exchange rates vis-à-vis DEM	BIS	na	76q1-00q3	80q1-00q3	na	na	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	78q1-00q3
Exchange rates vis-à-vis US Dollar	BIS	79q1-99q4	76q1-00q3	80q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	80q1-98q4	70q1-00q3	77q1-00q3	80q1-98q4	70q1-00q3
World market prices, raw materials, Total Inde: BIS	BIS	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3	70q1-00q3
Private loans ***	ECB	83q1-00q3	83q1-00q3	83q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	80q1-00q3	83q1-00q3	83q1-00q3	80q1-00q3	70q1-00q3

** At country level all data come from OECD_qna, except for PT, GR and BE we received data from the NCB's.

Eu-11 data come from the AWM, EMD ECB

*** For USA data come IMF

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