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Executive Summary

This Report analyses the current status of the Euro area economy, provides forecasts for key macroeconomic variables for 2002 and 2003, runs experiments designed to evaluate the effects of expansionary monetary and fiscal policy, and studies in details the consequences of monetary policy over different phases of the business cycle.

We use econometric and statistical tools to address these issues, but all results are reported and commented upon in a clear and non-technical manner.

Forecasts are obtained either from a medium-scale structural econometric model, or from sophisticated time series models. The underpinning theoretical framework of the econometric model refers to an open economy, the Euro area as a whole, where markets are competitive. Agents are aggregated into the sectors of households, firms, government and foreign countries. Within each sector individuals are assumed to be homogeneous. The model includes the goods, labour and financial asset markets, and the latter consists of money and bonds. Private households and firms maximize individual utilities or profits, respectively. Because the model is not designed to evaluate fiscal policies, government is broadly treated as exogenous as well as the behaviour of foreign countries. From the econometric point of view, the model is specified in error correction form, where long run relationships among the main variables are estimated using cointegration techniques, lagged regressors capture the dynamics of the variables, and the statistical adequacy of the model is checked by a set of diagnostic tests on the residuals. A complete description of the model is provided in Annex 2.

Policy simulations are conducted with an annual macro-econometric model for 17 countries: the 14 members of the European Union (Luxembourg and Belgium are merged), the United States, Japan and Canada. Each country is modelled by the same system of about 50 equations, and there is a comprehensive description of linkages across countries, through trade and capital flows. Most behavioural equations are based on intertemporal optimisation, under the assumption of perfect foresight. The two most important features of the model are a vintage capital structure with a putty clay technology and consumption habit formation in an inter-temporal utility maximising framework. The stickiness that this induces in consumption is also complemented by some stickiness of nominal values, interest rate parities, monetary rules, etc. The model assumes inter-temporal equilibrium of the budget of each government and of the balance of payments of each country. Estimation of the model is conducted by panel GMM techniques. More details are provided in Annex 3.

As far as the current economic situation is concerned, many of the fears that the September 11th Terrorist Attack would drive the world economy deeper into a cyclical downturn have been dispelled. A prompt loosening of monetary policy by the Federal Reserve, the European Central Bank and the Bank of England has helped to stabilise business and consumer confidence. Industrial production has started to turn up as order books have improved. Nevertheless, such is the momentum of the downswing, which we forecast the Euro area to grow in 2002 by only 1.2%. In 2003 growth will accelerate to 2.2%.

The world-wide upswing in the second half of the 1990s was characterised by a particularly strong increase in business investment relative to the growth in GDP. With the exception of Germany, this was also a feature of many countries in the Euro area. Some of this investment boom was fueled by unrealistic expectations about the possibilities of a new economy, and the pricking of the ICT boom in stock markets triggered a significant cutback in investment worldwide. This quickly translated into falls in US industrial production in the second half of 2000 and into 2001, and in turn this was propagated to the rest of the world. This has resulted in a greater degree of synchronisation of business cycles across the world than we have seen since the early 1980s.

Industrial production in the Euro area has been on a declining trend since the end of 2000. World trade in goods, which grew by 12 percent in 2000, hardly grew at all in 2001. Although the world economy is less sensitive to oil price rises than it was in the 1970s and 1980s, a rise from $12 a barrel at the beginning of 1999 to almost $30 by the end of 2000 added to the difficulties that industry was already facing, and depressed household incomes.

There are now signs that the worst is over. Though in the Euro area GDP dropped by 0.2% in the last quarter of 2001, industrial production grew by 0.3 % and retail trade by 0.4% in December of 2001. The Euro area unemployment rate has stabilised at 8.4%. Fourth quarter GDP grew at an annual rate of 1.4% in the US, after a fall of 1.3% in the third quarter. The sharp downturn in the world industrial sector has been offset in part by the resilience of households and some fiscal relaxation by public authorities as well as by a much more favourable monetary climate. The cyclical downswing will turn out to be relatively shallow. However, the overhang because of excessive investment in the upswing means that recovery is muted during 2002.

Unemployment declined during 2000, but this went into reverse in 2001, and levels of unemployment are likely to remain high in countries such as Spain, Greece and Italy. Nevertheless, the range of outcomes for member states in the Euro area has been diverse. Germany, specifically, has been particularly affected by the investment retrenchment. However, overall, we expect the Euro area unemployment rate to remain stable in 2002, at about 8.4%, and to decline slightly to 8.1% in 2003.

The central dilemma facing monetary policymakers is whether the signs that the bottom of the downswing may have been reached are enough to obviate the need for further monetary easing. Over the last three years inflation in the Euro area has been on a rising trend and this has prevented the ECB from responding as vigorously as the US Federal Reserve to the deterioration in economic circumstances. However, these inflationary pressures have now eased, as oil prices have weakened and the cyclical downturn has put pressure on the ability of companies to pass on costs. HICP inflation will fall in the middle of 2002 to below 1.5%, but core inflation in the price of services will bring HICP inflation back to the 2% ceiling at the end of 2002.The expected inflation rate is 2.2% in 2003, possibly lower in case of a decrease of indirect taxes and of a more stable evolution for non-processed food items. The scope for further monetary easing is therefore restricted, at least under the current strict formulation of the target for price stability. Hence, we expect the short term interest rate to remain steady this year, and to increase slightly next year to around 3.8%.

Simulations conducted with the multinational Marmotte model indicate that a mildly expansionary ECB monetary policy would not be sufficient to absorb the asymmetric effects of the US recession on the different members of the Euro area. The expansionary monetary policy followed by the Federal Reserve, without a complementary fiscal policy, may also not totally offset the effects of the recession in the US.

The effectiveness of monetary policy is somewhat enhanced if the possibility of a different reaction of the economy during recessions and expansions is taken into consideration. There is evidence to suggest that at the aggregate level of the Euro area, interest rates have larger effects in recessions than in expansions. A monetary easing will have a stronger effect on economic activity when embarked on in a downturn compared with the effects of a monetary tightening in a boom.

Part of the inflationary pressures that recently affected the Euro area can be traced to the depreciation of the Euro against the dollar since the beginning of 1999. The rise in volatility in asset markets after September 11th has abated and the dollar to Euro exchange rate is more stable. However, the more important effective exchange rate for the Euro, which matters more for inflation and the external balance since it is a weighted average of the exchange rates with the main trading partners, has fluctuated about a stationary mean since the spring of last year. We expect only a mild depreciation for 2002, of 3%, and 1% in 2003, mainly as a consequence of the shrinking of the interest rate spread with the US and of the expected better performance of the US economy. Yet, there is substantial uncertainty around these forecasts.

As far as the efficacy of fiscal policy in the Euro area is concerned, simulations indicate that it is relevant for stabilising national economies and to compensate for the asymmetric impact of the US shocks, particularly for the case of a co-ordinated expansionary policy. To prevent the constraints in the SGP being breached, reduction in taxation is preferable to an increase in government expenditures.

Although the worst may be over, it is clear that there still remain a number of imbalances in the world economy that will hinder a quick cyclical recovery. The fall in stock markets over the last two years will have helped to bring valuations of companies more into line with realistic expectations of dividend flows in the future. But over-investment in ICT may still dampen business investment in the medium term. Nevertheless, fiscal easing by the US in the second half of 2001 and the low level of short term interest rates will help to speed the US recovery in 2002. This, in turn, will re-invigorate world trade and provide a stimulus to the European economy.

The stimulus, though, could not be sufficient to bring the economy on a high and persistent growth path. More structural reforms, such as increased competition in the goods and services markets, easing on the movement of capital and labour, and incentives for trade unions and firms to agree on more adaptable labour markets would increase growth on a more permanent basis.

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Part I. Euro area Conjunctural Analysis

A feature of many countries in the Euro area in the 1990s was the increase in business investment relative to GDP growth, with the exception of Germany and in the presence of an even stronger increase in the US, which characterised their long cyclical upswing. Some of this investment boom was fuelled by unrealistic expectations about the possibilities of a new economy, and the pricking of the ICT boom in stock markets triggered a significant cutback in investment world-wide. This quickly translated into the fall in US industrial production in the second half of 2000 and in 2001, and this, in turn, was propagated to the rest of the world.

Industrial production in the Euro area has been on a declining trend since the end of 2000. World trade in goods that grew by almost 12% in 2000, hardly grew at all in 2001. Although the world economy is less sensitive to oil price rises than it was in the 1970s and 1980s, a rise from $12 a barrel at the beginning of 1999 to almost $30 by the end of 2000 added to the difficulties that industry was already facing, and depressed household incomes. The terrorist attack of September 11th came when the world economy was already well into a cyclical downturn.

Monetary policy which generally leant against the cyclical upswing during 1999 and 2000, moved quickly to offset a downswing, once evidence of the pricking of the investment boom became clear. The Federal Funds rate fell from 6.5% to 1.75% during the course of 2001, in part to offset the shock to business and household confidence after September 11th. Inflationary pressures in the Euro area led to a more moderate easing of monetary policy.

There have been some faint signs that the worst may be over: fourth quarter GDP grew slightly in the US, and in the Euro area seasonally adjusted industrial production grew by 0.3% in December of 2001. The severe downturn in the world industrial sector has been offset in part by the resilience of households and some fiscal relaxation by public authorities so the cyclical downswing may turn out to be relatively shallow. However, the overhang because of excessive investment in the upswing may mean that recovery is muted during 2002. Our forecasts for average GDP growth in 2002 are about 1.2%, with an improvement in the second part of the year, expected to last and foster in 2003 with an annual rate of 2.2%.

The momentum of a cyclical downswing is also to continue to have effects on unemployment. Unemployment declined during 2000, but this went into reverse in 2001, and levels of unemployment are likely to remain high in countries such as Spain, Greece and Italy. Nevertheless, the range of outcomes for member states in the Euro area has been diverse. Germany, in particular, has been particularly affected by the investment retrenchment. Overall, we expect the unemployment rate to remain stable in 2002, at about 8.4% and to decline slightly to 8.1% in 2003.

The central dilemma facing monetary policymakers is whether the signs that the bottom of the downswing may have been reached are enough to obviate the need for further monetary easing. Over the last three years inflation in the Euro area has been on a rising trend and this has prevented the ECB in responding as vigorously as the US Federal Reserve to the deterioration in economic circumstances. However, these inflationary pressures have now eased, as oil prices have weakened and the cyclical downturn has put pressure on the ability of companies to pass on costs. Nevertheless, inflation in the harmonised index of consumer prices is still close to the 2% ceiling that the ECB targets, and our forecast is 2% for 2002 and 2.1% for 2003. Thus the scope for further monetary easing is restricted, at least under the current strict formulation of the target. Hence, we expect the short-term interest rate to remain rather stable this year, and a slight increase next year to values around 3.8%.

Part of the inflationary pressures can be traced to the depreciation of the Euro against the dollar since the beginning of 1999. The rise in volatility in asset markets after September 11th seems to have abated and the dollar to Euro exchange rate is more stable. However, the more important effective exchange rate for the Euro which matters more for inflation and the external balance, has fluctuated about a stationary mean since the spring of last year. We expect only a mild depreciation for this year.

On the fiscal front, the cyclical deterioration should be seen against a background of steady improvements in fiscal positions across most of the Euro area since 1996. Those countries that now find their room to manoeuvre restricted by the SGP have generally been less successful in achieving structural surpluses in the last few years. The requirement to be close to balance or in surplus in normal years should provide a sufficient cushion to allow the automatic stabilisers to function in all but exceptional circumstances.

Although the worst may be over, it is clear that there still remain a number of imbalances in the world economy that will hinder a quick cyclical recovery. The fall in stock markets over the last two years will have helped to bring valuations of companies more into line with realistic expectations of dividend flows in the future. But over-investment in ICT may still dampen business investment in the medium term. Nevertheless, fiscal easing by the US in the second half of 2001 and the low level of short-term interest rates should help to bring the US economy out of recession in 2002. This, in turn, will re-invigorate world trade and provide a stimulus to the European economy.

We now discuss in more detail recent and expected developments for output and internal demand (Section 1), labour market (Section 2), prices (Section 3), exchange rates and external demand (Section 4), and financial variables (Section 5). Finally, we evaluate the effects on the forecasts of alternative scenarios for the exogenous variables (Section 6).

1. Output and Domestic Demand Developments

1.1 Current Economic Situation in the Euro area

In the third and fourth quarters of 2001, the economic downturn in the Euro area and in the European Union as a whole continued. Seasonally adjusted GDP merely stagnated in the second half of 2001. In the EU as a whole, in the course of the last year, it is forecast that the year-on-year growth rate will fall from 3.1% in the first quarter to 1.6% in the fourth quarter.

Regarding the larger Euro area economies, GDP growth remained relatively robust in France and Spain, whereas it was particularly weak in Germany.

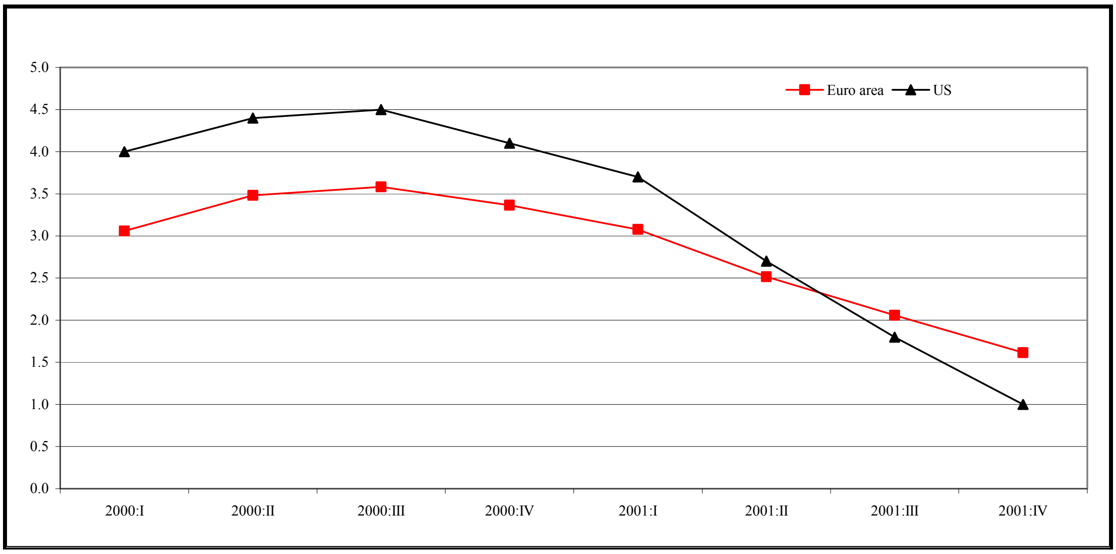
The economic downturn had started already mid-2000, i.e. well before the terrorist attacks of September 11th, 2001 in the USA. Among the reasons for the gloomy situation were the oil price hike which significantly reduced purchasing power of households, and the burst of the ICT bubble.

The long-lasting upswing of the US economy in the 1990s had been driven by high productivity growth due to accelerating technological progress in high-technology industries and by corresponding investment (see Stiroh, 2001). As it turned out in the course of 2000, the growth potential of the "New Economy" had been over-estimated, leading to over-investment in the high-technology sector. The bursting of this bubble was associated with a marked downturn of stock market prices. Besides negatively affecting investment, this exerted a negative wealth effect on private consumption. The gloomy economic perspective was also reflected in a drop in consumer confidence.

The negative stock market and confidence effects spilled over to Europe. The speed and strength of the linkage between the US and European cycles at this point was not altogether expected; the Euro area is a relatively closed economy and standard multi-country models where the trade link is prominent do not lead one to expect such a close relationship as the recent downturn has exhibited (see IMF, 2001, for a full discussion of this issue).

Figure I.1.1 depicts the paths of the average annual GDP growth rates in the Euro area and in the US over the last two years.

Figure I.1.1: Average annual GDP growth rates in the Euro area and in the US



Data seasonally adjusted. Sources: European Commission, Euroindicators database; U.S. Department of Commerce; Euro area fourth quarter of 2001: EFN forecast using a structural macroeconometric model.

Table I.1.1 shows the average annual growth rates of GDP and its expenditure components in the Euro area over the years 2000 and 2001. It can be seen that until the end of 2001, growth was mainly supported by net exports. While both exports and imports lost momentum in the course of the year, exports continued to grow faster than imports. Domestic demand, on the other hand, was weak in the entire year 2001, mainly because of the marked slump in gross fixed capital formation.

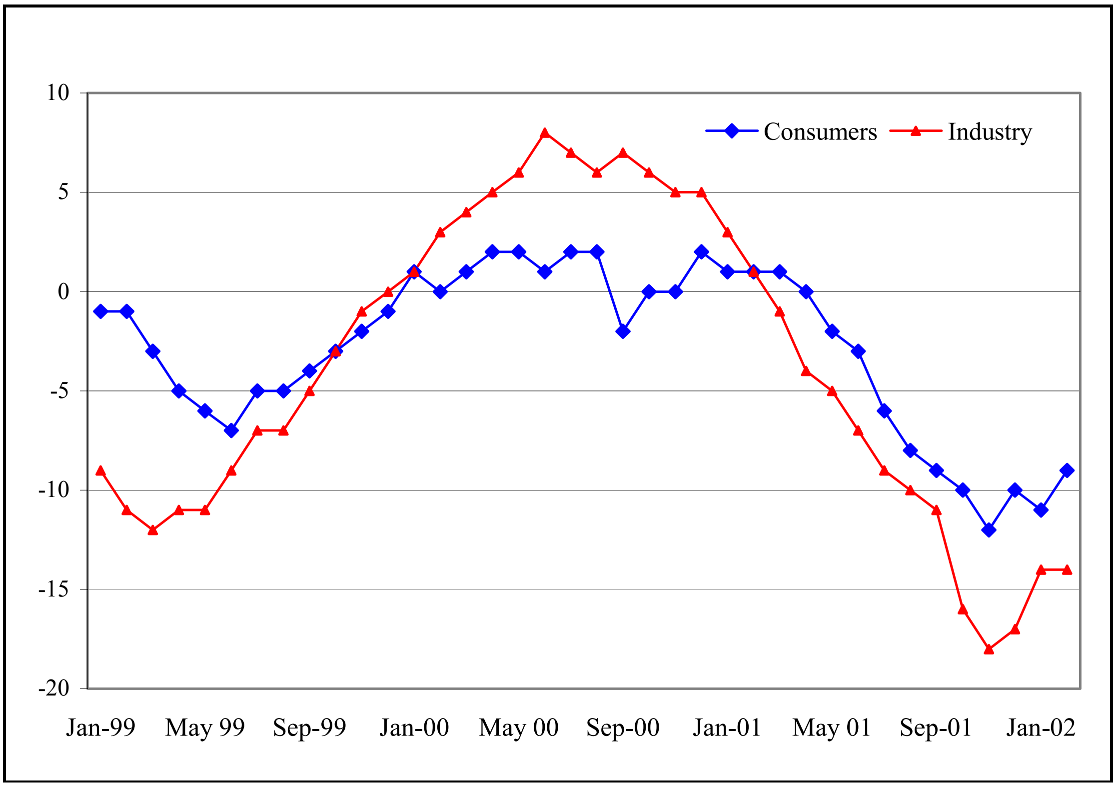
Table I.1.1: Euro area average annual growth rates in 2000 and 2001

	2000:I	2000:II	2000:III	2000:IV	2001:I	2001:II	2001:III	2001:IV
GDP	3.1	3.5	3.6	3.4	3.1	2.5	2.1	1.6
Domestic Demand	3.2	3.3	3.2	2.8	2.5	1.9	1.4	1.1
Private Consumption	3.0	3.0	2.8	2.6	2.4	2.0	1.9	2.0
Government Consumption	2.1	2.2	2.1	1.9	1.9	1.8	1.9	2.0
Capital Formation	5.6	5.5	5.0	4.4	3.4	2.0	0.7	-0.4
Exports	7.7	9.9	11.4	11.9	11.1	9.4	6.5	3.3
Imports	8.3	9.5	10.5	10.7	9.9	8.1	5.0	2.0

Sources: European Commission, Euroindicators database; fourth quarter of 2001: EFN forecasts using the structural macroeconometric model described in Annex 2.

The economic downturn is well reflected in the deterioration in both consumer and industry confidence as can be seen in Figure I.1.2.

Figure I.1.2: Consumer and industry confidence indicators in the Euro area



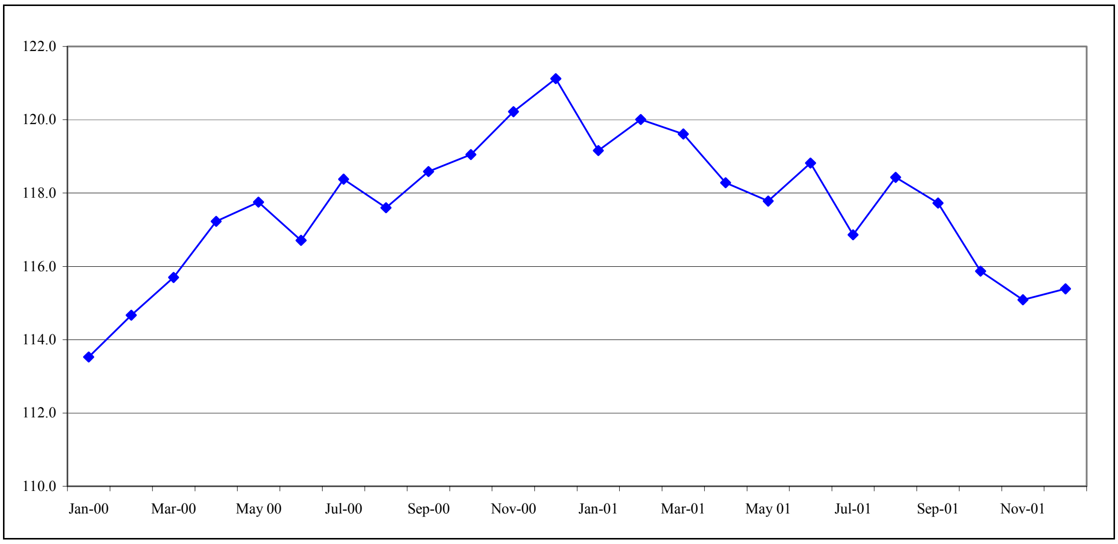
Balance between positive and negative replies, seasonally adjusted. Source: European Commission, Euroindicators database.

Besides the consumer and industry confidence indicators, the European Commission also publishes confidence indicators for the retail sales and the construction sectors. All confidence indicators declined more or less constantly from their peaks around June 2000. It was only in December 2001 that the downward trend could be stopped while it remains uncertain whether the reversal in the trend will be enduring.

While the sharpest monthly drop occurred in October in the aftermath of the September 11 attacks, confidence remained sluggish for the rest of last year. From its trough in November 2001, industry confidence increased in December and January. In February 2002, this slight upward trend came to a halt. This may be viewed as an indication for the continued uncertainty concerning the speed of the economic recovery in the US and the Euro area. This is also reflected in consumer confidence which increased in December 2001 and February 2002, while in January it dropped temporarily again. It may be concluded that at the time of writing this report, the confidence indicators do not provide clear signals for an imminent economic upswing.

The weak economic situation is reflected in the drop in industrial production. From August till October 2001, industrial production fell in the Euro area and in the European Union as a whole. Among the larger member countries, the drop was most pronounced in Germany where the industrial production index fell by four percent from August to November. In contrast, in France, the index dropped by around one percent only over the same period. In the Euro area as a whole, the seasonally adjusted industrial production index started to rise in December 2001. It remains to be seen whether the recovery will be enduring.

Figure I.1.3: Industrial production index in the Euro area, 1995=100

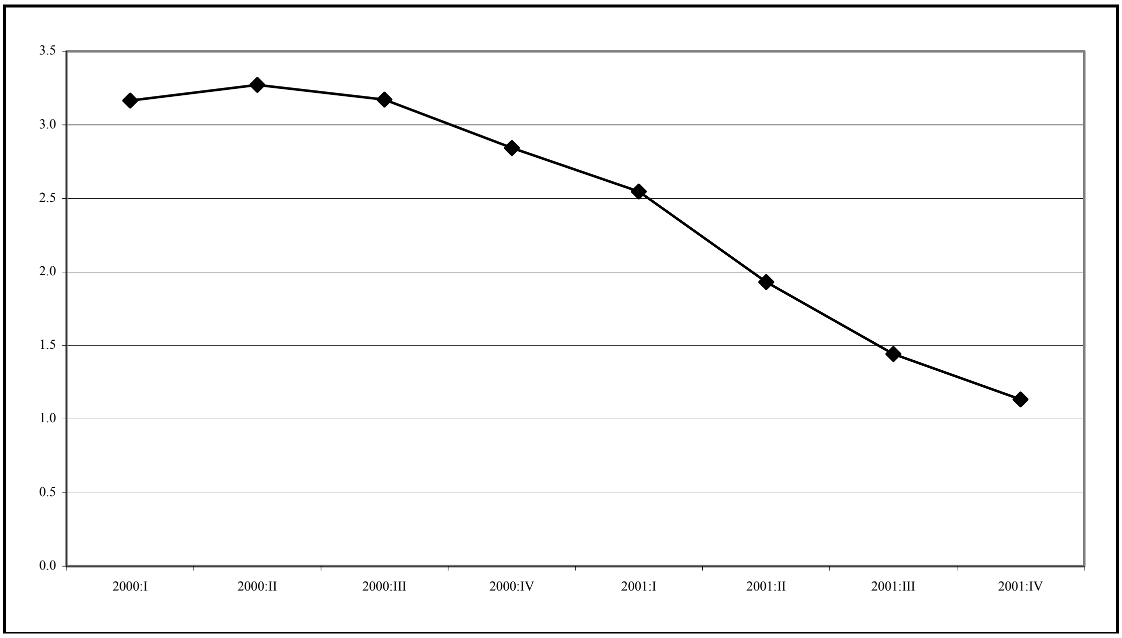


Data seasonally adjusted. Source: European Commission, Euroindicators database.

Domestic demand remains weak in the Euro area

In the second half of 2001, seasonally adjusted domestic demand stagnated in the Euro area. The economic deterioration is also reflected in the smoothed growth rate which fell from a peak of 3.3% in the second quarter of 2000 to 1.1% in the fourth quarter of 2001 (see Figure I.1.4). The average annual growth rate of domestic demand in the Euro area declined from 2.8% in 2000 to 1.1% in 2001. While both private and public consumption remained comparatively robust with annual average growth rates of 2% each, gross fixed capital formation was exceptionally weak with an annual drop of 0.4% in 2001, compared to an increase of 4.4% in 2000 and 5.4% in 1999.

Figure I.1.4: Growth rates of domestic demand in the Euro area



Data seasonally adjusted. Source: European Commission; fourth quarter of 2001: EFN forecast using the structural macroeconometric model described in Annex 2.

The gloomy economic situation, which was amplified by the oil price hike and the bursting of the ICT bubble, negatively affected company profit prospects and consequently consumer and industry confidence. Private consumption was supported by stable employment and by high real estate prices (that partly mitigated the negative wealth effect of the bad stock market performance). For several consecutive months, the unemployment rate remained almost constant at about 8,4%. As the labour market development lags behind the development of the real economy (see Agresti and Morjon, 2001), labour market conditions will worsen in the coming months. This may result in additional precautionary savings by private households, exerting a negative effect on private consumption.

Private consumption

Oil prices have been rising since mid-1999. The effects of this increase have been aggravated by increasing prices for meat and other food, caused by the outbreak of animal diseases and unfavourable weather conditions in some Euro area countries in the beginning of 2001, resulting in comparatively high inflation rates. The peak was reached in May 2001 with a Euro area HICP increase of 3.4%, exerting an adverse effect on real disposable income. Thereby, the positive impact of tax cuts initiated in some member countries was counteracted. Due to the fact that data on Euro area disposable income is not available, the exact impact of these effects on disposable income cannot be quantified.

Although in the second half of 2001 inflation was significantly curtailed to 2.0% in December, the smoothed growth rate of private consumption declined from 3.0% in the first and second quarters of 2000 to around 2% in the fourth quarter of 2001. Among the larger Euro area countries, private consumption remained robust in France, while it was particularly weak in Germany. This contrast can be explained by differences in fiscal policy measures and in labour market conditions between these two countries. Tax cuts were higher in France than in Germany. In addition, the French government tried to compensate private households for the purchasing power losses due to the oil price increase in winter 2000/2001. Furthermore, in France, the labour market development was more favourable in the course of last year.

Gross fixed capital formation

The economic downturn in the Euro area is particularly reflected in the dramatic slump in investment. While the smoothed growth rate of gross fixed capital formation amounted to about 5.5% in the first and second quarters of 2000, a drastic downturn in investment activity occurred in the course of 2001. For the fourth quarter, a further deterioration can be expected, resulting in a negative smoothed growth rate of 0.4% in the end of last year.

Medium-term prospects for gross fixed capital formation remain weak. In the fourth quarter, according to European Commission surveys among companies, industrial capacity utilisation in the Euro area continued its decline that had begun mid-2001. In addition, confidence in industry, retail sales and construction is still very low. Though at the end of the last year and in the first two months of 2002, these sentiment indicators stopped their decline that had started in the middle of the last year, the indices remain at low levels. At the moment, it is quite uncertain whether the reversal in trend has taken place.

The burst of the ICT bubble with the marked drop in stock market prices has a deteriorating effect on financing conditions of companies. While in continental Europe financing of investment projects by issuing new stocks is less common than other means of financing, it was particularly important for New Economy firms. Companies of traditional branches relied more on bank loans (see Edison and Sløk, 2001). The high stock market volatilities can at least be viewed as an indication of the current uncertainty. It can be expected that investment activity will remain weak until profit prospects improve significantly.

For companies of the telecommunications sector, financial conditions were further deteriorated by the need of financing UMTS licenses. Due to the lack of co-ordination between European governments, companies active in several markets had to purchase licenses for different economies. In some countries (e. g. Germany), the prices for these licenses were quite high. This may have resulted in fewer funds being available for other investment projects, thereby exerting a negative influence on gross fixed capital formation. On the other hand, amortisation of the licenses results in smaller profits and thus in lower profit tax obligations.

1.2 Expected Developments

Our expectations for growth in 2002 are rather low, about 1.2%, with a better performance from the last quarter of the year. There is of course some uncertainty around this figure, and a 80% confidence interval for GDP growth in 2002 ranges from 0.8% to 1.6%.

A disaggregate demand analysis indicates that the concurrent causes for the poor economic performance are a negative growth in investment (about –1.4% on the annual average), but also a rather restricted growth in both private and public consumption expenditures (about 1.8% and 1.5%, respectively). A positive but limited contribution comes from external demand. As discussed in section 4, the growth of net exports is expected to be about 0.2%.

In the course of this year, profit prospects are expected to improve as a consequence of the recovery in the US and of more optimistic expectations of companies in the Euro area. In addition, the capacity utilisation will increase from the low level at the beginning of 2002, thereby stimulating investment. Quarterly investment growth will increase from the second half of 2002. This will lead to higher income supporting private consumption.

GDP growth will be more sustained in 2003, with an average expected rate of 2.2%. This is mainly due to increased private consumption (about 2.1%), associated with an improved investment scenario and inventories accumulation, and higher net export growth. Public consumption reacts to the recovery with some lag. Due to the better economic performance a slight decline in unemployment is expected. The forecast is around 8.1% in 2003, after 8.4% in 2002.

These projections suggest the importance of stimulating private consumption and investment. As we will discuss in detail in the second part of the report, traditional expansionary fiscal policy would be able to achieve this goal only in part, and that too only by running a high risk of violating of the SGP requirements. Moreover, since the lack of confidence shown by consumers and industry is the main factor behind the current recession, economic policy should be tailored to restore private confidence. In this sense the measures should be directed to promote increases in productivity. Also, the reinforcement of the European market as a unique market, by political measures that increase competition and reduce costs of financial transactions and make the movements of capital and people easier, would generate more confidence.

As far as monetary policy is concerned, the effects of cuts in the interest rate turn out to be positive, even though limited. These cuts should be feasible in an environment characterised by moderate price stability, but could not be feasible because of the current unnecessarily rigid fixing of the inflation target by the ECB. Thus, it would be convenient to redefine the target in a more flexible way, possibly in terms of a range of values for inflation, giving at the same time full guaranties that the ECB keeps the fight against inflation as its main objective.

Table I.1.2: Euro area forecasts for annual growth rates

	2002:II	2002:IV	2003:IV
GDP	0.9	1.2	2..2
	[0.6, 1.2]	[0.8, 1.6]	[1.2, 2.9]
Private Consumption	1.7	1.8	2.1
	[1.4, 2.0]	[1.5, 2.1]	[1.4, 2.7]
Government Consumption	1.8	1.5	0.9
	[1.6, 2.0]	[1.3, 1.8]	[0.5, 1.4]
Private Investment	-1.2	-1.4	0.2
	[-2.0, -0.5]	[-3.0, -0.1]	[-3.0, 2.2]
Inventories / GDP	0.1	0.2	0.3
	[-0.2, 0.1]	[-0.2, 0.4]	[0.0, 0.5]
Exports	0.0	2.3	9.1
	[-1.1, 1.0]	[-0.3, 4.1]	[6.8, 11.5]
Imports	-0.3	2.1	8.3
	[-1.7, 0.9]	[-0.6, 4.0]	[5.4, 10.9]

For each projection, the first and the second rows report the mean and the 80% confidence bands, respectively, of 2000 stochastic simulations. EFN forecasts using the structural macroeconometric model described in Annex 2.

Box 1.1: The Cyclical Relationship between the Euro Area and the US Industrial Sectors

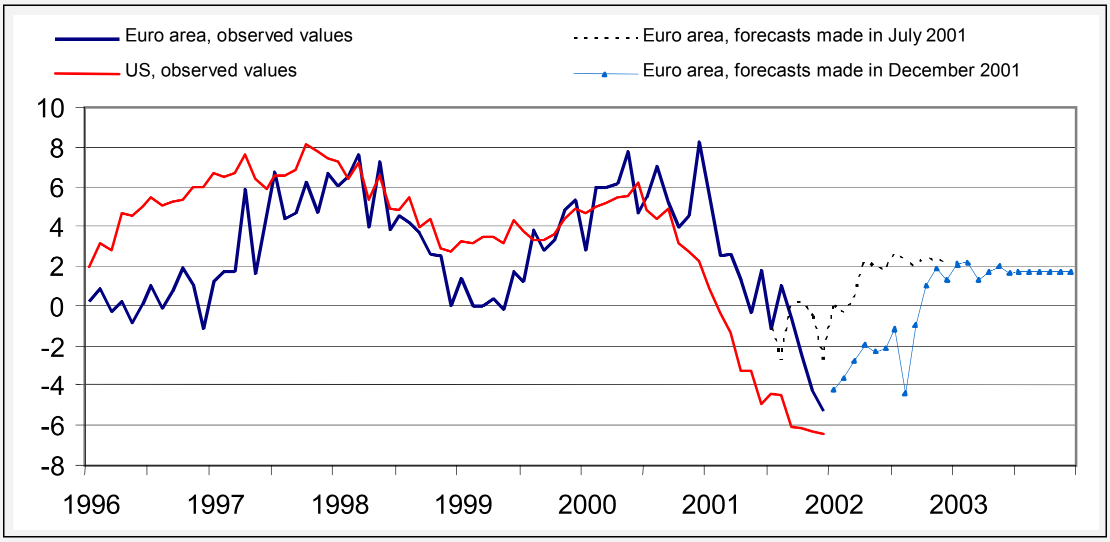
The expectations for the European economy have been deteriorating during 2001, mainly during the second part of the year. This can be more properly appreciated using variables measured at a monthly frequency. The industrial production index (IPI), which refers to the index of industrial production excluding construction, is one of the most relevant monthly variables of the real sector, because it directly covers an important percentage of the economy in the Euro area and because production in different services sectors is dependent on industry. The IPI is also a very reliable indicator because it directly measures production reported by firms. In national accounting, the industrial gross added value is obtained by subtracting the intermediate consumption from the production reflected in IPI. Finally, IPI measures the evolution of the sector most widely open to international trade and, as a result, the relationships between different economies during cycles are better reflected in the IPI´s than in GDP´s, see figure I.1.5.

The industrial production index in the Euro area can be analysed through a breakdown by production sectors according to the destination of the goods produced: capital goods, energy, other intermediate goods, consumer durable goods and consumer non-durable goods. With the disaggregate data, we capture relevant information on the different common factors driving the trend of the aggregate and the seasonality. The forecasts in this box are obtained from a VAR model for the five sectors mentioned above.

Since 1996, the IPI in the Euro area has shown two cycles. In the last one the peak turning point took place, in the year-on-year rate of growth, in January 2001. According to our forecast, the turning point at the bottom took place in January 2002. During this recession period the year-on-year rate of growth decreased from a positive value of 7.8% in December 2000 to a negative value of 6.0% in December 2001. This means that this recession has been harder than the previous one, where the negative rates only reached values of a few tenths of a percentage point.

Figure I.1.5 also shows that cycles in the US and Euro area industries are closely related. As a matter of fact, an econometric analysis of these two series shows that they share a common trend thereby imposing a long-run restriction which is significant when explaining the evolution of both indexes, and that there is feedback between the transitory dynamics of both time series.

Figure I.1.5: Monthly industrial production indexes for the Euro area and the US



The prospects for the recession in the Euro area have worsened with each appearance of new data. Thus, Figure I.1.5 shows two forecast paths calculated with information up to July 2001 and December 2001, respectively. It can be seen that with the first information the forecasts pointed to positive year-on-year rates from March 2002. Updating the forecasts with the information available at present −data up to December 2001− positive rates are not obtained until October of this year.

Our updated forecasts indicate that the recovery, which could have started in January 2002, will advance until reaching a 1.8% year-on-year rate of growth around April of next year. This implies average annual rates of growth of -1.6% and +1.8% for 2002 and 2003, respectively (Table I.1.3).

Table I.1.3: Euro area forecasts for annual IPI growth rates

	1999	2000	2001	2002	2003
Industrial Production Index	1.8	5.3	-0.3	-1.6	1.8

The industrial production data exclude construction. The forecasts are obtained from a VAR model for the following industry sectors: capital goods, non-energy intermediate goods, consumer durables, and consumer non-durables; and from a univariate model for energy production.

Several options to forecast Euro area IPI have been attempted: univariate ARIMA modelling for the total industrial production excluding construction, univariate ARIMA model for the different components, vector autoregression with US Industrial Production Index, leading indicator models and vector autoregression amongst the main sectoral components of the index. Models were estimated from 1995:01 to 1999:12 and evaluated by forecasting performance since then until July 2001. Best forecasting results were achieved by a vector autoregression model amongst the components, which is the model used to produce the forecasts in Table I.1.3.

The variables have been considered in logarithms and energy was excluded from the analysis. A VAR model with two lags of each of the four components of IPI as regressors properly captured the correlation among the variables. Centred seasonal dummies have also been included to account for seasonality and there were no cointegration relationships. The energy component was modelled separately as an AR(2) in first differences and includes seasonal dummies.

Box 1.2: Coincident Indicators

The evaluation of the current status of an economy relies on national accounts, which are based on economic theory and constructed according to a number of international standards. Gross domestic product (GDP) is usually chosen as a summary measure. However, the information on national accounts is released with a delay. At the beginning of March 2002, we still do not know the figures for the last quarter of 2001. This fact has motivated the appearance of coincident indicators, which are linear combinations of several economic variables and can be considered as estimates of the current status of the economy, and usually are built to track the behaviour of GDP.

The construction of coincident indicators for the Euro area has recently attracted considerable interest among economists. Though there is no sound economic basis for an indicator, and thus its relationship with GDP can be unstable over time, the fact that it summarises information from many series and can be timely computed is seen as a major benefit.[1]

In particular, if the economy is described by a large collection of macroeconomic time series, a dynamic factor model can be adopted to represent them. In this model, the joint evolution of the variables is driven by a very limited number of common factors. The so-called common component of GDP growth is a combination of the estimated factors, and it can be used as a coincident indicator, see e.g. Altissimo et al. (2001).

[1] The construction of leading indicators for GDP for the Euro area has been proposed, among others, by Grasmann and Keererman (2001).

In this box we compare GDP growth for the Euro area with two factor-based indicators, constructed using alternative estimation methods for the dynamic factor model, namely that of Forni, Hallin, Lippi, and Reichlin (2000, FHLR) and of Stock and Watson (1998, SW). In essence, the former estimates the factors as linear combinations of lags, current values and leads of all variables, while the latter uses current values only, with a different set of weights. We show that the three measures of the status of the economy are highly correlated and, in particular, they share the same business cycle structure.

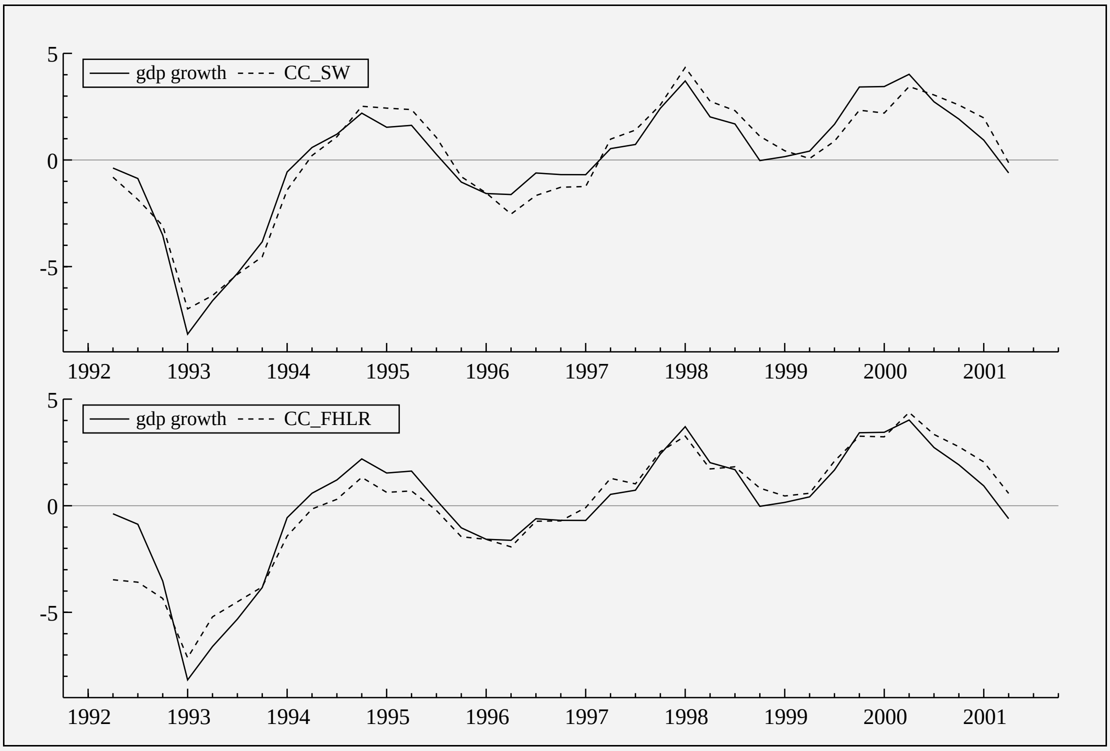
The balanced panel used to estimate the factors is similar to the one used for the forecasting model. In particular, it contains about 50 macroeconomic variables, including GDP and the demand components; employment, unemployment and unit labour costs; several deflators; fiscal variables such as direct and indirect taxes, government expenditure and transfers; short and long term interest rates; exchange rates; some foreign variables such as GDP, prices and interest rates for the US and Japan; and other miscellaneous variables. The sample period is 1991:I-2001:II, and the choice is due to the limited availability of Euro area data for a longer period, combined with the need to analyse a rather homogenous time period.

The factor model estimated with the SW methodology seems to fit the data rather well since about 60% of the variability of all the variables can be explained with four factors, a figure that increases to about 70% with six factors. The FHLR methodology works even better than SW as just two factors are enough to explain about 70% of the variability of all the variables.

Focusing on the regression of GDP growth on the estimated factors, with SW the R^2 is 0.80 when six factors are used. To obtain a similar value with FHLR, just three factors suffice. In both cases the regression residuals are well behaved.

Figure I.1.6 graphs the standardised annual GDP growth, together with the two resulting coincident indicators. Not only are the series highly correlated, but their business cycle behaviour is also virtually identical. This result supports our use of GDP growth as a simple but also fully informative measure of the status of the economy. Though the factor based methods can be useful for a timely evaluation, we prefer to rely directly on our model's forecasts of GDP.

Figure I.1.6: Standardised annual GDP growth rates and coincident indicators



CC_SW is the common component of GDP growth estimated using six SW factors. CC_FHLR is the common component of GDP growth estimated using three FHLR factors.

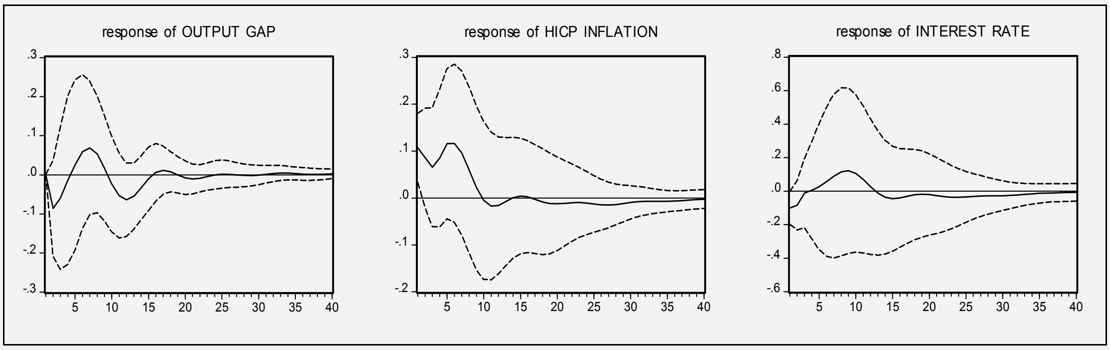
Box 1.3: The Impact of Macroeconomic Shocks on the Euro area

Several shocks have hit the Euro area in the recent past, including the temporary surge of oil prices, the slower growth in the US, the decrease in consumer and business confidence due to the terrorist attacks, the difficulties in the ICT sector and the related decrease in stock prices. The policy reaction to these shocks was first delegated to the monetary authorities, both in the US and in the Euro area, with the Federal Reserve and the ECB repeatedly cutting interest rates. An expansionary fiscal policy was also announced and partly implemented in the US. Instead, the European governments have had to rely mostly on the working of the automatic stabilisers, since the binding constraints of the SGP, combined with the deficit conditions in most countries, practically prevented the use of an active policy.

In this box we evaluate the likely impact on the Euro area of these shocks, and the expected effects of the expansionary monetary policy. We construct small-scale models (Vector Auto Regressions or VARs) for some key macroeconomic variables, relate the residuals in each equation to the shocks listed above, and evaluate the dynamic response of the variables to the shocks (see for instance Stock and Watson

(2001) for methodological details.[2]) We also report a measure of uncertainty around the estimated effects, which is unfortunately rather large as is common in this literature.

Figure I.1.7: Response of key Euro area macroeconomic variables to oil price shocks



Each graph reports the dynamic response to a 5% increase in the oil price with respect to its average value over the period 1991:I-2001:II. The size of the shock corresponds to one standard deviation of the residual in the VAR equation. The periods on the horizontal axis are quarters. The dashed lines are the 95% confidence bands.

To start with, we evaluate the effects of an oil price shock on the Euro area output gap (the difference of actual output from its potential level), HICP inflation, and short-term interest rate.[3]

In a standard aggregate supply – aggregate demand (AS-AD) model, this shock would cause an upward shift in the aggregate supply schedule, causing higher inflation and lower output. Actually, at the disaggregate level, the previous mix of inputs is no longer optimal for firms. Due to higher import prices, production is more expensive and thus lower in the new equilibrium. In addition, shifts between the sectors of the economy may be initiated, especially if higher oil prices are long lasting, due to the different energy intensity in the individual branches. However, structural adjustment is a long run phenomenon and cannot be analysed in this simple time-series framework.

Households are faced with a decline in real wages, implying a reduction in the purchasing power of their income. Workers may try to compensate these losses by demanding higher money wages, bearing the risk of wage-price spirals. As a consequence, the central bank may raise short-term interest rates to control inflation, thus holding down the resumption of growth somewhat.

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[2] VARs are estimated in levels over the period 1991:I-2001:II, using ECB data for the aggregate Euro area variables. This rather short sample is adopted to avoid major problems of instability in the parameter estimates and to focus on the recent past. The cost is that only a limited number of variables can be jointly analysed and the dynamics of the models have to be rather simple. Yet, the resulting models appear to provide a proper representation of the variables from the statistical point of view, and sensible economic results.

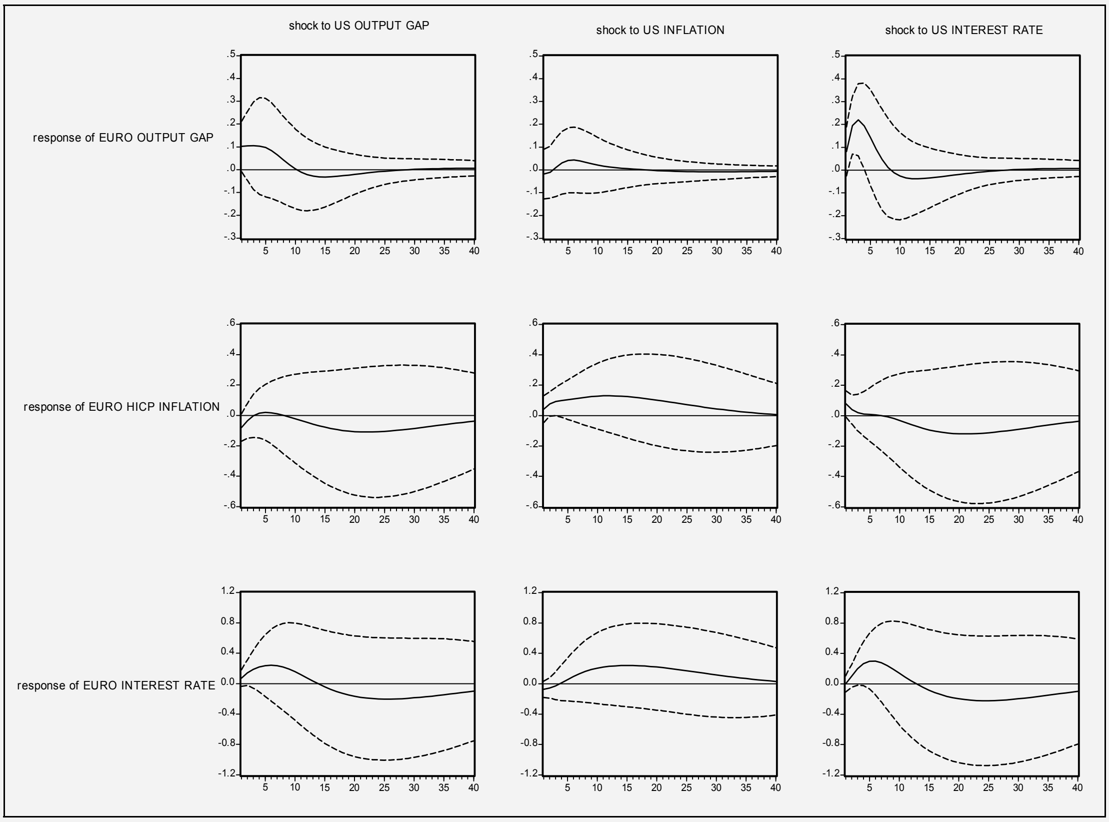
[3] In this case the VAR includes the oil price, a commodity price index, the output gap, HICP inflation and a short-term interest rate. Shocks to the first three variables are supposed to be uncorrelated, price shocks can have an immediate impact on inflation, and all shocks can affect the contemporaneous interest rate.

In addition there is a negative terms of trade effect through the worsening of the current account. If the oil-producing countries do not spend the higher revenues to increase their imports from the Euro area, demand in the Euro area falls.

Therefore, in response to the initial shock, output is expected to decline and inflation to increase, while the subsequent adjustment process is more uncertain, due to the possible demand effects and wage-price spirals.

The impact of the oil-price shock according to our model is coherent with expectations which can be seen from the first two graphs in Figure I.1.7. Moreover, the decrease in output appears to last about 4 quarters, while the increase in inflation is more persistent and eventually prompts a small increase in the interest rate, which serves to bring inflation down.

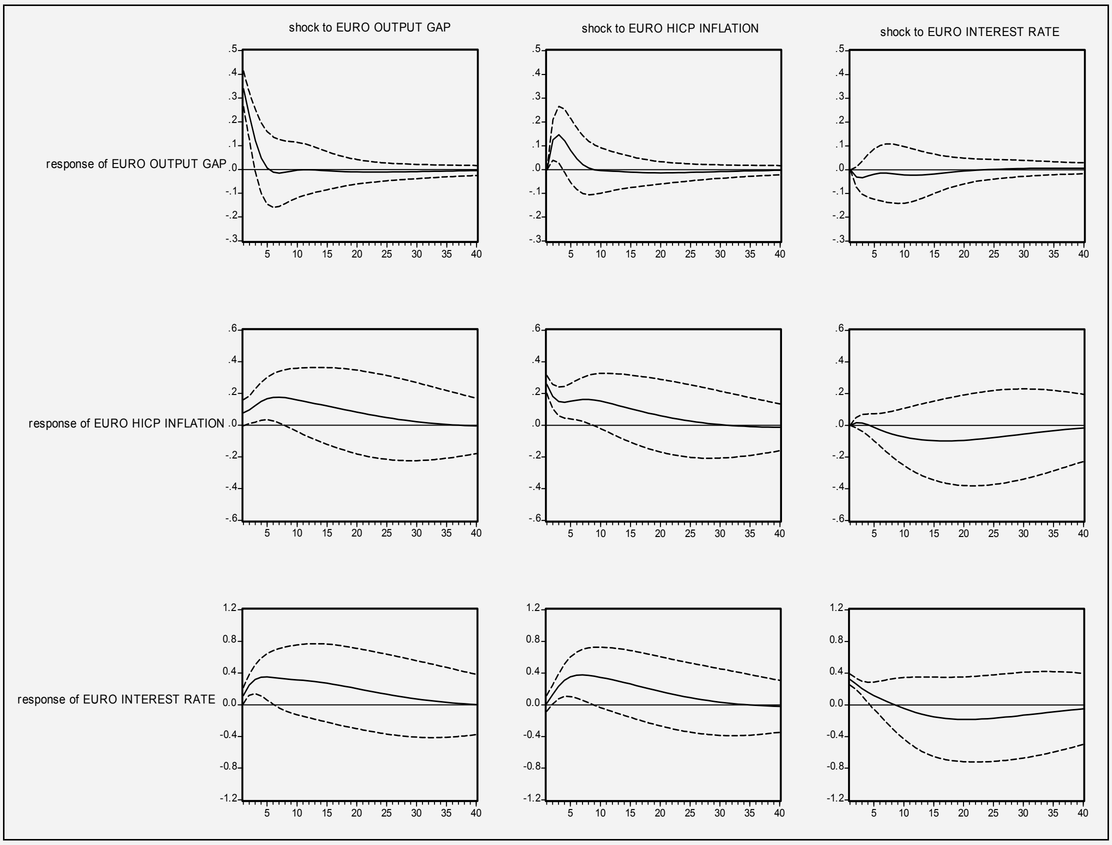
Figure I.1.8: Response of key Euro area macroeconomic variables to US shocks



The first column represents the dynamic response to a 4.5% increase in the US output gap with respect to its average value over the period 1991:I-2001:II. The second column represents the dynamic response to a 9% increase in the US inflation rate with respect to its average value over the period 1991:I-2001:II. The last column represents the dynamic response to an 8% increase in the US interest rate with respect to its average value over the period 1991:I-2001:II. The size of each shock corresponds to one standard deviation of the residual in each equation of the VAR. The periods on the horizontal axis are quarters. The dashed lines are the 95% confidence bands.

Next, we consider the effects of changes in the main US macroeconomic variables, a topic addressed in much more detail in the second part of the report.[4] From the graphs in the first column of Figure I.1.8, an increase in the US output gap has a positive but limited effect on the Euro area output gap, for 6-7 quarters; has virtually no impact on Euro area inflation (which suggests that the increase in output is mainly export driven), and is associated with a minor increase in interest rates. The latter is actually slightly delayed, mainly due to the increase in Euro area output. A shock to US inflation has virtually no effects on the Euro area output gap, while inflation starts increasing, which determines a later rise in the interest rate. Finally, from the last column of graphs in Figure I.1.8, an increase in the US interest rate leads to an increase in Euro area output (this is because higher US rates are typically associated with higher US output), and also a similar effect on Euro area interest rates, which then leads to a reduction in Euro area inflation.

Figure I.1.9: Response of key Euro area macroeconomic variables to Euro area shocks



The first column represents the dynamic response to a 4.7% increase in the Euro area output gap with respect to its average value over the period 1991:I-2001:II. The second column represents the dynamic

[4] The VAR includes the output gap, inflation and a short-term interest rate, for the US and for the Euro area. A recursive structure is adopted where the shock to the US output gap can contemporaneously affect all other variables, a shock to the US inflation can affect all variables except for the US output gap, and so on. The fact that US variables can have a contemporaneous effect on the Euro area but not vice versa is also supported by the large scale model used in the second part of the Report. The reason for the ordering output, inflation and interest rate is that the latter can react to contemporaneous values of the first two variables through a Taylor rule, while output typically reacts with a lag to changes in the other two variables. Moreover, alternative identification schemes do not alter substantially the results.

response to a 10% increase in the Euro area HICP inflation with respect to its average value over the period 1991:I-2001:II. The last column represents the dynamic response to a 5% increase in the Euro area interest rate with respect to its average value over the period 1991:I-2001:II. The size of each shock corresponds to one standard deviation of the residual in each equation of the VAR. The periods on the horizontal axis are quarters. The dashed lines are the 95% confidence bands.

Let us now consider the case of internal shocks. Since the equation for the Euro area output gap can be considered as a reduced-form supply schedule, shocks to this equation can approximate supply shocks, such as the problematic performance of the ICT sector. From Figure I.1.9, a supply shock of this type has a positive effect on the output gap, but for a very limited time, while the consequences on inflation, and on the interest rate, are more limited but also more lasting. The shock to inflation can be interpreted as a demand shock, for example a change in consumer and business confidence. Hence, it determines a temporary increase in output, for about 4-5 quarters, and an increase in inflation and in the interest rate. It is worth noting that the effect on inflation is more persistent than in the case of an oil price shock. Finally, the shock to the interest rate can be associated with a change in monetary policy. Its effects are also in line with what theory predicts: there is (a minor) negative effect on the output gap and a decrease in inflation.

Since the reaction to internal shocks is quite relevant from a policy point of view, we evaluated whether the effects we described are robust to changes in the specification of the model. In particular, it is important to evaluate the role of possibly omitted variables such as commodity prices, labour market conditions, exchange rates, stock market indexes, etc. Since only a few variables can be included in the model, we followed Favero and Marcellino (2001) in summarising the information in a large dataset of macroeconomic variables using a dynamic factor model, and then included the estimated factors into the VAR. There are only minor differences with respect to what is reported above.

With reference to the inflationary effects of the aggregate shocks, a higher Euro area output has a very minor negative impact on inflation, followed by a substantial increase due to the positive effect on output, while an aggregate inflation shock is transmitted rather quickly. The reaction to the interest rate is negative for France, Italy and Spain (after a few quarters), but it is positive for Germany, confirming that the structural VAR approach should be used with care for this country.

Overall, this analysis finds support for a traditional AS-AD interpretation of the macroeconomics of the Euro area, and confirms the relationships with the US, even though its magnitude is rather small.

2. Labour Market Developments

2.1 Labour market conditions in the Euro area

The effects that the advent of the monetary union will have on the European labour market have yet to be strongly evidenced and academic analyses point in different directions (for recent reviews, see Bertola and Boeri (2001) and Calmfors (2001)).

For the moment at least the term “European labour market” remains something of a misnomer as the mobility of labour that could make the labour market in Europe comparable with that in the US is lacking. Rather, as noted by Allsopp (2002), the various national labour markets in the Euro area are connected through the macroeconomic adjustments which arise from the wage and cost developments that occur in those markets. In the absence of the possibility of nominal exchange rate change, this must be a significant avenue for intra-area adjustment, the more so in those cases where the discipline of the SGP inhibits significant fiscal adjustments.

One insight into the debate about the effects of the introduction of the single currency comes from observing that product market competition stands to be sharpened as a result. This effect may in some countries work to encourage reforms operating in the direction of more competitive markets with greater flexibility; yet in some other countries it may work to encourage corporatist means of adjustment, as the social partners internalise the adjustment problem. To date, the latter effect is arguably the more visible form of adjustment (Pochet (2001)) to have taken place. An associated problem of some significance for the nature of intra-area adjustments arises where internalization takes the form of a decision to target wage increases against those arising in Germany (the "German wage leadership" model): this clearly has implications for Germany's ability to adjust via flexibility in its competitiveness and relative wage costs.

Another insight in the debate stems from the idea that an important part of the Bundesbank's former role – its ability to signal its policy intentions to labour unions in Germany – has been subverted by the transfer of monetary policy powers to the ECB. In other countries, too, it may be that the transition to EMU and the consequent relocation of monetary policy decision-making to a more remote location has a similar consequence, but clearly the German case is the most significant, especially given her influence on wage-setting in Europe.

A much older suggestion is that the transparency effects of the introduction of the single currency may lead to a premature convergence of wages, in advance of productivity. This would be very damaging for the lower-income, lower-productivity countries, whose competitive advantage would stand to be removed. (see Artus (2002)).

This is not the place to rehearse the entire debate, but enough has been said to indicate that developments in the European labour markets are likely to be highly significant for the way in which intra-area adjustment occurs. In what we say below we first of all review developments in unemployment in the Euro area and in the individual national markets and then report on the development of wages and associated costs.

Unemployment

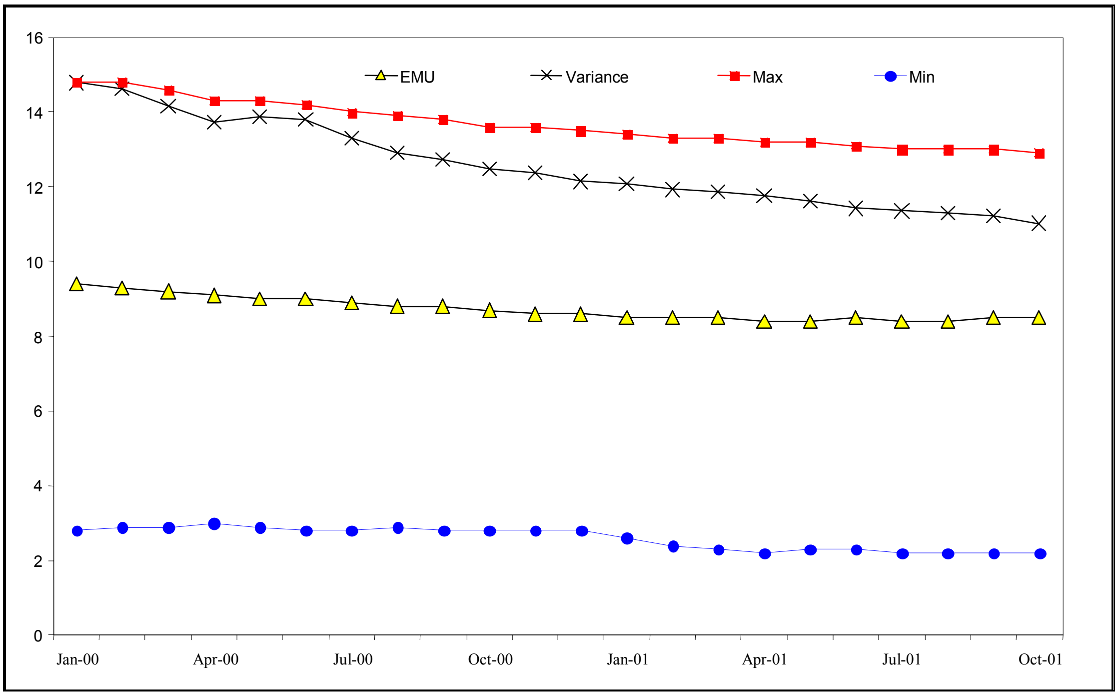
After a gentle decline during 2000, unemployment in the Euro area as a whole began to rise through 2001 (Figure I.2.1). In retrospect, this increase set in even before the events of September 11th and reflects the nearly coincident downturn in economic activity in the Euro area and the US from the beginning of the year. A decline in its dispersion (Figure I.2.1) accompanied the tendency for the overall level of unemployment at first to fall and was then partially reversed as the average level of unemployment rose again. The country detail of the unemployment experience is reflected in the summary data below and in Figure I.2.2.

Table I.2.1: Unemployment rates (%) in the Euro area

	EMU	AUT	BEL	DEU	ESP	FIN	FRA	IRE	ITA	NLD	PRT
Dec-00	8.6	3.6	6.8	7.7	13.5	9.3	9.1	3.8	9.9	2.8	4.0
Dec-01	8.5	4.2	6.9	8.0	12.9	9.1	9.3	4.2	9.3	2.2	4.3

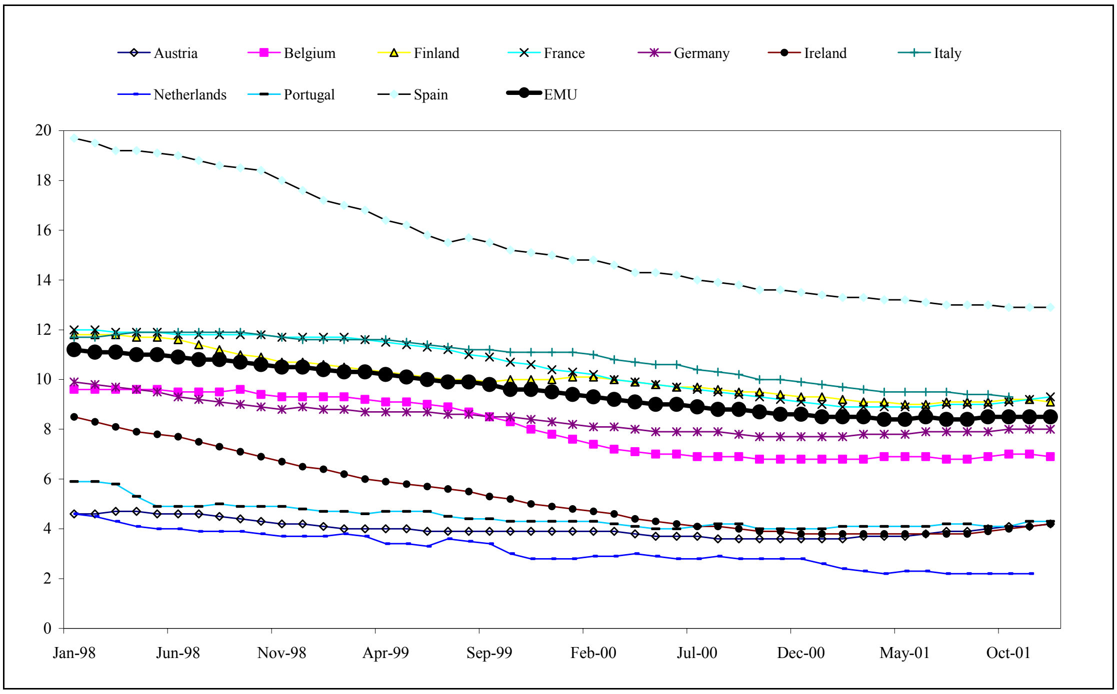
Countries labelled using OECD standardised definition.

Figure I.2.1: Unemployment rates: max, min, variance



The figure shows the range, from maximum to minimum, of member-country unemployment rates, as well as the overall Euro area mean and the cross-country variance around that mean.

Figure I.2.2: National unemployment rates



Source: OECD

The group of high unemployment countries, including Greece, Spain, Italy and Finland, shows a generalised fall in the unemployment rates. Low unemployment countries on the other hand show an increase in the unemployment rate in the last 12 months. The positive exceptions are Ireland and the Netherlands, with the worrisome cases being France, and especially Germany, considered until recently to be the driving force of the continental economy. These differentiated trends appear to be the product of very different structural and policy stances in the different countries, underlining the segmentation of the European labour markets.

Perhaps the most worrisome case at the beginning of 2002 seems to be Germany, where the standardized unemployment rate stood at 8% in December 2001, up from 7.7% 12 months earlier, thereby ending the continuous reduction in unemployment that began in 1998. In the same month vacancies went down by 14.6% on a yearly basis.

The prospects for the German labour market remain quite weak, and it is therefore to be expected that unemployment will remain above 8% for some time before starting to recede. The German government is putting into place incentive schemes to enter the job market targeted at low-skilled workers; it is likely that this program will affect about 20.000 workers, which is quite a small number compared with the number of 154.000 new unemployed since January 2001, and an even smaller number compared to the total unemployment figure of about 4 million.

France has experienced an economic slowdown somewhat similar to Germany, but with more sustained domestic demand. In December 2001 the unemployment rate was at 9.3% of the workforce, 0.2% higher than 12 months before, but still lower than the level before 2000. The reduction of weekly working hours to 35, introduced in 1998, has had a role in keeping employment high, as well as the increase in part-time jobs. The same legislation will apply to small (less then 20 employees) firms from 2002, but the additional effect is expected to be moderate. The positive aspect is that the reduction of working hours does not appear to have substantially deteriorated the competitiveness of French labour; unit labour costs having risen by only 5.5% since the entry in the EMU, more than Germany but less than many other Euro area members. A measure that could have helped to get such an outcome is the decrease in social compensation for low wages.

Greece, Italy and Spain are examples of countries with high but decreasing unemployment. Despite the relatively good performance recently, unemployment rates in these countries remain high and are not likely to decrease much in the near future. Furthermore, many of the newly created jobs are of a temporary nature and productivity growth in Spain seems to have lost momentum due to the entrance in the labour market of more unskilled workers. Spain is also characterised by a relatively strong increase in real labour costs since the entry in the EMU (around 11%). Ireland and the Netherlands represent two special cases in terms of their labour market behaviour. Until recently, the Irish case represented a very tight labour market with a strong pressure of demand causing an upward adjustment of real wages; now, however, unemployment has started to rise a little. The "unemployment miracle" of the Netherlands (Nickell and Van Ours, 2000) has experienced a marked slowdown in the first half of 2001. Unit labour costs have increased by 14 per cent since the beginning of the EMU. Still, the unemployment rate was 2.2 per cent in December 2001, lower than the 2.8 per cent of the previous year, following a trend that began in 1995.

Wage and cost developments

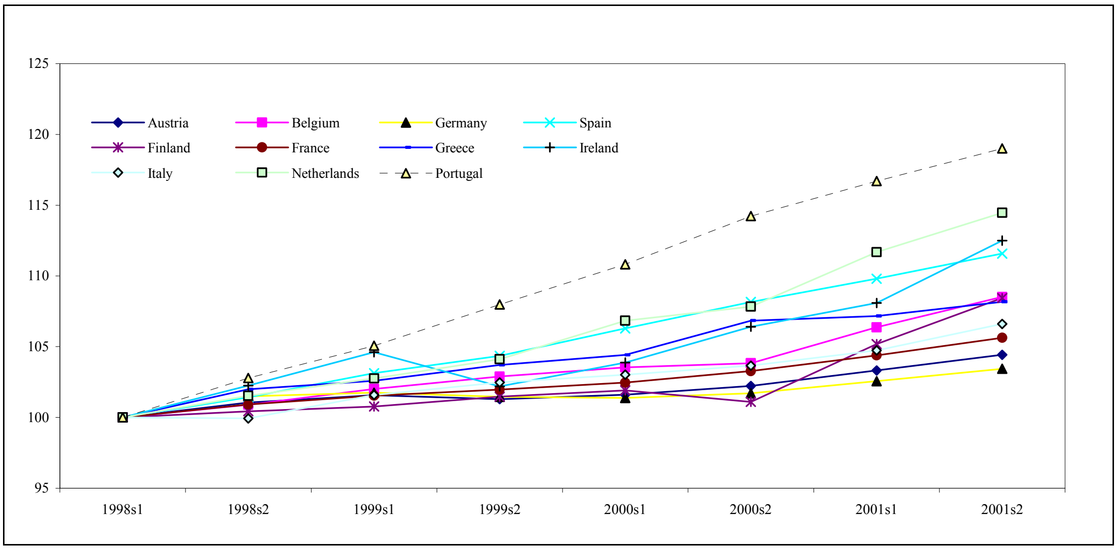
The development of wage costs (compensation per employee) and of unit labour costs is shown in Figures I.2.3 and I.2.4 and the summary table below. The position of Portugal stands out, with its increase in compensation per employee the second highest in the group and its unit labour costs the highest of all. The Netherlands also demonstrates a relatively fast development in both these variables.

Table I.2.2: Compensation per employee and unit labour costs (1998= 100)

	AUT	BEL	DEU	ESP	FIN	FRA	GRE	IRE	ITA	NLD	PRT
Unit Labour costs, end 2001	104.4	108.5	103.4	111.6	108.4	105.6	108.2	112.5	106.6	114.5	119.0
Compensation per employee, end 2001	108.0	112.5	105.4	113.5	113.0	108.1	119.1	127.1	109.1	115.6	119.5

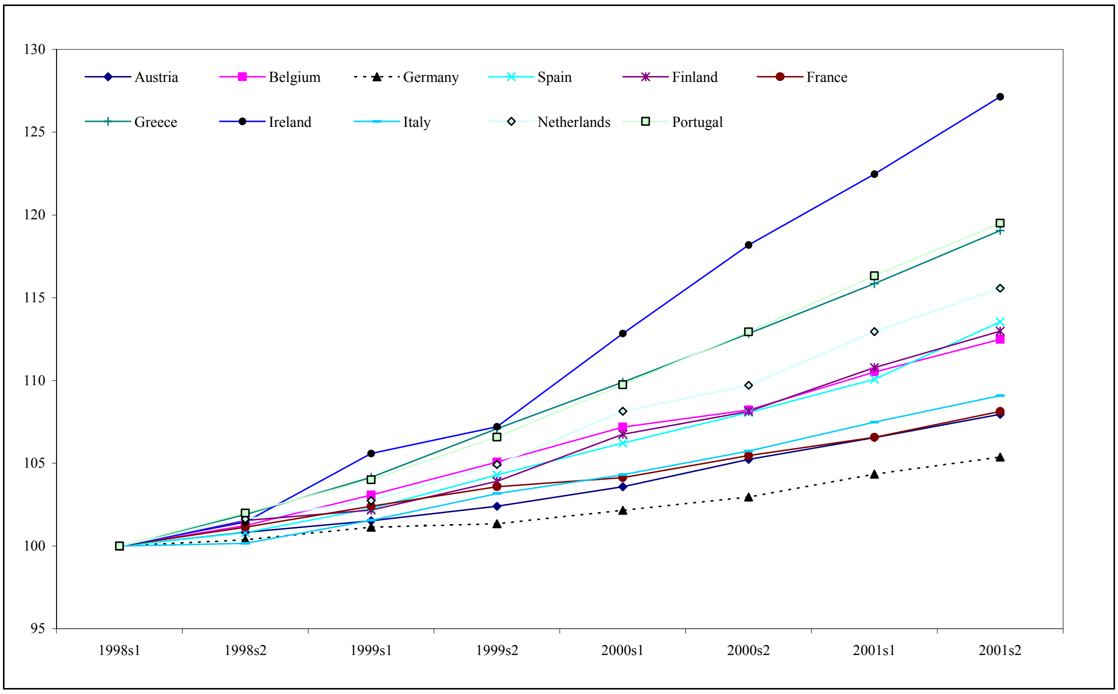
No data are available for the Euro area and the UK.

Figure I.2.3: Unit labour costs, 1998=100



EFN calculations on OECD data. Euro area data are not available.

Figure I.2.4: Compensation per employee, private sector, 1998=100



EFN calculations on OECD data. Euro area data are not available.

2.2 Expected Developments

As a consequence of the rather low GDP growth forecast for 2002, unemployment in the Euro area as a whole is expected to remain rather stable, at values around 8.4%. Unit labour costs are expected to increase in line with inflation, while real wage growth is expected to be about one percentage point higher than inflation, notwithstanding the unemployment conditions.[5]

The higher GDP growth expected in 2003 is not sufficient to reduce unemployment very much; firms are still likely to be cautious about the strength of the recovery and will prefer to postpone new hirings. Higher output combined with a more or less stable employment should foster a moderate rate of increase in unit labour costs, while the wage growth is positive.

Table I.2.3: Euro area forecasts for annual rates of unemployment, unit labour costs growth and wage growth

	2002:II	2002:IV	2003:IV
Unemployment (%) rate	8.4	8.4	8.1
	[8.1, 8.7]	[7.9, 9.1]	[7.5, 9.2]
Unit labour costs growth rate	2.4	2.5	2.3
	[2.1, 2.8]	[1.7, 3.0]	[1.5, 3.1]
Wage growth rate	2.7	2.9	2.7
	[2.4, 3.0]	[2.3, 3.4]	[2.0, 3.3]

For each projection, the first and the second rows report the mean and the 80% confidence bands, respectively, of 2000 stochastic simulations. EFN forecasts using the structural macroeconometric model described in Annex 2.

Structural reforms that persuade firms to believe in a persistent increase in GDP growth would have positive effects on the unemployment rate. A more flexible labour market might also induce firms to anticipate their hiring decisions.

Box 2.1: Response of Labour Market Variables to a Temporary Shock to GDP

In this box we evaluate the possible effects on labour market variables of a shock to GDP using the VAR methodology.[6] After a negative shock, different adjustment mechanisms can act to attenuate its effects. Migration to more dynamic territories, fiscal redistribution, a high flexibility of prices and wages can help to adjust quickly to negative shocks to production and employment.[7] Yet, within the framework of the optimum currency area literature, different studies have shown that in Europe these mechanisms do not work particularly well, compared with other countries such as the United States or Canada.[8]

In Figure I.2.5 we plot the reaction of the participation rate, unemployment, real wages, the output gap and the inflation to a positive shock to growth. It can be seen

[5] Our inflation forecasts are reported below, in Table I.3.1

[6] VARs are estimated in levels over the period 1991:I-2001:II, using the ECB data for the aggregate Euro area variables. The VAR considered here includes the participation rate, the unemployment rate, real wages (deflated with the GDP deflator), the output gap and GDP deflator inflation for the Euro area. An alternative ordering of the variables does not substantially alter the results.

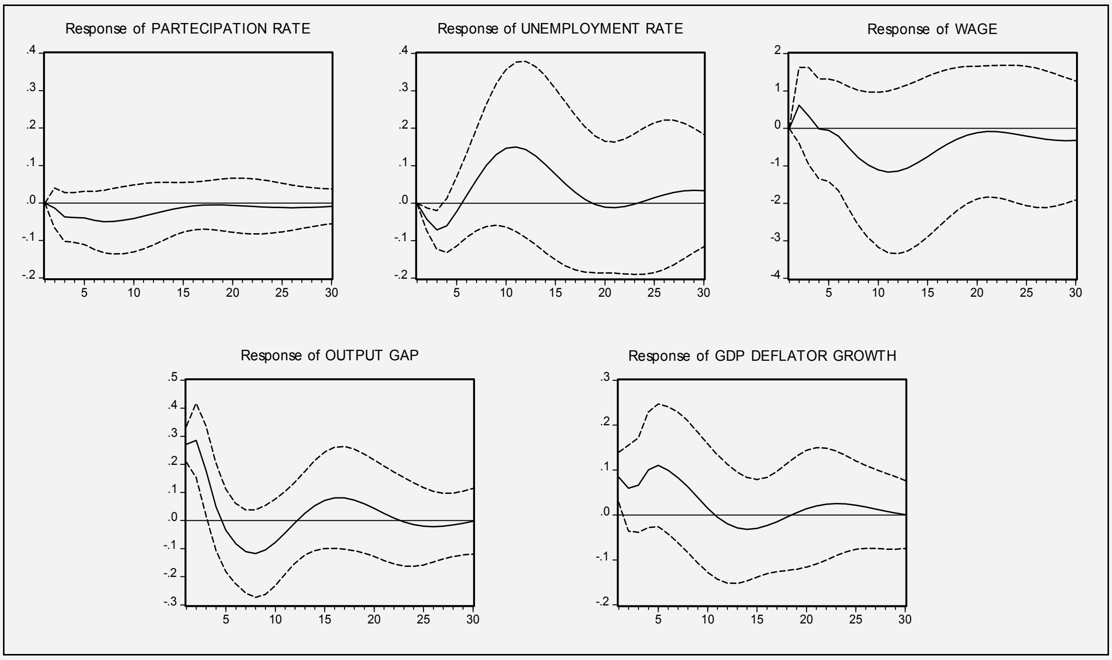
[7] In this analysis, it is assumed that monetary policy is not used after the shock.

[8] Layard et al. (1991), Blanchard and Katz (1992), Decressin and Fatás (1995), and Viñals and Jimeno (1996), among others.

that such a shock is absorbed after about 5 quarters, but during this period unemployment decreases and the real wage mildly increases, notwithstanding the increase in inflation. The effects on the participation rate are very minor.

After the initial period, the shock in output is reversed, and this is associated with an increase in unemployment and a decrease in real wages. These results, though, should be interpreted with care, due to a high degree of uncertainty as testified by the magnitude of the bands around the expected responses of the variables.

Figure I.2.5: Response of Euro area labour market variables to output gap shocks



Each graph reports the dynamic response to a 3.8% increase in the output gap with respect to its average value over the period 1991:I-2001:II. The size of the output gap shock corresponds to one standard deviation of the residual in its VAR equation. The periods on the horizontal axis are quarters. The dashed lines are the 95% confidence bands.

The impact of the output gap shock on unemployment implies a coefficient of about 3.5 in Okun's law, versus a common estimate of about 2.5-3 for the US. [9] Hence, stronger growth is required in Europe than in the US to decrease unemployment or, in other words, the impact of a negative output shock is larger in Europe than in the US. Such an outcome is related to the aforementioned higher flexibility of the US labour market,[10] and confirms the need to advance in labour market reforms that could improve the adaptability of the European economy against adverse shocks.[11]

[9] Okun's law empirically relates deviations of output from its potential level and deviations of unemployment from its natural rate.

[10] The results of a survey reported in European Economy (2000) show that in the opinion of both managers and employees there is considerable a need for greater flexibility in the European labour markets.

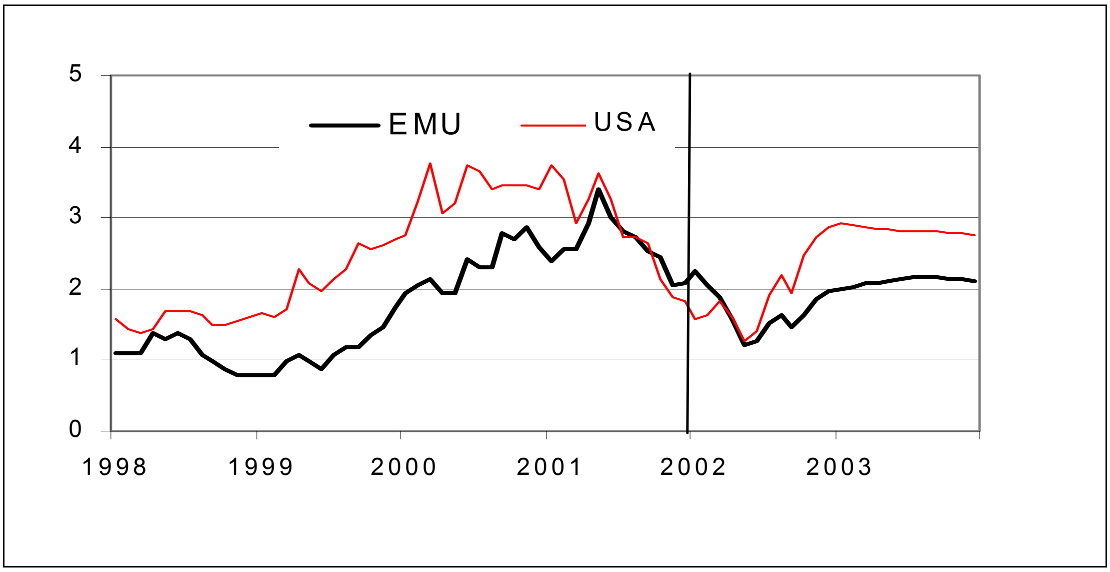
[11] See for example Nickell (1997) or Blanchard and Wolfers (2000).

3. Price Developments

3.1 Recent Evolution

During the last three years inflation in the Euro area has shown a systematic increase (see Figure I.3.1). Thus the annual rate has passed from an average value of 1.1% in 1998 to a year-on-year rate of 2.1% in December 2001. The rise in inflation between 1999 and 2001 was partly due to the rise in energy prices. However, the main factor behind these higher inflation rates has been core inflation. Core inflation is defined as inflation after excluding energy and non-processed food prices from the HICP. Our results and conclusions are practically the same if the core measure also excludes processed food prices.

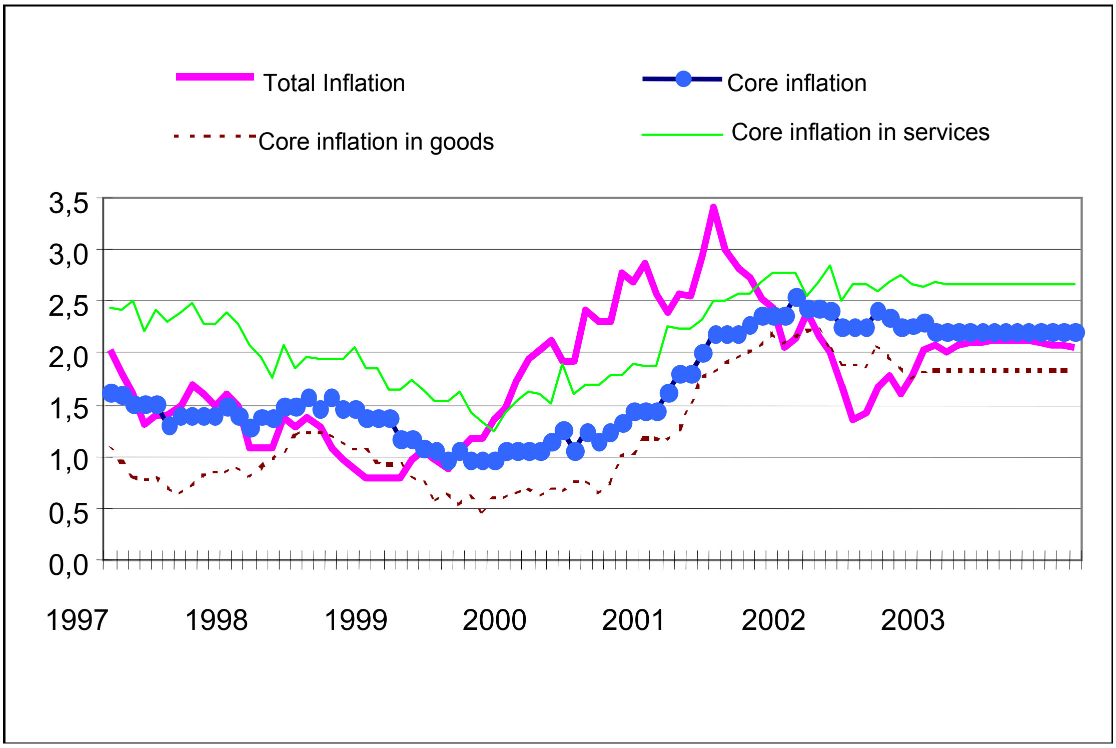
Figure I.3.1: Year-on-year inflation rates in the Euro area and in the US



From January 2002 the values are forecast.

Core inflation in the Euro area has gone from an average annual rate of 1.1% in 1999 to a year-on-year rate of 2.5% in December 2001 (see Figure I.3.2). The corresponding rates for the US core inflation are 2.1% and 2.7%. Therefore, the increase in prices during these years in the Euro area has been general, and in the core part of them the increment has been higher than in the US.

Figure I.3.2: Year-on-year rates of core and total inflation



From January 2002 the values are forecast.

Core inflation can be broken down into inflation in goods markets and in services markets. The core inflation in services in the Euro area has increased from 1.5%, the annual average rate in 1999, to 2.5% the year-on-year rate in December 2001. A similar profile has been seen in the US, but from a higher level, going from 2.7% to 4.0%. In spite of the depreciation of the Euro with respect to the dollar of about 25% during these three years, the inflation differential with respect to the US in the service sector in the Euro area has increased slightly from 1.2 to 1.5 percentage points. This has been so because the service sector is relatively closed to international trade.

Looking at core inflation in goods, a completely different story emerges. In the Euro area, core good inflation has jumped from an annual average rate of 0.7% in 1999 to a year-on-year rate of 1.6% in December 2001. The corresponding rates in the US have been 0.7% and a negative one of 0.3%, with a positive average rate of 0.3% in 2001. The competitive advantage obtained in the Euro area from the depreciation has been undermined by the adverse inflation differential in the sector most widely open to international trade.

3.2 Expected Developments

In forecasting inflation, it has been observed that the structural model produces less accurate forecasts than those obtained by an alternative approach proposed in Espasa et al. (1987 and 2002) based on disaggregating HICP and modelling its components. Consequently, the inflation forecasts in this report are obtained from the Espasa et al. procedure and imposed on the structural model.

The inflation forecasting approach used is suggested by the observation that prices in different markets are driven by more than one common trend factor and more than one common seasonal factor. In such circumstances disaggregating HICP by markets (processed food, non-processed food, energy, other goods and other services) provides more information on the key elements for the behaviour of HICP: trend and seasonality.

The forecasting procedure uses linear and non-linear time series models for each component and does not give a causal explanation of the inflation forecasts. Hendry (2001) shows that single theories, demand-pull, cost-push, monetary, imported inflation, etc. fail to explain inflation in the UK in a sample of 125 years, and in order to account adequately for the behaviour of inflation over this period, the econometric model should include all theories. The estimation of a model of this type, given the data available for the Euro area, is not possible. However, the alternative followed in this report is quite in accordance with Hendry´s results because each one of the above theories is more relevant to explaining inflation in one market than in the others. Thus, by disaggregating by markets we implicitly capture more precisely the effect of the different causes of inflation, even using time series models. In addition, since we end up with inflation forecasts for the different markets, by analysing the differences between those forecasts we get a hint about the causes which could be driving inflation.

The prospects for 2002 and 2003 (see Table I.3.1) are that core inflation decreases by a few tenths of a percentage point. The forecast values for the annual average rates in 2002 and 2003 are 2.2% for both years. This minor reduction in the core inflation rate will come from prices on processed food and services, since core inflation in commodities excluding food will increase by 1.8% in 2002 and will grow at the same rate in 2003.

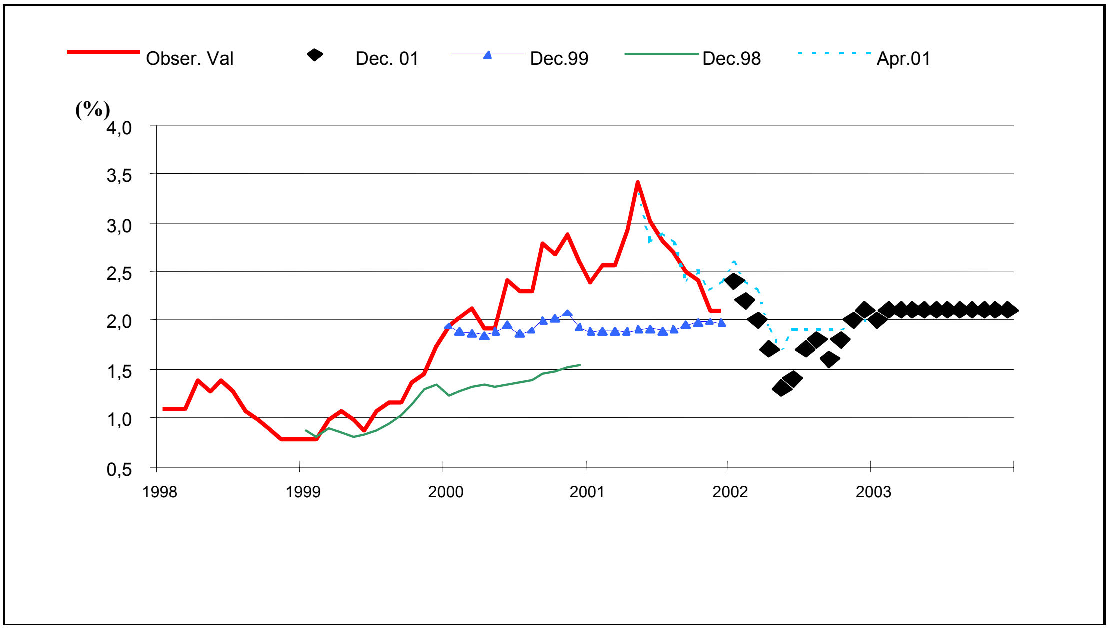
For total inflation the expectation is for a minor reduction at the end of 2002 to a value of 2.0%, from the 2.1% observed in 2001, to increase again to a level of 2.2% in 2003. In contrast with the relatively stable evolution forecasted for core inflation, total inflation will oscillate - increasing in January 2002, decreasing to around 1.4% in May-June 2002 and jumping again to 2.0% at end of the year, and to 2.2% at the end of 2003. Figure I.3.3 shows different path forecasts for total inflation at different points in time.

The above forecasts imply that the inflation target established by the ECB will only be attained during the period March to November 2002. This will be due to two main factors. The first is the favourable behaviour of non-processed food prices for which the year-on-year rate of growth will decrease from values of over 9% in the middle months of 2001 to values of around 1.5% from May 2002 onwards. The other force pushing down global inflation in the greater part of 2002 will be the price of energy. The average annual rate of growth will decrease to a negative value of -3.4% in 2002 from a positive value of 2.7% in 2001.

Therefore, the fulfilment of inflation targets in most of the months in 2002 is due exclusively to the behaviour of the most volatile prices in the economy, namely non-processed food and energy, which weight around 17.5% in the HICP. These prices are more sensitive to imported inflation and less affected by demand-pull, cost-push or monetary factors. On the other hand, core inflation has not been below 2% since April 2001 and is not expected to be so during 2002 and 2003. As a result, the fulfilment of the inflation target is not very firm. In fact, in December 2002 it is expected that energy prices will attain positive year-on-year rates of growth which will be maintained during 2003 around a mean of 1.4%. This will push total inflation to 2.2%, very close to the core inflation rate.

The above forecasts show that the 2% inflation target is not achieved in the medium term, because core inflation is above the target and the remaining prices will not help in reducing total inflation from the core rates in 2003. Thus, it can be said that those factors causing inflation are mainly domestic and we can expect that it will take time for a change in the behaviour of such factors. This also opens up the question of whether the inflation target should be regarded as important. As far as it has been adopted in such terms by the ECB, which is a very young institution which needs to earn the credibility of economic agents, there is neither much room nor time for a flexible interpretation of the inflation target and the target once it has been defined must be taken seriously.

Figure I.3.3: Annual forecasts for Euro area total inflation at different points in time



Nevertheless, the positive aspect of an inflation target is possibly the same or even higher when the target is defined, explicitly or implicitly, by an interval. In this sense, it is practically the same to have an inflation rate in the Euro area just below 2% in 2003 as just above it, as forecast. The big difference relies on how it could affect the credibility of the ECB. The definition of the inflation target becomes more relevant if we consider that HICP most probably measures inflation with a positive bias due to quality improvements not only in commodities but also in many services. If this is the case, it seems convenient that once the inflation target is achieved in the next few months, the ECB reconsider a new definition of the inflation target which contemplates an interval value.

By countries the inflation situation is as follows. In the average annual rate, the inflation target in 2001 was not achieved by anyone except France (1.8%). Six other countries, namely, Germany (2.4%), Austria (2.3%), Belgium (2.1%), Finland (2.7%), Italy (2.7%) and Luxembourg (2.4%) registered inflation rates below 3% and the remaining five countries, Spain, The Netherlands, Ireland, Portugal and Greece had inflation rates between 3.7% and 5.1%.

Therefore, the lack of success in attaining the inflation target was general by sectors throughout the whole Euro area: processed goods and services excluding energy, on which core inflation is calculated, non-processed food and energy, and quite general by countries. For 2002-2003 it can be expected that the target will be achieved in seven countries, which weight around 79% in the total, but for four of the other five countries, which are the ones experiencing more inflation at present, the expectations are that in 2002 and 2003 they will register average annual rates still above 3%.

The results seem to point out that before Maastricht, a convergence process in inflation took place, but once the Monetary Union has been in operation, the convergence could be in the price levels. This is the result which could be expected for homogeneous goods and services, but in most of the countries with higher inflation - Spain, Ireland, Portugal and Greece - the quality of goods and services could be different from the other countries of the Union. Then the convergence in prices would be worrisome unless a parallel convergence process in quality also takes place. Statistics on quality and consumer satisfaction in goods and services seem necessary in order to evaluate the impact of quality improvements in the possible bias in measuring inflation and in the process of price convergence throughout the Euro area.

Table I.3.1: Comparative summary of inflation forecasts for the Euro area and the US

Inflation forecasts for the Euro area and the US								
					Forecasts			
	1998	1999	2000	2001	2002		2003	
	(a)	(a)	(a)	(a)	(a)	(b)	(a)	(b)
TOTAL INFLATION								
Euro Area	1.1	1.1	2.3	2.6	1.8	2.0	2.1	2.2
US	1.6	2.2	3.4	2.8	1.7	2.9	2.9	2.8
CORE INFLATION								
Services and Non-energy industrial goods excluding food.								
Euro Area	1.4	1.1	1.2	2.1	2.3	2.2	2.2	2.2
US	2.3	2.1	2.4	2.7	2.7	2.8	2.8	2.8
DIFFERENT COMPONENTS OF CORE INFLATION								
(1) Services								
Euro Area	1.9	1.5	1.7	2.5	2.7	2.7	2.7	2.7
US	3.1	2.7	3.3	3.7	3.8	3.7	3.7	3.7
(2) Non-energy industrial goods excluding food								
Euro Area	0.9	0.7	0.7	1.4	1.8	1.8	1.8	1.8
US	0.6	0.7	0.5	0.3	0.1	0.5	0.6	0.7
INFLATION IN EXCLUDED COMPONENTS FROM CORE INFLATION								
(1) Food.								
Euro Area	1.6	0.6	1.3	4.6	2.4	1.9	1.8	1.8
US	2.2	2.1	2.3	3.1	2.4	2.6	2.7	2.7
(2) Energy								
Euro Area	-2.6	2.4	13.3	2.7	-3.4	1.1	1.4	1.1
US	-7.8	3.6	16.9	3.8	-10.3	5.0	3.8	2.5

(a)Average annual rate of growth. (b)Year-on-year rate of growth in December

4. Exchange Rates and External Demand

4.1 Recent Evolution

The dollar to Euro nominal exchange rate

From January 1999 until the end of 2001, the Euro has depreciated by around 25% against the dollar. Although this depreciation has been continuous over time, some differences in the time evolution of the exchange rate against the dollar can be observed.

During the first seven months of 1999, the Euro declined against the dollar by around 12% (see Figure I.4.1, upper graph). During the following three months, the Euro recovered but it ended the year with a 15% depreciation. The most important factors explaining this behaviour were the respective cyclical outlooks for the US and the Euro area and the better than expected performance of the US Economy after the global financial crisis in the second half of 1999.

During most of 2000, the Euro continued to decline against the dollar although it strongly rebounded at the end of the year. This declining trend was also interrupted in May and June when the exchange rate achieved levels above 0.95. On October 26th the Euro dropped to 0.8252 , its lowest value against the dollar since its birth. At the end of the year, however, the total depreciation was lower than the previous year: around 8%. The factors behind this evolution were more related to the relative strength of the US economy rather than to the bad perspectives of the Euro area economy.

The volatility of the Euro against the dollar during 2001 has been the lowest of the last three years. The standard deviation of the daily exchange rate was 0.04 during 1999, 0.05 during 2000 and 0.027 during 2001. The downward trend observed during the first half of the year was similar to the one in the previous year, although it did not reach the trough of October 2000.

Changes in the evolution of interest rates in the United States and in the Euro area also contribute to explaining the evolution of the dollar to Euro exchange rate from July to September 2001. As will be explained in the next section, after having increased since the second quarter of 1999 to the fourth quarter of 2000, short-term interest rates in the Euro area decreased substantially in 2001. This decrease, together with the reduction of the differential with US short-term interest rates, put pressure on the dollar to Euro exchange rate during these months. The influence of the terrorist attacks of September 11th seemed to prompt the appreciation of the Euro, but the expectations of a quick recovery of the US economy together with the relative success of the US military campaign in Afghanistan and changes in expectations affecting long-term interest rates eventually depressed the Euro. In this sense, it is important to remark that during the last months the exchange rate against the dollar has remained more stable than before. During 2001, the Euro depreciated by 6.5%, much less than in 1999 and 2000.

Figure I.4.1: Nominal exchange rate of the Euro against the US dollar (upper graph) and the Japanese Yen (lower graph)

Daily nominal exchange rates. Source: ECB Monthly Bulletin, January 2002.

The Yen to Euro nominal exchange rate

The evolution of the nominal exchange rate of the Euro against the Japanese Yen has been very similar to the Euro against the dollar during most of the last three years.

From January 1999 to December 2001, it has depreciated in nominal terms by about 14% (see Figure I.4.1, lower graph).

From January 1999 until October 2000, the Euro depreciated more than 33% against the yen in nominal terms. On October 26th it reached its lowest value: 89.3 yens per Euro. Since that time, the Euro has strongly recovered achieving levels close to 110 yens per Euro and its volatility has reduced considerably. The strong recovery of the Euro can be explained by the quick worsening of the outlook for the Japanese economy.

During 2001, the exchange rate against the yen was quite stable, although two different trends can be observed. From April to May the Euro depreciated, whereas since May until the end of the year it appreciated substantially (more than 14%), due to a further deterioration of the Japanese situation and some strong intervention by The Central Bank of Japan on foreign exchange markets.

The effective exchange rate of the Euro in nominal and in real terms

According to the methodology used by the ECB, the effective exchange rate of the Euro is measured against the currencies of the 12 most important trading partners of the Euro area. As nearly 50% of the total trade of the Euro area is done with the UK, the US, Switzerland, Japan and Canada (see Figure I.4.2), the evolution of the effective exchange rate of the Euro is very similar to the one commented on in the previous sections: from the beginning of 1999 until October 2000 there was a continuous depreciation of around 23%, from October 2000 to December 2001, the Euro appreciated to a value 16% lower than in January 1999 (see Figure I.4.3). Movements in the effective exchange rate mirrored quite closely those of the real rate.

Figure I.4.2: Main trade partners of the Euro area during 2000

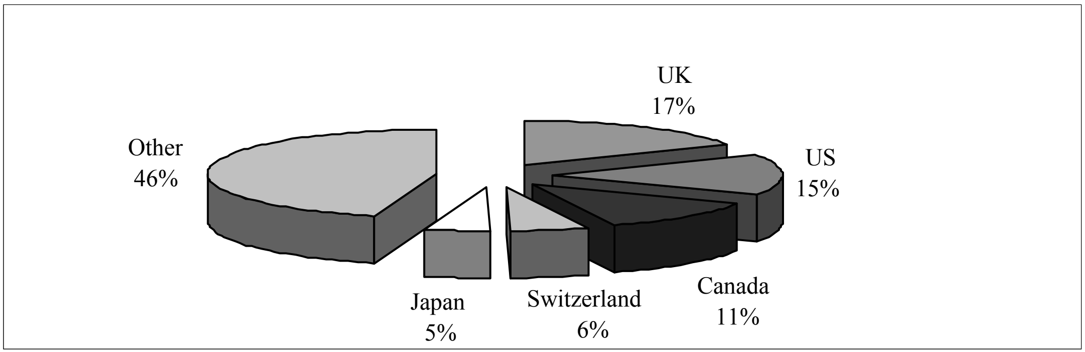


Figure I.4.3: Nominal effective exchange rate of the Euro

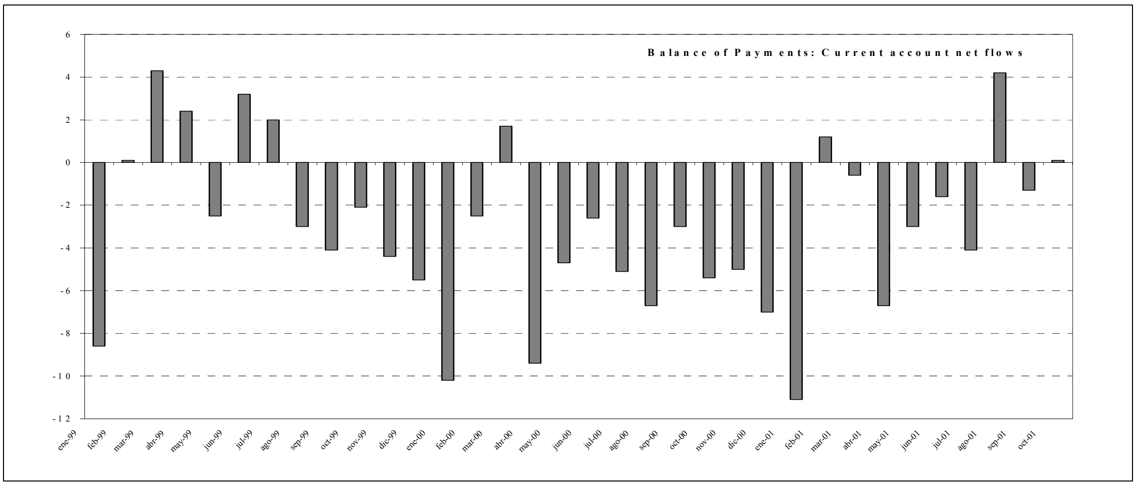
Daily nominal effective exchange rate, 1999:I=100. Source: ECB Monthly Bulletin, January 2002.

Balance of payments

Current account

Since 1999, the current account has usually recorded deficits that have, however, substantially decreased during the last months of 2001 (see Figure I.4.4). In fact, in August and in October 2001 the current account moved to surplus. During the first ten months of 2001, the cumulated current account deficit halved with respect to the same period of the year before. This fact reflects the increase in the cumulated surplus in goods trade (due to an important increase in exports combined with a decrease in imports caused by a slowdown in domestic demand) and the switch of the services account from deficit in 2000 to surplus in 2001. However, the deficit for current transfers was similar to the one registered in the previous year. It is also important to highlight that the income deficit increased during 2001.

Figure I.4.4: Balance of Payments: Current Account net flows

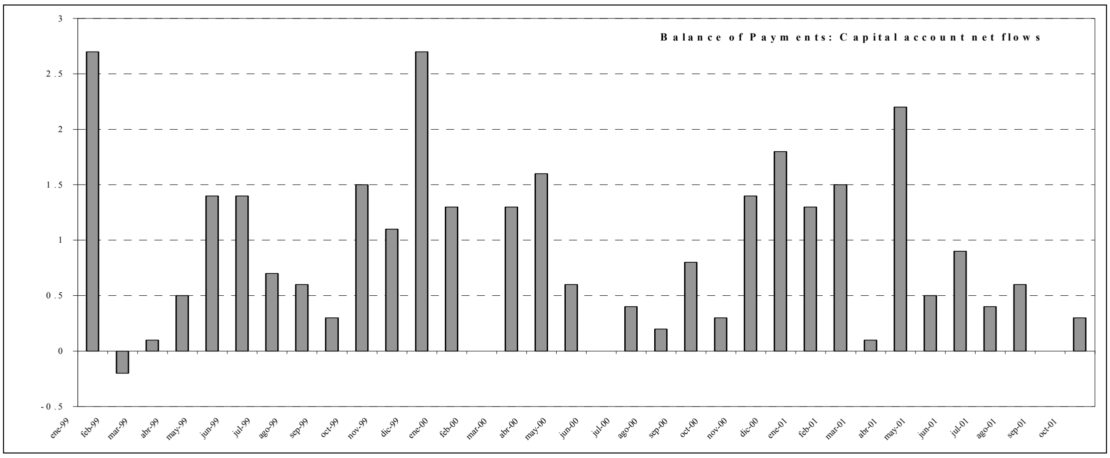


Billion of Euro. Source: ECB Monthly Bulletin, January 2002.

<u>Capital account</u>

The capital account covers capital transfers involving mainly the ownership of fixed assets and the acquisition/disposal of non-produced non-financial assets (mainly intangibles such as patents, leases or other transferable contracts). It has remained fairly stable and almost constantly in surplus since 1999 (see Figure I.4.5); after a mild decrease during 2000, it strongly rebounded in 2001, mainly due to transfers related to purchases of fixed assets in the Euro area.

Figure I.4.5: Balance of Payments: Capital Account net flows

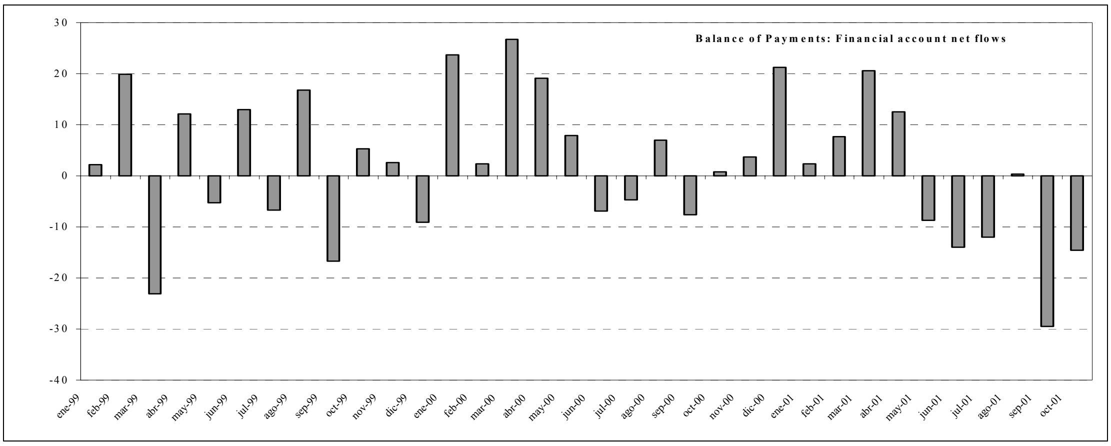


Billion of Euro. Source: ECB Monthly Bulletin, January 2002.

<u>Financial account</u>

The evolution of the financial account during the first 10 months of the year 2001 shows a noticeable decrease from previous years. While from January to October, during 1999 and 2000 there was a substantial surplus in the financial account, the same period in 2001 saw a sizeable deficit, as direct investment and financial derivatives declined markedly, although this fall has been partially offset by the observed surplus in portfolio investment and reserve assets. The balance on other types of transactions has shown a continuously shrinking surplus. Moreover, during the last part of 2001 Euro area residents made net sales of foreign securities for the first time since the start of the EMU.

Figure I.4.6: Balance of Payments: Financial account net flows



Billion of Euro. Source: ECB Monthly Bulletin, January 2002.

4.2 Expected developments

According to our forecast, the Euro effective exchange rate is expected to depreciate in nominal terms by 3% during the fourth quarter of 2002 with respect to the same period of 2001. By the end of 2003, it should stage a further 1% depreciation. In real terms, the slide is expected to be 3.1 % and 1.3%, respectively. These dynamics are the result of the closing of the interest rate differential between the Euro area and the US, benefiting the Euro, offset by a brighter growth outlook for the US compared to Europe, which would prop up the dollar.

Exports are expected to grow in annual terms by 2.3% in the fourth quarter of 2002, mainly due to a still weak world demand. By the end of 2003, a pronounced recovery in world trade should lift exports up to 9.1%. Imports should increase by 2.1% by the end of the year and by 8.3% in the fourth quarter of 2003.

Table I.4.1: Euro area effective exchange rates and trade

	2002:II	2002:IV	2003:IV
Nominal exchange rate	0.1	-3.0	-1.0
	[-3.2 , 3.0]	[-6.0 , 1.0]	[-7.0, 4.0]
Real exchange rate	0.5	-3.1	-1.3
	[-2.5 , 3.4]	[-6.4 , 1.2]	[-7.3, 3.5]
Exports	0.0	2.3	9.1
	[-1.1 , 1.0]	[-0.3 , 4.1]	[6.8, 11.5]
Imports	-0.3	2.1	8.3
	[-1.7 , 0.9]	[-0.6 , 4.0]	[5.4, 10.9]
World trade	-0.8	1.7	10.3
	[-1.7 , 0.0]	[0.3 , 3.0]	[8.1, 12.4]

For each projection, the first and the second rows of the column labelled Interval Forecast report the mean and the 80% confidence bands, respectively, of 2000 stochastic simulations. EFN forecasts using the structural macroeconometric model are described in Annex 2.

Since predicting exchange rates is a notoriously difficult exercise, our forecast for nominal rates is surrounded by a high degree of uncertainty. The forecast for the fourth quarter of 2002 has a 6% depreciation as its lower bound and a 1% appreciation as its upper bound. The corresponding values for 2003 are a 7% depreciation and a 4% appreciation. Table I.4.2 presents the deviations from the baseline implied by these two extreme scenarios, i.e. considering the lower and upper bounds for the 2002 and 2003 forecast. The outcome is symmetric for inflation, with a slightly worse effect of currency appreciation on growth.

Table I.4.2: The effects of alternative scenario for the effective exchange rate

	2002		2003	
	GDP growth	HICP inflation	GDP growth	HICP inflation
Euro depreciation[a]	0.2	0.1	0.7	0.2
Euro appreciation[b]	-0.3	-0.1	-0.6	-0.2

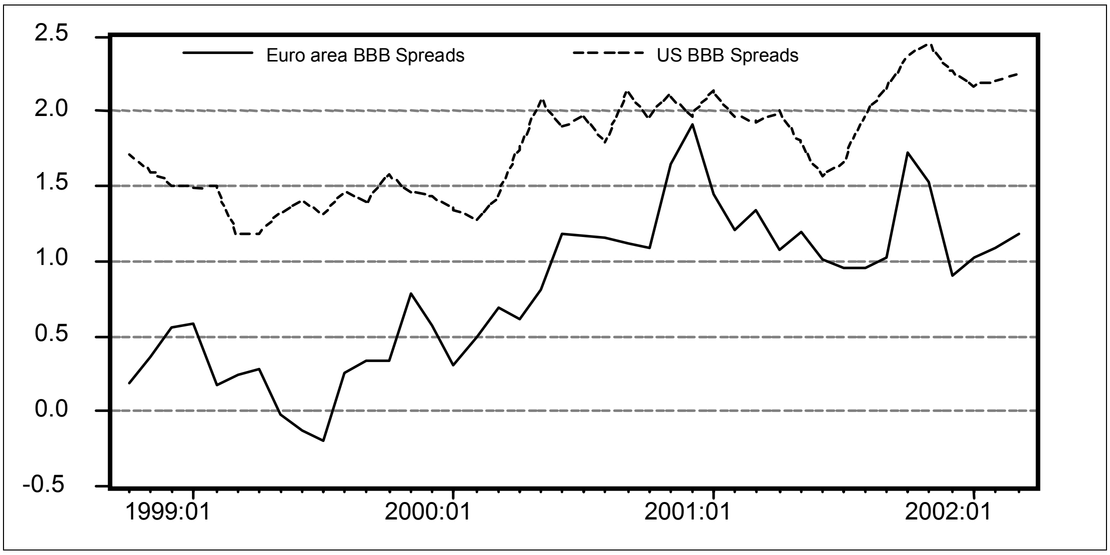
The table reports deviations with respect to the baseline scenario where nominal and real effective exchange rates depreciate by 3% in 2002 and 1% in 2003.
(a) Euro depreciation: -6% in 2002, -7% in 2003 (lower bound of interval forecasts).
(b) Euro appreciation: 1% in 2002, 4% in 2003 (upper bound of interval forecasts)

5. Financial Developments

5.1 Recent Evolution

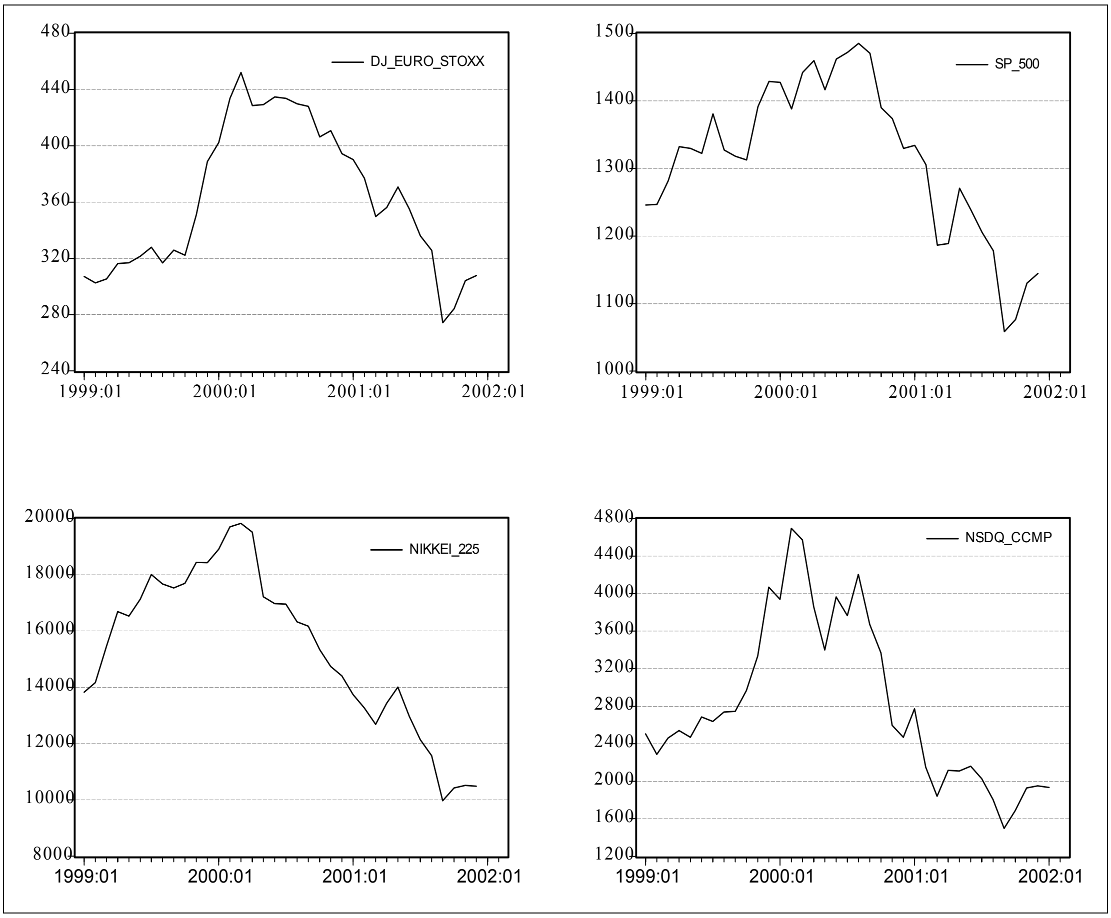
Stock prices are suggestive of market participants' expectations about future dividends and more generally of future corporate earnings prospects. Asset prices have shown a declining trend since 2000 all over the world reflecting a significant downturn revision in the earning expectations for high-technology firms. The over-estimation of the growth potential of the New Economy has contributed to the bursting of the ICT bubble. In addition, corporate-government spreads have gone up both in the US and in the Euro area (see Figure I.5.1) clearly indicating that higher risk premia are requested. Trends in corporate bond spreads and in stock market volatility tend to co-move. Hence it appears that the degree of uncertainty in market expectations has increased.

Figure I.5.1: Long-term corporate bond spreads in the US and in the Euro area



In 2001 a large swing in stock prices occurred following the terrorist attack in the United States on September 11th. This episode had a dramatic negative impact on world stock markets. As shown in Figure I.5.2, the Dow Jones Euro Stoxx registered a 16% drop, the US S&P 500 declined by 10%, the Nikkei 225 by 14% and the US Nasdaq Composite Index went down by 17%. These drops are attributable to a substantial increase in uncertainty about future economic prospects for airline and insurance industries.

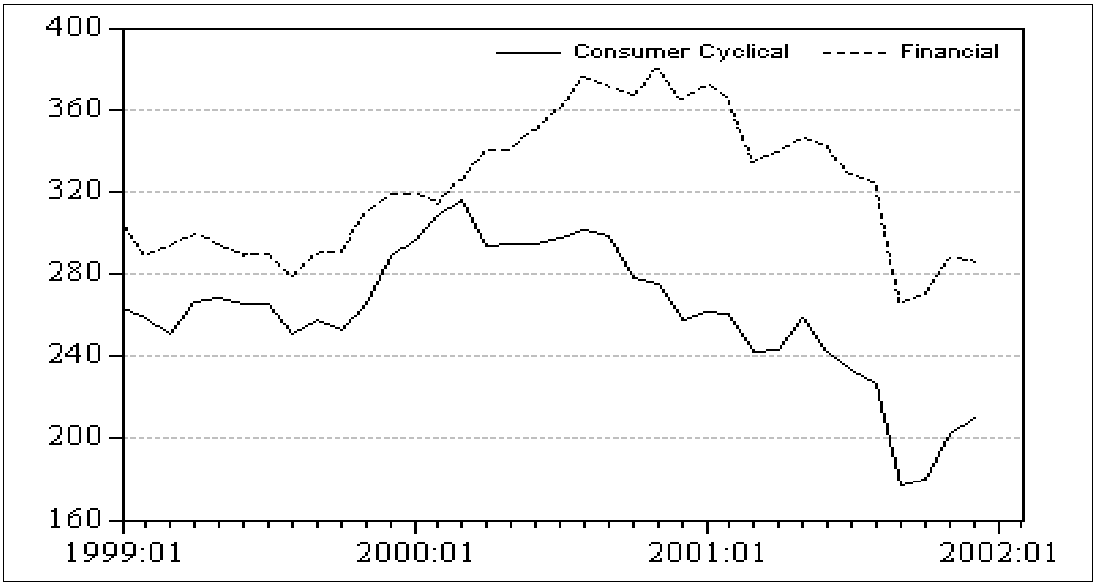
Figure I.5.2: World stock indices



Among the sectors included in the broad index for the Euro area, the consumer cyclical sector, which includes airlines, and the financial sector, including the insurance sector, were the mostly affected; their stock indices dropped by 22% and 18%, respectively (see Figure I.5.3). However, these marked declines in the stock indices were reversed in the following months as the effects of September 11th were more precisely gauged.

The overall decline in stock prices has contributed to a reduction in investment and in consumption, and consequently to the poor growth performances outlined in the first sections of Part I of this report.

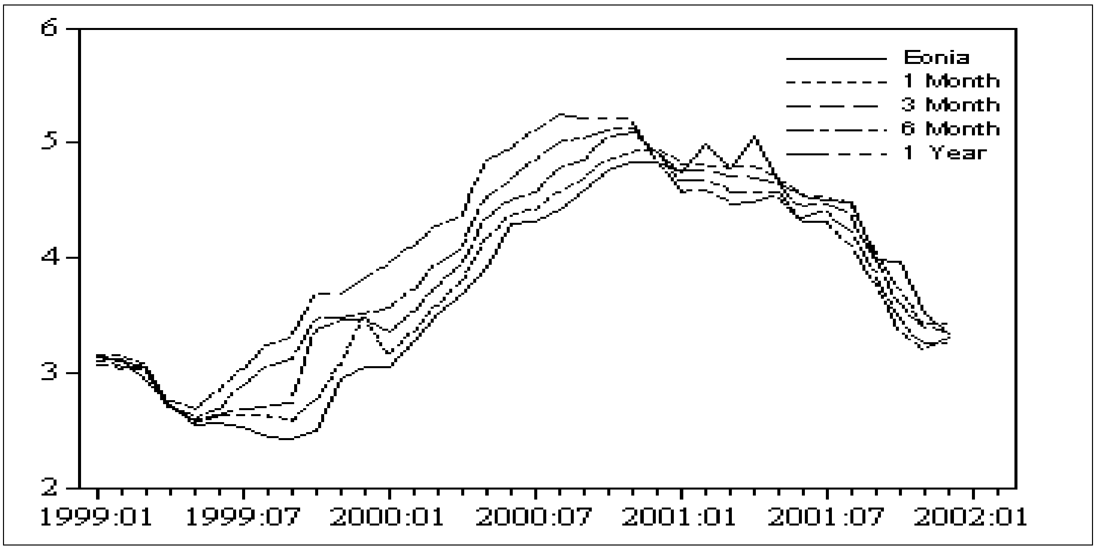
Figure I.5.3: Consumer cyclical sector and financial sector in the Euro area



Money Market Interest Rates

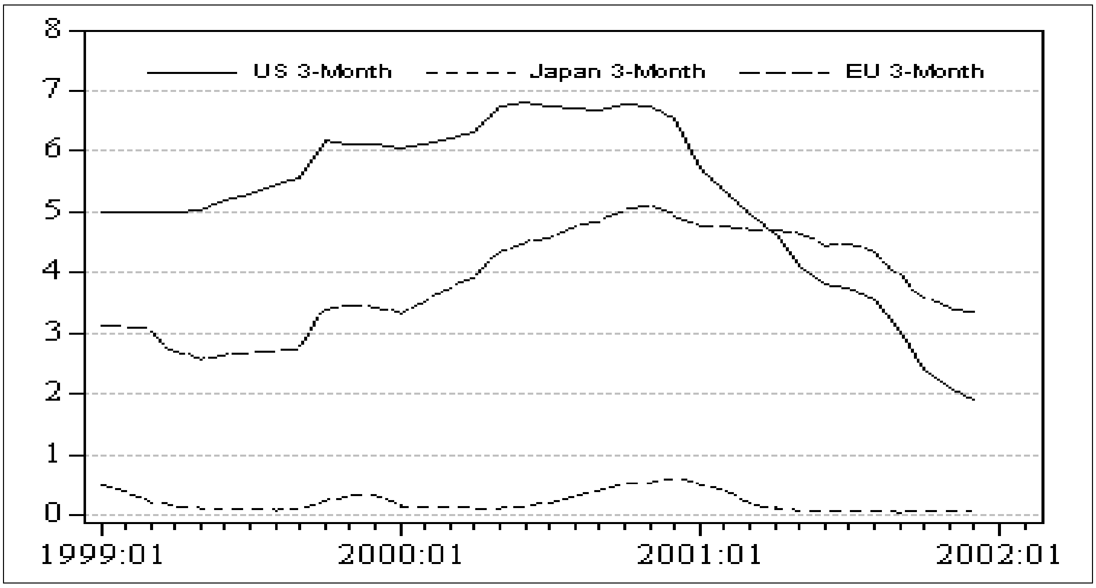
In 2001 short-term interest rates in the Euro area declined steadily (see Figure I.5.4). During the course of 2000 money market rates had increased substantially, but the upward trend came to a halt at the end of that year.

Figure I.5.4: Euro area short-term interest rates



The downward movement in the rates in 2001 reflected market expectations of declining inflationary pressures in the Euro area associated with an anticipated looser monetary policy. Similar hump-shaped patterns have been observed also for short-term interest rates in the US and Japan (see Figure I.5.5). Compared to the Euro area, the decline in US rates has occurred at a brisker pace. In fact, in April 2001 the differential between the US three-month rate and the Euro area three-month rate changed from being positive to zero and since then it has been negative. This reflects the fact that lately the Federal Reserve has been more aggressive than the ECB in cutting interest rates.

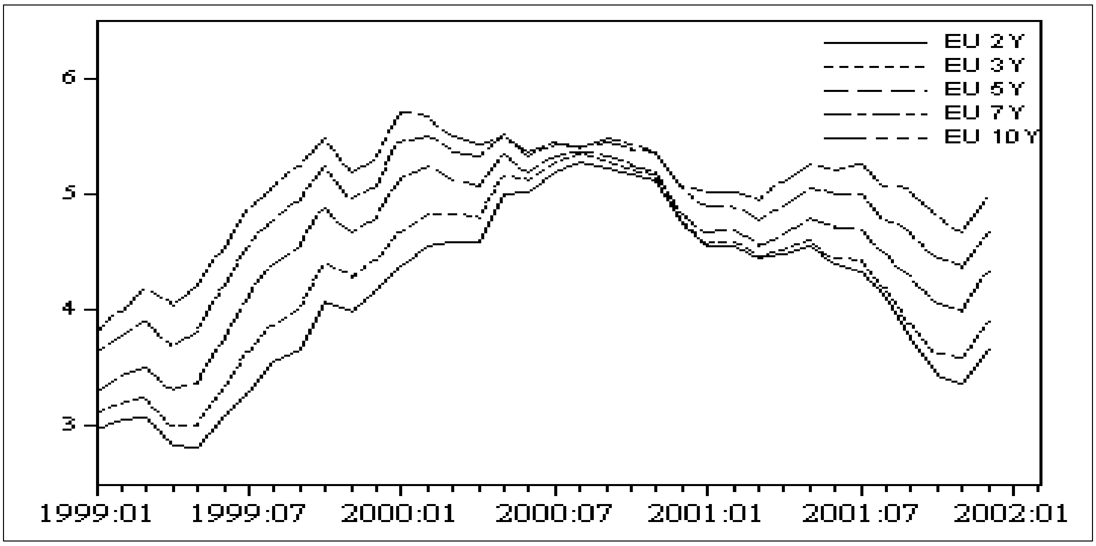
Figure I.5.5: Three-month interest rates for the Euro area, the US, and Japan



Long-term Interest Rates

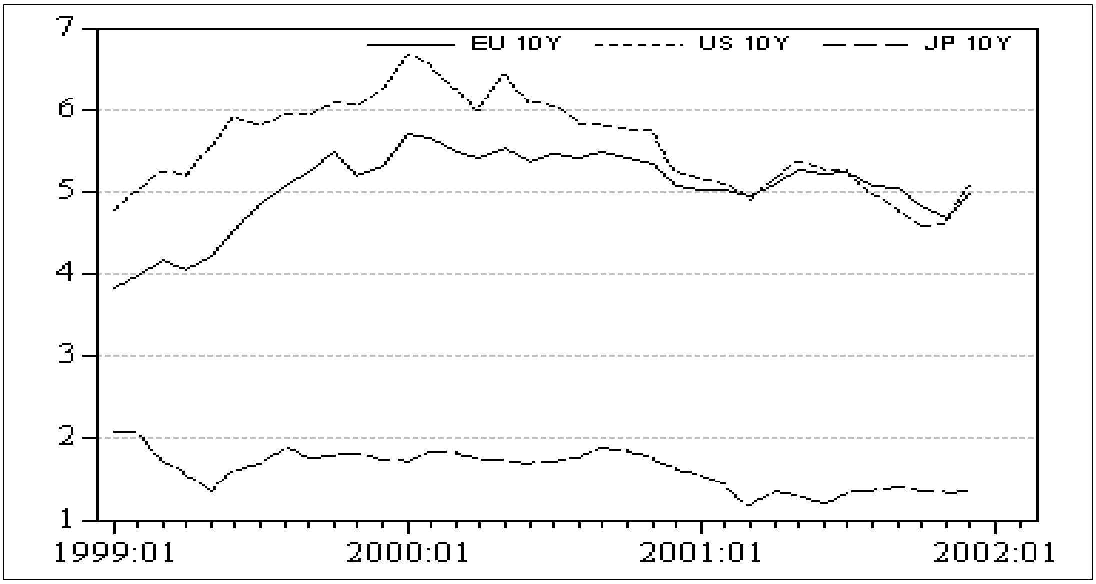
As shown in Figure I.5.6, long-term government bond yields in the Euro area remained broadly stable throughout 2000 until mid 2001. In July 2001 the yields declined somewhat, but their trend sharply reversed in November. This recent increase is mainly attributable to a reversal of flight-to-safety portfolio flows from stocks into bonds caused by September 11th terrorist attacks and to lower inflation expectations.

Figure I.5.6: Euro area long-term interest rates



Flight-to-safety flows and their subsequent reversal have been observed also for the US bond market. It is interesting to notice how US and Euro area long-term rates have co-moved rather closely since 2001 (see Figure I.5.7).

Figure I.5.7: Ten-year government bond interest rates for Euro area, the US and Japan

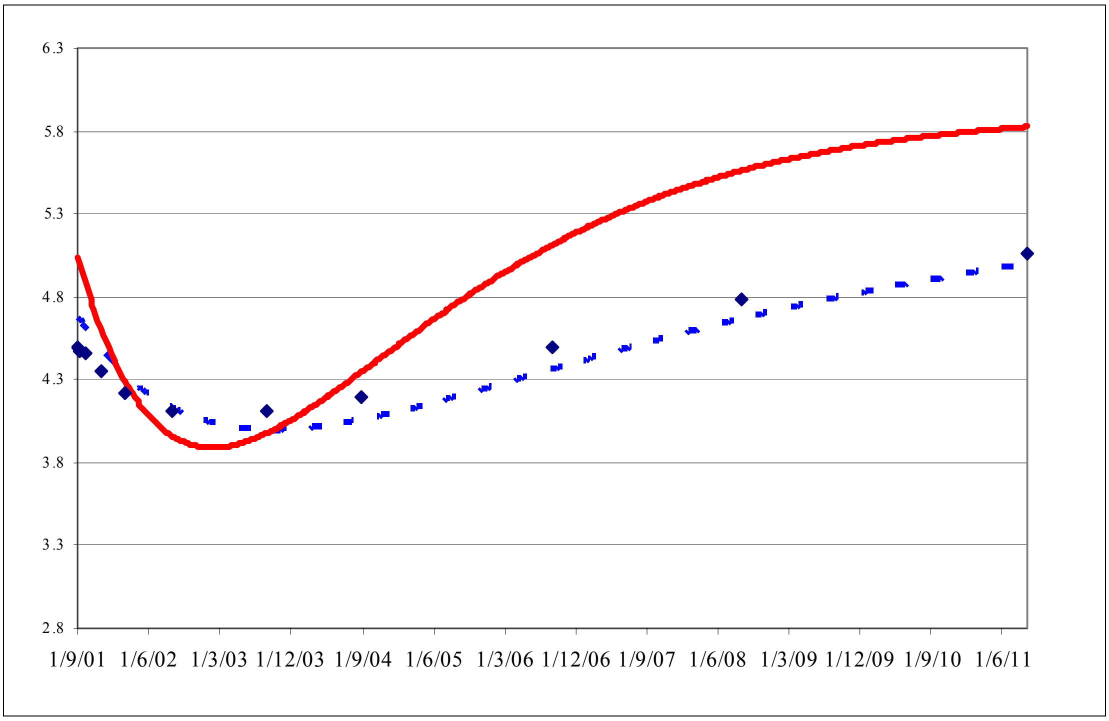


Euro area Yield Curves

The yield curve can provide useful information on future developments in the economy. Comparing the yield curves constructed with data available as of August 2001 and the ones produced in February 2002 (Figures I.5.8 and I.5.9) it is clear that there has been a downward shift in the entire yield curve reflecting the declines observed in both short-term and long-term interest rates. The slope of the curve has also steepened since the declines were larger at the short end than at the long end of the maturity spectrum.

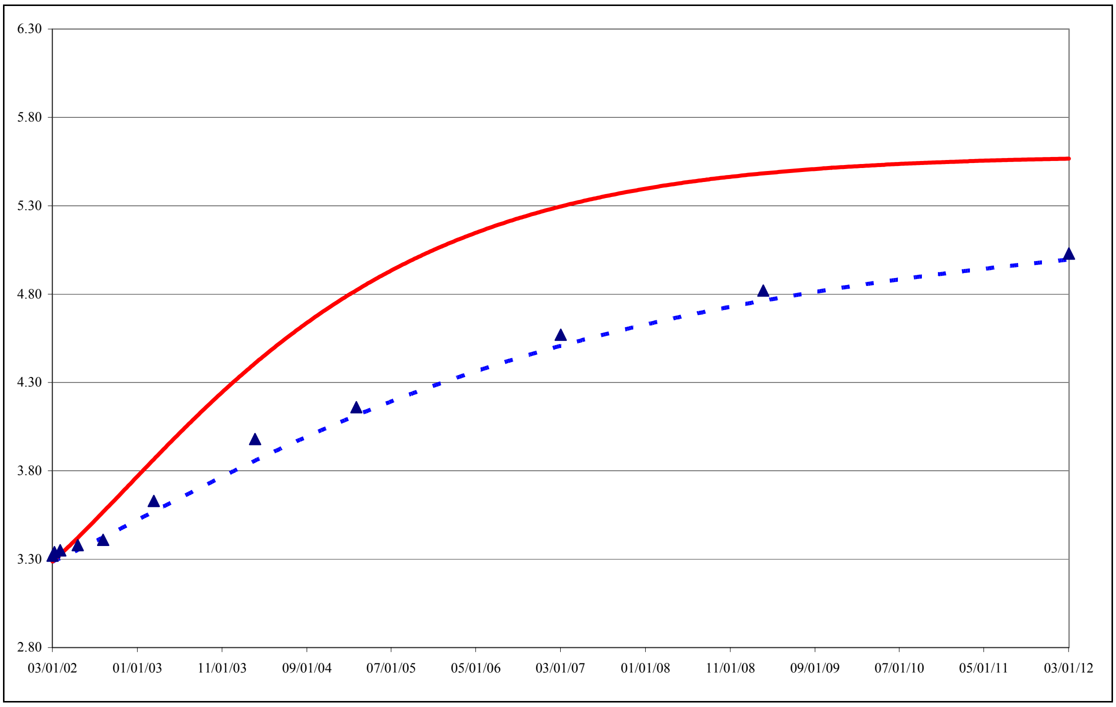
The instantaneous forward curve implied by the prevailing spot rates captures market expectations about the future level of the overnight rate. The Euro Overnight Index Average (EONIA) is expected to moderately decline in 2002 and start to increase in 2003. The upward sloping yield curve signals that in the long run rates are expected to increase.

Figure I.5.8: Euro-area yield curve in August 2001



The solid and the dashed line are, respectively, the forward and the spot curves. Spot rates are represented by dots.

Figure I.5.9: Euro-area yield curve in February 2002



The solid and the dashed line are, respectively, the forward and the spot curves. Spot rates are represented by dots.

5.2 Expected Developments

Three-month interest rates are forecast to be 3.5% in 2002 and 3.8% in 2003 (see Table I.5.1). These forecasts are derived from the forward curve, which provides an efficient summary of market expectations. Ten-year government bond yield forecasts are higher, to compensate for expectations of increasing interest rates in the longer run. Interest rates are expected to increase in 2003 as a consequence of higher output and inflation. US short-term and long-term interest rates are assumed to be around 2% and 5%, respectively, in 2002 and to increase gradually to around 3% and 6%, respectively, in 2003.[12]

Table I.5.1: Euro area forecasts for short-term and long-term interest rates

	2002:II	2002:IV	2003:IV
Short-term interest rate	3.5	3.5	3.8
	N/A	N/A	N/A
Long-term interest rate	4.8	4.8	5.2
	[4.2, 5.1]	[3.8, 5.3]	[4.5, 6.2]

For each projection, the first and the second rows report the mean and the 80% confidence bands, respectively, of 2000 stochastic simulations. EFN forecasts using the structural macroeconometric model are described in Annex 2.

6. Alternative Scenarios for the Oil Price, US Growth, and the Exchange Rate

To conclude this part, we present some additional sensitivity analyses concerning the forecasts based on the macroeconometric model. Specifically, we focus on the role of the oil price, the dynamics of the US economy, and the behaviour of the Euro to dollar exchange rate for the Euro area GDP growth and HICP inflation forecasts. In the general specification employed in the forecasting process, both the oil price and the growth rate of the US economy are exogenous, while the exchange rate is endogenous. The latter is treated as exogenous in the exchange rate simulation. By considering more general patterns for the exogenous variables and a more detailed model of the Euro area, the analysis here complements the VAR-based simulations discussed in Box 1.3. The reactions are, however, in line with what we reported earlier. Additional information on the transmission of US shocks is provided in Part II of the report, using a large structural model, disaggregated at the country level.

[12] Forecasts for inflation and output growth in the Euro area remain basically unaltered if it is assumed that US short-term and long-term interest rates stay constant at 2% and 5%, respectively, in 2002 and 2003.

Oil Price Shock

As mentioned before, the price of oil is an important determinant of economic performance. Taking Germany as an example, each of the two oil crises in the 1970s and 1980s led to cumulative output losses in the range of 4 percentage points of GDP growth. This was accompanied by a significant rise in both the unemployment and inflation rates, and a similar effect can be expected at the Euro area level, as can be seen in the VAR analysis in Box 1.3. Therefore, the short-run effects of an oil price shock on output and inflation deserve a more detailed investigation. In particular, in the baseline scenario, oil price is constant at $20 per barrel, while in the alternative, a 50% increase is assumed.[13]

The results reported in Table I.6.1 indicate that the consequences of a rise in the oil price on the economic course in the Euro area seem to be very limited. In 2002 GDP growth declines by about 0.1 percentage points, while inflation accelerates by 0.3 points. It seems therefore that the sensitivity to increases in oil prices indicated by these results is significantly lower than the impact of previous crises; see also Oxford Economic Forecasting (2000). Note though that these responses provide only a lower bound, because supply-side issues are not considered in the simulation. Moreover, higher oil prices will also affect the other oil-importing countries outside the Euro area. Thus a reduction in foreign demand for European goods could also take place, and this in turn would have additional negative impacts on the economic course.

Table I.6.1: The effects of alternative scenarios for oil price, US growth, and the US dollar exchange rate

	2002		2003	
	GDP growth	HICP inflation	GDP growth	HICP inflation
Oil price increase[a]	-0.1	0.3	-0.1	0.2
US growth slowdown[b]	-0.2	0.0	-0.3	-0.1
US dollar depreciation[c]	-0.2	-0.1	-0.2	-0.1

The table reports deviations with respect to the baseline scenario.
(a) Oil price increase: 50% increase, from $20 to $30 in 2002 and 2003.
(b) US growth slowdown: 0% (instead of 0.7%) in 2002 and 0.7% (instead of 3%) in 2003.
(c) US dollar depreciation: 5% in 2002 and 2003.

US Growth Shock

The effects of a slower course of the US economy on the Euro area operates in the model through the foreign trade channel. As US growth deccelerates, exports of the Euro area are reduced, generating a decline in the current account. The adverse demand effect leads to losses in production and employment, while inflation is expected to fall.

[13] Due to data limitations some re-specification of the model is needed. To capture the losses in the purchasing power of household income, GDP in the consumption function is deflated by consumer prices instead of using the GDP deflator. In addition, labour and capital enter the production function as inputs, but energy is not treated as a separate input, so supply effects are neglected. The latter are expected to be more important in the long run.

The growth rate of the US economy will be 0.7% in 2002, according to the projections of the IMF (2001). In our baseline scenario growth is assumed to accelerate to an annual rate of approximately 3% percent from 2003 onwards. This assumption is consistent with the mainstream: actually most forecasts expect a significant recovery in the second half of 2002. In the alternative scenario, a more pessimistic view is considered. Growth rates of 0.0% and 0.7% are assumed for 2002 and 2003, respectively, implying a deeper and longer-lasting recession.

As a consequence of the adverse demand shock, Euro area GDP growth declines in the alternative scenario. In particular, there are negative deviations from -0.2 and -0.3 percentage points in 2002 and 2003, respectively. A decrease of 0.3 percentage points implies a decline of 10 billion Euro per quarter in real GDP, accompanied by about 0.9 million job losses in the Euro area. Since even in the alternative scenario a higher US growth is expected after 2003, a partial reversal of these effects can be expected. However, there is no full catch-up with the baseline, and net losses remain even after several years.

The response of inflation approximately mirrors the course of demand, adjusted for some lag structure because of sticky prices in the short run. In particular, there would be no effects in 2002 and a minor decrease, about 0.1 percentage points, in 2003. Similar results are obtained when a higher US growth rate is assumed in the baseline scenario for 2002.

Exchange Rate Shock

Finally, we consider the effects of a 5 % depreciation of the nominal dollar to Euro exchange rate in 2002 and 2003. As in the oil price simulation, we concentrate on the short-run demand responses.

Overall, the effects are similar to those reported for a change in the effective exchange rate in Part I, section 4. Specifically, the Euro area growth perspectives are more pessimistic as growth forecasts decline by 0.2 points in 2002 and 2003[14], while there is only a minor reduction in inflation.

[14] However, this decline may be overestimated since, due to data limitations, both exports and imports include only intra-area trade.

Part II. Economic Policy in the Presence of a Euro Wide Shock

Following a slowdown in mid-2000, the US economy entered into recession in the middle of 2001. In the same year, the European economies, especially Germany, also slowed down. The goal of this part of the report is to identify the main sources of the recession in the US, analyse their consequences for the Euro area, and evaluate the stabilising role of monetary and fiscal policy.

The first section briefly reviews the economic conditions in the US in 2001 and the main shocks that hit the economy. In particular, we try to identify whether a demand or a supply shock is more relevant for explaining the American economic situation. We find that the effects of a supply shock appear to be more in line with the actual evolution of most US macroeconomic variables.

The second section analyses the transmission channels of the US slowdown to the Euro area, focusing particularly on exchange rate and price adjustments and their consequences. The overall effects of this transmission appear to be rather small, for example, anyway, not sufficient to explain the current German recession.

Since the diffusion of the shocks and the magnitude of their impact depend on counteracting economic policy measures, the third section evaluates the stabilising role of different monetary policy rules for the Fed and the ECB. More precisely, the macroeconomic impact of the supply shock is assessed in the presence of different degrees of sensitivity of the interest rate response of central banks to a change in the inflation rate. This analysis sheds light on the ability of common monetary policy to limit the diffusion of the US recession into the Euro area. Since symmetric shocks, such as the US recession, may induce different effects on Euro area countries displaying significant structural asymmetries, ECB monetary policy would not be sufficient to absorb resulting cyclical differences among member of the Euro area. Furthermore, we show that the monetary policy followed by the Federal Reserve may not totally counterweigh the effects of the recession in the US. Hence, an evaluation of the role of fiscal policy is required.

The fourth section therefore focuses on the likely consequences in the US and in Europe of the Bush expansionary fiscal policy, and of other alternative fiscal measures, undertaken to limit the recession in the US. It turns out that substantial and positive effects are expected for the US, while the spillovers for Europe are minor.

An interesting question arising from the previous result is whether an expansionary fiscal policy would be helpful also in the Euro area. Section five shows that fiscal policy is relevant for stabilising the national economies and to compensate for the asymmetric impact of the US shocks, particularly for the case of a co-ordinated expansionary policy. However, the growth surplus induced by this measure does not reduce the public deficit enough to prevent the constraints in the SGP to be binding.

1. What Happened in the US in 2001?

The US economy entered into recession in the third quarter of 2001, after a slowdown in the second quarter caused by a strong decrease in investment. At this time, firms expected a decrease in the return to investment in new technologies. The producers of these investment goods faced a contraction in demand, a decrease in the value of their equities and a contraction in the supply of credits. Investment by high technology firms contracted. The reduction of their activity diffused to the other sectors of the economy in the third quarter. Consumption decreased and unemployment increased in the same quarter. However, consumer spending picked up despite the fall in equity prices and rising unemployment. This was likely due to a housing wealth effect led by the rise in house prices. Most of the American households (nearly 70%) own their house whereas only relatively few Americans own shares. The increase in consumption in the last quarter of 2001, induced by generous discount policies by some firms, especially in the car industry, is expected to be short-lived. However, it was enough to drive GDP up for this quarter.

Inflation (measured by producer prices) was very weak, even negative, from the third quarter of 2001 onwards. This is due to the strong effective exchange rate of the dollar and the sharp decline in the capacity utilisation rate in the manufacturing sector. Low inflation and rising unemployment restrained wage increases.

The stance of monetary policy in the US has significantly changed since the start of 2001 with the Federal Funds rate being reduced by 475 basis points since that date. Fiscal policy was relaxed in 2001 by $40 billion with tax rebates enacted in the fiscal year 2001 (from October 1st 2000 to September 30th 2001). New tax cuts enacted in the current fiscal year (which started on October 1st 2001) are expected to reduce households' direct taxes by $70 billion in 2002. After the September 11th events, Federal expenditures increased by $45 billion, covering expenditure of $40 billion on reconstruction and anti-terrorism measures and $5 billion subsidies to the airline industry.

According to the forecast released in December by the IMF, the US economy is going to stage quite a slow recovery (see Table II.1.1). GDP is expected to grow by just 0.7% this year, with unemployment surging to 6%. This is bound to keep inflation at bay. At the same time, the expansionary policies implemented by the Bush administration coupled with the economic slowdown reducing tax revenues will shift the government balance into the red. However, more recent indicators seem to point to a quicker rebound in economic activity.

Table II.1.1: US current and forecast conditions

	2000	2001	2002
GDP growth	4.1	1.0	0.7
Unemployment rate	4.0	4.9	6.0
Consumer prices	3.4	2.9	1.6
Current account balance ($ bn)	-444.7	-392.0	-393.8
General government balance - GDP ratio	1.5	0.3	-0.5

Source: IMF World Economic Outlook, December 2001

The US recession in 2001 had its roots in the deterioration of the economic environment of the US private sector, but it is not clear whether it was driven mainly by demand or supply factors. Households' expenditures slowed down, as a reaction to an increase in the perceived uncertainty of their environment. But the contribution of the new economy to high growth and productivity also decreased, and is expected to be lower also in the future.

The multinational model Marmotte can help to evaluate and provide diagnostics of these causes. In particular, the effects of demand and supply shocks can be simulated, and the two shocks can be discriminated on the basis of the simulated path of the main macroeconomic variables compared with their actual values.

All the shocks considered in this chapter are assumed to be unforeseen before 2001, observed in 2001, and expected this year to last until 2005. From 2006 onwards the economic environment is assumed to come back to its initial position. Various simulations were also undertaken for shocks expected to last for more or less than 5 years. The effect on economic conditions in 2001 increased with the expected duration of the shocks, but at a decreasing rate. Thus, a shock expected to last for 10 years is only marginally more serious than a shock expected to last for 5 years. However, if the shocks were expected to last for only 1 or 2 years their consequences would be very modest. *Ex post*, the US private sector could look like having overestimated the amplitude and the length of the causes of the recession, and having overreacted and increased its depth relative to what would have happened if its expectations had been perfect.

1.1 Negative Private Consumption Shock

The first source of the US recession considered here rests on the fact that American consumers became more pessimistic in 2001. This change in attitude could have resulted of the perception that times had become more uncertain, and that it was wise to postpone some spending to a more safe future.

Table II.1.2 gives the simulation results of a negative private consumption shock in the US. The rate of time preference of the American households is supposed to stay at a lower level during the 5 years. In general, the numbers represent relative deviations from the baseline, measured in percentages. However, interest rates, although given in absolute deviations, are nevertheless measured in percentage points. Production represents effective private output, identical to total demand. The trade balance is measured in millions of US dollars and is given in absolute deviations. The public balance, that is the primary surplus of the Government plus public debt service, is given in percentage points of the baseline GDP. Scrapping date represents the age of the oldest production unit in activity.

The simulated temporary decrease in the time preference of American consumers induced them to re-allocate the spending of their wealth over time. However, since in the model households do not like to change too quickly their consumption relative to the levels they enjoyed in the past, the decrease in consumption can only be very progressive.

If US households want to consume less, they must save and therefore, firms invest more. Thus, investment increases progressively, and potential production starts increasing one year after the demand shock. Higher investment induces a rise in the capital intensity of new production units and an increase in employment. This last evolution drives the cost of labour higher.

Table II.1.2: Negative shock on the time preference rate

US	YEAR 1	YEAR 2	YEAR 3
Production	-0.086	-0.070	-0.038
Consumption	-0.225	-0.327	-0.344
Investment	0.283	0.677	0.855
Capital intensity	0.097	0.099	0.101
Scrapping age	0.001	0.005	-0.001
Employment	-0.004	0.008	0.020
Real cost of labour	-0.009	-0.006	0.002
Inflation rate	-0.027	-0.024	-0.020
Real exchange rate	0.183	0.1843	0.183
Nominal interest rate	-0.029	-0.025	-0.022
Real interest rate	-0.004	-0.005	-0.006
Public balance	0.002	0.003	0.005
Trade balance	-1465.3	415.6	1581.5

Note that the US time preference rate is reduced from 4% to 3.5% for 5 years.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

The real interest rate adjusts to the discount rate of households by decreasing during the first years of the simulation. In the model, central banks are assumed to react to changes in inflation and the output gap (the difference between potential and effective productions). With such a Taylor rule followed by the Federal Reserve, the nominal interest rate over-reacts to a change in inflation and the real interest varies in the same direction as the variation in the rate of inflation. Moreover, inflation in the model decreases if the economy turns to a situation of over capacity, that is, if effective production becomes lower than potential production. As effective production is identical to total demand, this means that the decrease in consumption is only partly compensated by the increase in investment. However, if the Taylor rule were softer, that is if the sensitivity of the nominal interest rate to a change in inflation were lower, the temporary contraction of output would disappear and the increase in investment would be larger than the decrease in consumption.

A negative consumption shock in the US is not able to reproduce most economic features observed in 2001. The major problem is that such a shock causes an immediate increase in investment and a delayed increase in employment. In reality, we observed a decrease in investment and an increase in unemployment in 2001 expected to last at least for a part of 2002. Thus, the investigation of the consequences of this shock will not be pursued further.

1.2 Negative Supply Shock

The shock considered is a decrease in total factor productivity for all new investment (Hicks neutral shock). Table II.1.3 gives the results of the simulation for a shock lasting 5 years. Such a slump in productivity can be thought of as a consequence of the dramatic surge in private investment between 1998 and 2000, which led to an excessive build-up of productive capacity, with negative repercussions on total factor productivity.

Investment is expected to be less efficient for the current year and the next 4 years. Thus, in the last year of the shock it will be wise to reduce investment substantially and to wait for one year before investing further in more efficient production units. In 2001 investment is much less depressed than what follows because it is more costly to postpone investment for 5 years than for 1 year. Hence, investment decreases in the first year and is expected to decrease more during the years after.

As investment starts being productive the year after its installation, postponing or bringing forward the scrapping date of old production units changes potential production in 2001. Thus, potential production shows a small change in 2001 and is expected to decrease more during the following years. However, the decrease in potential output is smoother than the decrease in investment, i.e. in effective production (which is identical to total demand). Therefore, the excess of capacity drives a price deflation.

This last result may look counterintuitive, but can easily be understood. The productivity shock decreases the efficiency of new capital vintages for the following five years. However, the efficiency of old vintages is not reduced. Thus, after the shock, supply does not change by much. But investment and demand are strongly reduced. So, we have a deflationary effect of the shock. The productivity shock could have been defined differently, as decreasing the efficiency of all capital vintages; old capital and new investment. Then, supply would strongly decrease, and the shock would have an inflationary effect. With a putty-putty model, only this second kind of shock could be simulated. The first kind of shock was retained here because inflation strongly decreased in the US in 2001 and 2002.

Table II.1.3: Negative productivity shock in the United States

US	YEAR 1	YEAR 2	YEAR 3
Production	-0.610	-0.750	-1.037
Consumption	0.116	0.147	0.144
Investment	-3.381	-4.426	-6.097
Capital intensity	0.526	0.505	0.499
Scrapping age	0.070	0.139	0.275
Employment	0.044	-0.044	-0.121
Real cost of labour	-0.093	-0.205	-0.374
Inflation rate	-0.192	-0.188	-0.226
Real exchange rate	-0.305	-0.243	-0.162
Nominal interest rate	-0.272	-0.297	-0.384
Real interest rate	-0.081	-0.068	-0.051
Public balance	0.089	0.048	0.016
Trade balance	14724.6	21952.6	31760.7

Note that US total factor productivity is temporarily reduced by 0.50% for 5 years.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, and trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

The effects of a change in the scrapping age of old units is *a priori* ambiguous. As new investment has become less productive than was expected before, keeping more old units in activity becomes an attractive option. On the other hand, as demand has decreased, scrapping more old units is also a sensible choice. The simulation shows that the first mechanism is stronger than the second. However, keeping old production units in activity for a longer time slows down the decrease in investment and allows a tiny increase in employment in 2001. But lower investment drives employment down from 2002 onwards. More unemployment drives the labour cost down, and dominates the opposite positive effect on real wages of the decrease in the rate of inflation. As the real cost of labour is somewhat sticky, when the real interest rate is very flexible, the relative cost of labour with respect to capital increases. Thus, the capital intensity of new production units increases.

The negative inflation rate drives the nominal and the real interest rates under their pre-shock levels, i.e. the nominal interest rate decreases more than the rate of inflation. The decrease in the real interest rate drives consumption up.

Thus, this productivity shock seems to reproduce the major economic events in the US in 2001. The evolution of the different components of demand is consistent with what happened in the US in 2001. In particular we can reproduce the strong decrease in investment and the robustness in consumption observed in 2001 and foreseen for the first half of 2002.

Hence, the analysis of both the transmission of the US recession to Europe and of the evaluation of economic policies will be done on the basis of the above supply shock.

2. Diffusion of the US Supply Shock to the Euro Area

This section investigates the diffusion of the US negative supply shock towards Europe, and more especially towards the Euro area, as well as their feedback effects into the US.[15]

As the supply shock is temporary, the US real exchange rate stays unchanged in the long run. But as the US experiences a temporary deflation, their price level will be weaker in the long run and the nominal value of the dollar relatively to the Euro will increase at this horizon. By intertemporal arbitrage, the appreciation of the dollar starts in the year of the shock, 2001. Marmotte (see Box 5.1) assumes some stickiness of prices, which stays connected to the value they had before the shock. On the other hand, the exchange rate is perfectly flexible. Thus, for the first periods, US prices will decrease by less than the dollar will appreciate[16] and the real value of the dollar will increase.

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[15] Note that the temporal frequency here is annual and the simulations are run with a large scale model, which makes it difficult to compare these results with those obtained from the VAR analysis in the first part of the Report, even though overall the results are consistent. Another difficulty in the comparison is that the VAR model investigates the effects on the Euro area economy of an increase in, respectively, the US output gap, US inflation and the US interest rate. Here, we investigate a more basic productivity shock in the US, which increases their output gap, and decreases their inflation and interest rates. The results of Marmotte are also consistent with those obtained with the macroeconometric model in Part 1 of the Report. However, there is the same difficulty in the comparison, which is that the US shock investigated in Marmotte is more "basic" than the ones investigated by the macroeconometric model.

[16] If the US productivity shock hit the efficiency of all capital vintages, the US price deflator would increase in the long run, and the dollar would depreciate in the long and the short runs relative to the Euro.

Table II.2.1: Negative productivity shock in the US: impact on the Euro area

	Euro area			Germany			France		
	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3
Production	-0.038	-0.009	-0.041	0.063	-0.034	-0.088	0.049	-0.014	-0.022
Consumption	-0.027	-0.049	-0.065	-0.027	-0.046	-0.059	-0.021	-0.032	-0.038
Investment	-0.994	-1.603	-2.582	-0.845	-2.077	-3.340	-0.696	-1.768	-2.790
Capital intensity				-0.199	-0.196	-0.191	-0.211	-0.210	-0.210
Scrapping age				0.000	-0.002	0.004	-0.005	-0.004	-0.008
Employment	0.000	-0.024	-0.074	0.000	-0.023	-0.082	-0.003	-0.019	-0.073
Real cost of labour	0.006	0.017	0.019	-0.005	0.005	-0.004	-0.001	0.016	0.015
Inflation rate	0.014	0.013	0.023	0.019	-0.001	0.0075	0.015	0.004	0.023
Real exchange rate				0.273	0.397	0.543	0.239	0.346	0.462
Nominal interest rate	0.009	0.017	0.033	0.009	0.017	0.033	0.012	0.032	0.062
Real interest rate	-0.005	-0.006	-0.009	0.009	0.010	0.011	0.009	0.009	0.011
Public balance	-0.046	-0.058	-0.075	-0.047	-0.052	-0.072	-0.050	-0.057	-0.079
Trade balance	11206.0	25164.5	42796.6	3788.2	8181.2	13606.9	1585.8	3970.5	6902.5

Note that US global productivity of factors is temporary reduced by 0.50% for 5 years.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity..

The real depreciation of the Euro increases the price of investment in the Euro area, as capital goods are partly imported. Thus, Euro area investment decreases. The symmetric mechanism will take place in the US, i.e. the price of investment will tend to be reduced in the US, but this will not be strong enough to change the previous result of a decrease of investment in the US. The decrease in European investment drives employment down in 2002. The cost of labour has an ambiguous evolution: it should decrease because of higher unemployment and increase because of the real depreciation of the Euro. In the US, the real appreciation of the dollar strengthens the decrease in the cost of labour.

The allocation of investment (and consumption) between the imports of US goods and the use of European goods depends on the real price of the dollar. As the real value of the dollar appreciates, total demand for European commodities has an ambiguous evolution. Actually, effective production decreases slowly, particularly in Germany. The real depreciation of the Euro reduces the potential supply of European goods with a one-year lag. Finally, the output gap decreases in Europe and the inflation rate increases. This drives the nominal and the real interest rates up, which depresses consumption more in Germany than in France.

The recession in both the US and the Euro area improves their respective trade balances in spite of the real appreciation of the dollar. Marmotte assumes that the decrease in US production price reduces the competitiveness of the rest of the world, which worsens its trade balance.

The most interesting result is that the US depression decreases the real value of the Euro, increases the real cost of capital in the Euro area, which in turn depresses investment and employment in this area. The US recession diffuses to the Euro area through this channel. However, the depressive effects of the US recession on European economies are weak, and they are not much stronger in Germany than in the other members of the European Union. The comparison with France, for example, reveals that the effects are roughly of the same order of magnitude. These results were already found in the first part of the report using a VAR methodology and a macroeconometric model. Thus, explanations of the current German recession as being induced by the US slowdown look unconvincing. The synchronisation in GDP growth rates in the Euro area and in the US noted in the first part of the report must be related to a correlation between shocks hitting both economies and not to the transmission of a US shock to European economies.

3. Evaluation of the Policy Rules of the Fed and the ECB Faced with a Negative US Supply Shock

The baseline simulations suppose that the nominal interest rate for all central banks is only sensitive to the variations of the most recent observation of inflation with a coefficient of 1.5.[17]

This section investigates the consequences of the higher sensitivity of the interest rate to changes in the inflation rate, first for the Federal Reserve, then for the ECB.

3.1 Increased Sensitivity of the Fed Monetary Rule to Changes in Inflation Rate

The sensitivity of the interest rate to inflation was increased from 1.5 to 2.5 in the US and kept unchanged for the ECB. The simulation assumes the same negative supply shock occurring in the US as in Tables II.1.3 and II.2.1. The results are given in Tables II.3.1 and II.3.2.

If the Federal Reserve is more sensitive to inflation, it reacts to a given level of deflation by decreasing the interest rate more, which tends to reduce the appreciation of the dollar. Thus the real cost of investment decreases less in the US and increases less in Europe. Investment becomes lower in the US and higher in Europe. However, deflation is less strong in the US. This induces US firms to slow down their postponement of investment to a date when prices have stabilised. Thus, US investment actually decreases less than with the former Federal Reserve policy. The same result prevails for US employment with a one-year lag. As the loss of competitiveness of US firms is also weaker than with the previous policy, demand to these firms, that is effective production, decreases less than with the previous monetary policy.

Because of the weaker real depreciation of the Euro, the Euro area is wealthier than under the previous scenario. So it invests more. However, its exports to the US are also lower and its imports are higher. The effect on total demand for European goods, that is, on effective production, is ambiguous. The simulation shows that it increases instead of decreasing. Consequently, inflation is higher. Comparing the results for the Euro area as a whole with those for its two biggest members, it is evident that the shock is transmitted in a fairly symmetric way.

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[17] In Marmotte the interest rate fixed by central banks depends on expected inflation rates and current and past output gaps. However, as output gaps are related to contemporaneous inflation, the reaction functions of central banks depend on past, current and expected future inflation rates. In the simulation of this paragraph, we simplify this equation by dropping all the expectational variables.

Table II.3.1: Negative supply shock, increasing the sensitivity of the Fed monetary rule to changes in inflation rate

US	YEAR 1	YEAR 2	YEAR 3
Production	-0.216	-0.297	-0.461
Consumption	0.079	0.094	0.073
Investment	-1.329	-1.842	-2.634
Capital intensity	0.475	0.449	-0.432
Scrapping age	0.025	0.056	0.155
Employment	0.0159	-0.024	-0.038
Real cost of labour	-0.035	-0.094	-0.228
Inflation rate	-0.068	-0.068	-0.097
Real exchange rate	-0.228	-0.225	-0.205
Nominal interest rate	-0.158	-0.172	-0.266
Real interest rate	-0.084	-0.073	-0.056
Public balance	0.071	0.051	0.041
Trade balance	7508.9	10294.3	14550.4

Note that US total factor productivity is temporary reduced by 0.50% for 5 years.
In the Taylor rule, the parameter on the US current inflation rate is increased from 1.5 to 2.5, whereas it stays equal to 1.5 for the ECB.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

Table II.3.2: Negative supply shock, increasing the sensitivity of the Fed monetary rule to changes in inflation rate: impact on the Euro area

	Euro area			Germany			France		
	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3
Production	0.033	0.058	0.051	0.104	0.061	0.049	0.033	0.040	0.042
Consumption	-0.065	-0.106	-0.132	-0.091	-0.143	-0.173	-0.073	-0.118	-0.145
Investment	-0.064	-0.181	-0.552	0.159	-0.249	-0.729	-0.038	-0.242	-0.630
Capital intensity				-0.312	-0.311	-0.308	-0.315	-0.313	-0.312
Scrapping age				-0.008	-0.005	-0.006	-0.005	-0.001	-0.006
Employment	-0.004	0.010	0.009	-0.005	0.013	0.014	-0.003	0.009	0.008
Real cost of labour	0.007	0.016	0.028	0.002	0.010	0.012	0.005	0.010	0.017
Inflation rate	0.024	0.018	0.018	0.032	0.014	0.011	0.010	0.010	0.012
Real exchange rate	0.000	0.000	0.000	0.087	0.158	0.240	0.095	0.161	0.234
Nominal interest rate	0.030	0.027	0.026	0.030	0.027	0.026	0.025	0.026	0.031
Real interest rate	0.011	0.009	0.005	0.015	0.015	0.015	0.015	0.014	0.014
Public balance	-0.057	-0.057	-0.057	-0.059	-0.055	-0.056	-0.055	-0.055	-0.058
Trade balance in current $	3427	7644	14667	1232	2703	4970	500	1242	2441

Note that US total factor productivity is temporary reduced by 0.50% for 5 years.
In the Taylor rule, the parameter on the US current inflation rate is 2.5, whereas it stays equal to 1.5 for the ECB.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

3.2 Increased Sensitivity of the ECB Monetary Rule to Changes in Inflation Rate

The sensitivity of the interest rate to inflation is increased from 1.5 to 2.5 in the Euro area and kept at its baseline value for the Federal Reserve (1.5). The simulation assumes the same depressive supply shock in the US as in Tables II.1.3 and II.2.1. The results are given in Tables II.3.3 and II.3.4.

If the ECB attaches more importance to its inflation target, it will react to a given level of inflation by increasing the interest rate more, which will reduce the depreciation of the Euro. Thus the real cost of investment decreases less in the US and increases less in the Euro area, which limits the decrease in Euro area investment compared with a less reactive monetary rule. Employment follows investment with a one-year lag and its decrease is also dampened. If European investment deteriorates less, consumption decreases more. Thus, the impact on the effective production is ambiguous. In our simulations, production in Europe declines while in the US it does not change by much when the ECB is more reactive. Finally, a monetary rule more sensitive to changes in inflation stabilises the exchange rate, but does not protect the Euro area against an exported recession from the US. More precisely, a change in the monetary rule of the ECB seems ineffective in protecting economic conditions in Europe against the transmission of a recession from the US. On the other hand, a change in the monetary rule of the Federal Reserve is a very effective means of shielding the US and the Euro area against a negative supply shock in the US. Looking at the repercussion on the countries within the Euro area, we can notice that Germany would be affected slightly more by the shock, as long as domestic demand, and especially investment, is concerned.

Table II.3.3: Negative supply shock in US with an increased sensitivity of the ECB to inflation: effects in the US

US	YEAR 1	YEAR 2	YEAR 3
Production	-0.608	-0.745	-1.028
Consumption	0.115	0.147	0.144
Investment	-3.387	-4.427	-6.086
Capital intensity	0.530	0.510	0.504
Scrapping age	0.069	0.136	0.272
Employment	0.044	-0.046	-0.123
Real cost of labour	-0.092	-0.202	-0.371
Inflation rate	-0.191	-0.186	-0.223
Real exchange rate	-0.290	-0.229	-0.149
Nominal interest rate	-0.270	-0.294	-0.386
Real interest rate	-0.081	-0.068	-0.055
Public balance	0.088	0.047	0.015
Trade balance in current $	14639	22039	31868

Note that US total factor productivity is temporary reduced by 0.50% for 5 years.
In the Taylor rule for the ECB, the parameter on the European current inflation rate is increased from 1.5 to 2.5 whereas it stays equal to 1.5 for the Fed.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

Table II.3.4: Negative supply shock in US with an increased sensitivity of the ECB to inflation: impact on the Euro area

	Euro area			Germany			France		
	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3
Production	-0.043	-0.030	-0.083	0.021	-0.060	-0.135	0.027	-0.034	-0.063
Consumption	-0.063	-0.109	-0.142	-0.076	-0.125	-0.159	-0.062	-0.102	-0.129
Investment	-0.861	-1.430	-2.404	-0.807	-1.880	-3.142	-0.601	-1.537	-2.541
Capital intensity				-0.267	-0.264	-0.258	-0.286	-0.285	-0.284
Scrapping age				0.006	0.012	0.025	0.000	0.005	0.007
Employment	0.004	-0.009	-0.047	0.004	-0.011	-0.057	0.000	-0.007	-0.048
Real cost of labour	-0.001	0.001	-0.005	-0.009	-0.012	-0.030	-0.006	0.001	-0.006
Inflation rate	0.010	0.002	0.002	0.005	-0.011	-0.013	0.008	-0.006	0.003
Real exchange rate				0.199	0.323	0.468	0.168	0.272	0.386
Nominal interest rate	0.002	0.001	0.002	0.002	0.001	0.002	0.007	0.017	0.031
Real interest rate	0.000	-0.001	-0.004	0.013	0.014	0.016	0.013	0.013	0.015
Public balance	-0.033	-0.042	-0.054	-0.033	-0.039	-0.054	-0.038	-0.044	-0.061
Trade balance in curent $	11989	24958	41780	3931	8094	13322	1743	3922	6694

Note that US total factor productivity is temporary reduced by 0.50% for 5 years.
In the Taylor rule for the ECB, the parameter on the European current inflation rate is increased from 1.5 to 2.5, whereas it stays equal to 1.5 for the Fed.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

4. Evaluation of a Fiscal Expansion in the US

The tax reduction decided by the Bush administration and enacted by the Congress in May 2001 totals about $1.4 trillions over the next 10 years (2001-2011). This amount represents approximately 1.5 % of GDP per annum over this period. The scenario considered in this section aims to simulate (1) an increase in government spending, and (2) a tax reduction over a period of 10 years, starting in 2001.

4.1 Increase in US Government Spending

In the simulations, US government expenditures are increased by 1% of GDP in 2001 and this rise is assumed to last for the following 9 years (see Tables II.4.1 and II.4.2).

In the short run the potential output cannot change by much, but the demand will suddenly increase. If prices were fully flexible they would immediately increase. To avoid the effects of such a transitory price rise, households and firms would transfer their consumption and investment from the present to the future, which would leave room for the rise in government consumption. The decrease in investment would decrease employment one year after the shock. As consumption is sluggish, its decrease would be somewhat slow. Since investment would be used for many years in the future, building plants a little later than planned to avoid a transitory increase in prices is an attractive option. Thus, the relative decrease should be much stronger for investment than for consumption. The reduction in investment would have negative effects on employment after the first year.

However, prices are sluggish, and do not increase as much as they would if they were perfectly flexible. Thus the decrease in private demand does not fully substitute for the increase in demand by the government, and the effective output of the US increases for a few years. The imbalance between a demand, which increases, and a potential production that cannot change enough, will be solved in the short run by some inflation, which will drive both the nominal and the real interest rate up.

The higher demand for American goods will also induce a real appreciation of the dollar. As prices are sluggish in the short run, when the exchange rate is fully flexible, the nominal value of the dollar can be expected to increase. The appreciation of the dollar is strengthened by the rise in the interest rate in the US. The real depreciation of the Euro increases the price of investment in the Euro area because capital goods are partly imported. Investment decreases and also effective production. The effect on Germany is proportionally larger than the Euro area average.

Table II.4.1: Increase in the US government expenditures

US	YEAR 1	YEAR 2	YEAR 3
Production	0.343	0.237	0.138
Consumption	-0.080	-0.172	-0.243
Investment	-1.739	-1.478	-1.380
Capital intensity	-0.348	-0.356	-0.360
Scrapping age	-0.025	-0.015	0.013
Employment	-0.016	-0.057	-0.076
Real cost of labour	0.033	0.018	-0.025
Inflation rate	0.106	0.093	0.075
Real exchange rate	-0.764	-0.765	-0.754
Nominal interest rate	0.110	0.096	0.080
Real interest rate	0.016	0.020	0.022
Public balance	-0.840	-0.771	-0.709
Trade balance	8018	111	-5671

Note that The shock implies an increase in US expenditures by 1% of GDP during 10 years.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

Table II.4.2: Increase in the US government expenditures: impact on the Euro area

	Euro area			Germany			France		
	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3
Production	-0.035	-0.033	-0.054	0.034	-0.063	-0.074	-0.021	0.053	0.034
Consumption	0.063	0.093	0.111	0.118	0.176	0.208	0.110	0.181	0.217
Investment	-0.710	-0.494	-0.368	-0.703	-0.763	-0.511	-0.041	-0.298	-0.240
Capital intensity				0.084	0.089	0.094	0.131	0.134	0.135
Scrapping age				0.005	0.002	0.011	-0.031	0.005	-0.020
Employment	0.002	-0.027	-0.042	0.003	-0.026	-0.048	-0.020	0.041	0.010
Real cost of labour	0.000	0.000	-0.012	-0.009	-0.003	-0.015	-0.040	0.010	0.035
Inflation rate	-0.004	-0.004	-0.005	0.010	-0.009	-0.003	-0.012	0.000	0.003
Real exchange rate	0.000	0.000	0.000	0.725	0.729	0.724	0.495	0.501	0.500
Nominal interest rat	-0.013	-0.006	-0.006	-0.013	-0.006	-0.006	-0.007	-0.006	-0.004
Real interest rate	-0.009	-0.001	-0.001	-0.004	-0.003	-0.002	-0.007	-0.009	-0.008
Public balance	-0.022	-0.032	-0.036	-0.026	-0.028	-0.033	-0.047	-0.018	-0.018
Trade balance in current $	-13398	-19107	-24873	-3485	-5590	-7615	-2914	-3520	-4230

Note that the shock implies an increase in US expenditures by 1% of GDP during 10 years.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

4.2 Decrease in Corporate Taxes and in Wage Taxes

In these simulations, the decrease in tax rates is financed by an increase in lump sum taxes. So, distortionary taxes are substituted by non-distortionary taxes, and government spending stays unchanged. The time profile of the rise in lump sum taxes does not matter, because of the Ricardian equivalence assumed by Marmotte. Thus, postponing these taxes until a far future, and using public indebtedness in the short and the medium runs are possible options. Hence, decreasing taxes improves the efficiency of the supply side of the economy, but has no direct effect on effective demand. As a decrease in taxes has an expansionary effect on government budget, an automatic tax stabiliser can be built. When economic conditions are bad, taxes are decreased and public indebtedness increases. When economic conditions are good, taxes are increased and public indebtedness decreases. Thus, public indebtedness fluctuates around a constant value over time, and lump sum taxes (subsidies) need never to be increased (decreased). Actually this would be politically difficult: imagine decreasing government pensions or social securities spending. In the simulations, the tax reduction of 1% of GDP takes place, as before, in 2001 and is expected to last for 10 years.

In the model, two kinds of taxes are considered in each country: a tax on wages and a tax on profits. The addition of the two is equivalent to a production tax. An increase in this tax, which bears on the output of all production units, has some similarities with a negative supply shock hitting all capital vintages. Thus, decreasing this tax rate can be a good policy against this kind of shock. A supply shock only hitting new capital could probably be compensated by a subsidy to investment.

The decrease in the wage tax rate reduces the wedge between the real cost of labour and real wages. Thus, this measure benefits both households, as real wages increase, and firms since the cost of labour decreases. Because of this last effect, employment increases. The decrease in labour costs also improves the efficiency of investment, leading to a higher capital accumulation, which is however smaller than the increase in employment. The final effect is a small decrease in capital intensity. In addition, the increased efficiency of the economy translates into a higher households' wealth, with a beneficial effect on consumption. However, in Marmotte the sensitivity of labour cost to the wedge is weak, and the overall effects on the economic conditions are quite tiny. Therefore the corresponding tables are omitted.[18]

Decreasing the taxation of profits is a more efficient way of improving economic efficiency. However, new investments become more capital intensive instead of less capital intensive, which dampens the beneficial effects on employment. The spillover effects on the Euro area are positive, with namely a moderate increase in investment because of the limited real depreciation of the Euro (see Table II.4.4).

Table II.4.3: Decrease in the taxation of profits in the US by 1% of GDP

US	YEAR 1	YEAR 2	YEAR 3
Production	0.131	0.115	0.102
Consumption	0.001	-0.006	-0.010
Investment	0.651	0.664	0.640
Capital intensity	-0.027	-0.021	-0.015
Scrapping age	-0.009	-0.009	-0.013
Employment	-0.006	0.017	0.038
Real cost of labour	0.010	0.015	0.020
Inflation rate	0.040	0.027	0.015
Real exchange rate	0.016	0.014	0.018
Nominal interest rate	0.057	0.044	0.032
Real interest rate	0.029	0.028	0.028
Public balance	-0.127	-0.109	-0.093
Trade balance	-2365	-3683	-4441

Note that the shock on the corporate tax rate has been calibrated to induce a tax decrease by 1% of GDP during 10 years: the tax rate is then reduced by 0.384 percentage points.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

[18] The decrease in the taxation of wages has been calibrated to induce a tax decrease of 1% of GDP during 10 years: the tax rate is then reduced by 0.17 percentage points. As the effects of this tax reduction on the US and the Euro area were very weak, the results of the simulations are not given here.

Table II.4.4: Decrease in the taxation of profits in the US by 1% of GDP: impact on the Euro area

	Euro area			Germany			France		
	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3
Production	0.004	-0.001	0.003	-0.008	0.004	0.011	0.000	-0.001	0.000
Consumption	0.005	0.008	0.011	0.005	0.009	0.011	0.004	0.007	0.009
Investment	0.155	0.245	0.327	0.146	0.321	0.432	0.145	0.263	0.346
Capital intensity				0.028	0.027	0.027	0.029	0.029	0.029
Scrapping age				0.000	0.001	0.000	0.001	0.002	0.001
Employment	0.000	0.004	0.012	0.000	0.005	0.014	0.001	0.005	0.012
Real cost of labour	-0.001	-0.003	-0.002	0.000	-0.001	0.000	-0.002	-0.003	-0.001
Inflation rate	-0.002	-0.003	-0.004	-0.002	-0.001	-0.002	0.000	-0.002	-0.005
Real exchange rate	0.000	0.000	0.000	-0.023	-0.047	-0.069	-0.022	-0.041	-0.059
Nominal interest rate	-0.002	-0.004	-0.006	-0.002	-0.004	-0.006	-0.003	-0.006	-0.010
Real interest rate	0.001	0.001	0.000	-0.001	-0.001	-0.002	-0.001	-0.001	-0.002
Public balance	0.005	0.008	0.011	0.005	0.007	0.011	0.006	0.008	0.012
Trade balance in current $	-2625	-4558	-5770	-830	-1444	-1823	-398	-712	-916

Note that the shock on the corporate tax rate has been calibrated to induce a tax decrease of 1% of GDP during 10 years: the tax rate is then reduced by 0.384 percentage points.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

5. Evaluation of a Co-ordinated Fiscal Expansion in the Euro Area

Since US fiscal policy is effective in the US, but its spillover effects on the Euro area are negligible, we now evaluate whether a fiscal expansion in the Euro area or a reduction in taxation would be beneficial. The effects of a fiscal expansion in the Euro area and in the US are not necessarily comparable because it lasts for five years in the Euro area and ten years in the US.

5.1 Increase in European Government Spending

In the simulation, government expenditures in all countries of the Euro area are increased by 1% of GDP in 2001 and this rise is assumed to last for the following 5 years (see Table II.5.1).

This demand shock does not change by much the potential production of Euro area economies and thus leads to higher inflation. Households and firms transfer their expenditures from the present to the future to avoid this transitory increase in prices. The reduction of private demand does not fully substitute for the increase in public demand because prices are sluggish in the short run. So, effective output is higher during two years. The crowding out effect on private demand is particularly evident in investment. At the national level, we can observe that the effects on consumption are spread quite symmetrically, whereas investment is affected slightly more pronouncedly in France and Germany. The higher demand for European goods induces a real appreciation of the Euro. As prices are sluggish in the short run, when the exchange rate is fully flexible, the nominal value of the Euro can be expected to increase. The appreciation of the Euro is strengthened by the raise in the interest rate in the Euro area. The spillover effects on the US economy are minor, therefore the table is omitted.

Table II.5.1: Increase in government expenditures of the Euro area countries by 1% of GDP: impact on the Euro area

	Euro area			Germany			France		
	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3
Production	0.171	0.049	-0.025	-0.047	0.028	-0.043	0.243	0.096	-0.016
Consumption	-0.114	-0.201	-0.258	-0.164	-0.278	-0.341	-0.146	-0.254	-0.323
Investment	-2.706	-2.812	-2.862	-3.545	-2.959	-3.017	-2.988	-3.095	-3.246
Capital intensity				-0.267	-0.272	-0.271	-0.359	-0.364	-0.364
Scrapping age				-0.028	-0.016	0.028	-0.035	-0.009	0.029
Employment	-0.020	-0.093	-0.156	-0.018	-0.121	-0.182	-0.022	-0.094	-0.160
Real cost of labour	0.023	0.016	-0.044	0.042	0.024	-0.032	0.025	0.015	-0.058
Inflation rate	0.053	0.054	0.060	-0.011	0.055	0.063	0.077	0.066	0.063
Real exchange rate				-0.397	-0.400	-0.395	-0.433	-0.446	-0.443
Nominal interest rate	0.067	0.079	0.091	0.067	0.079	0.091	0.083	0.086	0.092
Real interest rate	0.012	0.019	0.026	0.011	0.016	0.019	0.017	0.022	0.027
Public balance	-0.998	-0.936	-0.885	-1.002	-0.954	-0.905	-0.977	-0.916	-0.871
Trade balance in current $	8803	7203	6566	1900	1630	1612	1802	1495	1380

Note that the shock on government expenditures affects all the Euro area countries in such a way as to increase their respective government expenditures by 1% of their GDP during 5 years.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

5.2 Decrease in Corporate Taxes and in Wage Taxes

The reduction in wage taxes benefits both households (via higher real wages) and firms (via lower labour costs): the overall effects on the economy are similar to those explained in section 4.2. We observe an increase in employment and, to a lesser extent, in investment, leading to an overall decrease in capital intensity. However, since the effects of a reduction of the tax wedge to labour costs are small, the repercussions on the economy are of second order. Thus the corresponding tables are omitted.[19]

Decreasing the taxation of profits is a more efficient way of improving economic efficiency. However, new investments become more capital intensive instead of less capital intensive, which dampens the beneficial effects on employment. Moreover, production increases more than capacities and thus leads to higher inflation and higher interest rates.[20]

[19] In the simulation, the decrease in the taxation of wages has been calibrated to induce a tax decrease of 1% of GDP during 5 years in all countries of the Euro area. As the effects of this tax reduction on the US and the Euro area were very weak, the results of the simulations are not given here.

[20] Also in this case the spillover effects on the US economy are negligible, therefore the table is not reported.

Table II.5.2: Decrease in the taxation of profits in the Euro area by 1% of GDP: impact on the Euro area

	Euro area			Germany			France		
	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3	YEAR 1	YEAR 2	YEAR 3
Production	0.117	0.126	0.114	0.163	0.135	0.121	0.151	0.126	0.114
Consumption	0.025	0.034	0.042	0.033	0.044	0.053	0.029	0.039	0.048
Investment	0.361	0.380	0.319	0.514	0.396	0.324	0.532	0.424	0.350
Capital intensity				-0.008	0.000	0.007	-0.006	0.003	0.013
Scrapping age				-0.021	-0.013	-0.012	-0.024	-0.005	-0.010
Employment	-0.017	0.007	0.020	-0.013	0.009	0.023	-0.015	0.015	0.026
Real cost of labour	0.016	0.023	0.023	0.013	0.023	0.021	0.010	0.020	0.025
Inflation rate	0.042	0.037	0.027	0.052	0.036	0.026	0.048	0.031	0.023
Real exchange rate	0.000	0.000	0.000	0.014	0.025	0.035	0.017	0.030	0.042
Nominal interest rate	0.066	0.056	0.041	0.066	0.056	0.041	0.068	0.059	0.045
Real interest rate	0.029	0.028	0.027	0.030	0.029	0.029	0.036	0.035	0.035
Public balance	-0.137	-0.116	-0.099	-0.146	-0.123	-0.106	-0.151	-0.127	-0.110
Trade balance in curent $	-1026	-1481	-1791	-280	-364	-433	-273	-381	-425

Note that the shock has been calibrated in such a way that the profits taxation is reduced by 1% of GDP in all the countries of the Euro area during a period of 5 years.
Units: percentage deviation from the baseline with the exception of interest rates, expressed in absolute deviations, public balance, expressed as absolute deviation in percentage points of baseline GDP, trade balance, expressed as absolute deviation in million of US$; scrapping age is the age of the oldest production unit in activity.

A tax cut policy seems more efficient to stabilise the economic activity than increasing public expenditures. Decreasing taxes improves the supply side of the economy and has no negative effect on private demand. So, the expansionary effect allows for the building of an automatic tax stabiliser. In the case of public expenditures, it appears that private demand decreases and public balances in the Euro area economies deteriorate more. Moreover, inflation is much higher because demand increases more than capacity, which does not change substantially.

This co-ordinated fiscal expansion in the Euro area countries is however different from what happens in the Euro area in 2002 and afterwards. Moreover, the simulations do not reproduce the depreciation of the Euro because they do not take into account other economic events like Japanese Central Bank behaviour.

On the other hand, our simulations show that the fiscal expansion policies would lead to public deficits over the SGP target, at least for Germany (see Table II.5.3). So, in this particular context of high deficits in most of the Euro area countries, it appears that there is no room for manoeuvre of national fiscal policy to cope with symmetric negative shocks.

Table II.5.3: Public deficits as percentage of GDP for selected EU countries in 2001 and increase in points after expansionary fiscal policy

Deficit/ GDP		Fiscal expansion by: Increasing public expenditures			Reducing households taxes			Reducing corporate taxes		
	2001	2002	2003	2004	2002	2003	2004	2002	2003	2004
Germany	2.6	1.00	0.95	0.90	0.12	0.11	0.10	0.15	0.12	0.11
France	1.4	0.98	0.92	0.87	0.13	0.12	0.11	0.15	0.13	0.11
Italy	1.1	1.07	1.00	0.94	0.10	0.10	0.09	0.15	0.12	0.10

Box 5.1: The Multinational Model Marmotte[21]

Marmotte is a yearly macro-econometric model built by Cepii and Cepremap and implemented on Troll software. It includes 17 countries: the 14 members of the European Union (Luxembourg and Belgium are merged), the United States, Japan and Canada. Each country is modelled by the same system of about 50 equations. The values of the parameters of these equations, and the exchange rate system, can differ between countries. Each country produces a specific commodity, which is imperfectly substitutable with the commodities produced by other countries.

Marmotte is a dynamic model with a strong theoretical content and built under the assumption of perfect forecast/foresight. Most behavioural equations are based on intertemporal optimisation. Many parameters were estimated by econometric methods (in general GMM over the panel of 17 countries, with tests of the significance of the difference of values of parameters between countries). Marmotte follows the same basic principles as Multimod Mark 3 (an IMF model) and Quest 2 (a model built by the European Commission). It can be used to simulate the consequences of changes in economic policies or in economic environment, over the future, and around a baseline, which was built independently of the model and which rests on forecasts given by OECD, IMF, etc.

Since Marmotte has strong and clear theoretical background, the results of its simulation can be given clear and precise interpretations in non-technical terms. It is better used as an interface in discussions between applied economists, with different expertise, who are interested in analysing medium-run problems of the European or the world economy.

The most original feature of Marmotte is a putty-clay technology. A series of papers by Caballero and Hammour show that such a technology is especially adapted to the analysis of medium-run movements in the allocation of national income between wages and profits. It can explain how a change in the structure of the labour market will change progressively production technology and the working of the economy. It can explain the stickiness of employment and investment better than by assuming quadratic adjustment costs.

Another specific feature of Marmotte is that consumers optimise intertemporally with a non-separable utility function which takes into account habits formation. This introduces some stickiness in consumption behaviour. The other features of the model

[21] More details are provided in Annex 3.

(imports, exports, wages and prices equations with some stickiness of nominal values, interest rate parities, monetary rules, etc.) are quite classical. The model assumes intertemporal equilibrium of the budget of each government and of the balance of payments of each country.

Part III. Asymmetries in the Cyclical Effects of Monetary Policy on Output: Some Evidence for the Euro Area

In this part of the report, we analyse how monetary policy shocks affect real output growth in the Euro area. We allow these effects to depend on the phase of the business cycle, distinguishing between recessionary and expansionary regimes. For this purpose, we follow the work of Ravn and Sola (1996), Garcia and Schaller (1995), Kakes (2000), Dolado and María-Dolores (2001) and Peersman and Smets (2000) in applying Hamilton's (1989) Markov-Switching methodology to endogenously determine the prevailing business cycle regime and the transition probabilities from one phase to another. We specify a Multivariate Markov-Switching (MMS) model for output growth and allow this to depend on shocks to a short-term interest rate controlled by the monetary authorities, describing a Taylor-type monetary policy rule. The use of the MMS methodology is appropriate to analyze the cyclical effects of changes in the monetary policy stance in the Euro area since, unlike what happens with the NBER dating for the US cycle, an official dating for the European cycle is not yet available. Hence, the MMS approach enables us to address a number of interesting issues ranging from "*Do monetary policy shocks have different effects on output depending on the phase in which the change in monetary policy took place?*" to "*Do changes in the monetary policy stance alter the transition probabilities from a recession to a boom and vice versa?*"

To measure the stance of monetary policy in the EU, a monetary policy reaction function is estimated using quarterly data during the period 1984: I to 2001: II. The data is obtained from the OECD database, where the inflation rate and a short-term interest rate for the EU have been constructed as GDP-weighted averages of the individual data for the 15 countries that belong to this economic area. The GDP data is the EU aggregate, measured in units of PPP at 1995 prices. As a sensitivity analysis check, the analysis was repeated for the twelve countries in the monetary union, which yielded very similar results.

Our approach consists of two stages. First, a generalised Taylor rule specification is estimated for the EU, as if a surrogate European Central Bank (ECB) was exerting monetary policy control during the period under study. The residuals of this reaction function are interpreted as monetary policy shocks. In the second stage, those shocks are used as explanatory variables in a MMS model for GDP growth, in order to examine whether the effects of unanticipated changes in monetary policy on output growth depend on the business cycle regime at the time the shock occurred. In this analysis, the form of the central bank's reaction function is assumed to be the same across business cycle phases. This assumption could be relaxed in future work.

Proceeding in this way, we obtain two interesting results. First, evidence is found in favour of such asymmetries, whereby monetary policy shocks have larger effects during recessions than during expansions. Secondly, we find that monetary policy shocks affect the transition probabilities from one cyclical phase to another.

The rest of this part is organised as follows. In Section 1, we discuss the related literature on asymmetries in the effects of monetary policy shocks. In section 2, we estimate a forward-looking Taylor rule for the surrogate ECB. In Section 3, we offer a brief explanation of the empirical methodology underlying the MMS model and present results for the effects of monetary policy shocks on output growth in a model with constant probabilities of switching from one business cycle regime to another. In

Section 4 we relax the assumption of constant transition probabilities by allowing them to be affected by monetary policy shocks in a direct way. Finally, section 5 concludes.

1. Related literature

Three main types of asymmetries have been discussed in the literature on the effects of unanticipated monetary policy changes on real aggregate activity: (i) *Keynesian* asymmetries, associated with the "*sign*" of the monetary shocks, (ii) "*menu cost*" asymmetries, related to the "*size*" of those shocks, and (iii) "*state*" asymmetries, according to which the effects on output depend on the phase of the business cycle.

One can find many theoretical contributions that provide the micro-foundations for those asymmetries. Regarding the "*sign*" asymmetry, Ball and Romer (1989, 1990), Caballero and Engel (1992) and Tsiddon (1991), *inter alia*, have analysed S-s threshold-type price adjustment rules that lead to convex aggregate supply curves, as in the standard Keynesian framework. The "*size*" asymmetry relies upon the nominal stickiness properties of menu costs and has been examined, among others, by Akerlof and Yellen (1985). More recently, the possibility of having a hybrid "*sign-size*" asymmetry, according to which only "*small negative*" shocks affect real output, has been considered as well in models which combine dynamic menu costs with a positive trend inflation rate. As indicated by Ball and Mankiw (1994), the underlying explanation for this more complex type of asymmetry is that, in the face of a positive trend inflation rate, "*small negative*" shocks should bring actual prices closer to their optimal values and the opposite should be expected when shocks are positive, either large or small. Consequently, under the former case, firms will not adjust their prices and, therefore, real effects will occur.

Empirical support for both sign and size asymmetries is well documented in the literature. On the one hand, Cover (1992), DeLong and Summers (1988) and Karras (1996) find favourable evidence for the Keynesian asymmetry in the US and a number of European countries. On the other hand, Ravn and Sola (1996) and María-Dolores (2001) find strong evidence for both the "*Keynesian*" and "*menu cost*" asymmetries in the US and Spain, respectively.

Our aim is restricted to the analysis of the possible existence of "*state*" asymmetries. This type of asymmetry is related to the issue of whether unanticipated changes in monetary policy affect real output growth rates differently in business cycle recessions and expansions. Although it has received far less attention in the literature than the two other types of asymmetry, there are at least two arguments justifying its possible existence. First, the above-mentioned price adjustment models leading to a convex aggregate supply curve could be re-interpreted as implying that monetary policy will have stronger real effects during recessions, when output is below its long-run level, than in expansions, when the aggregate supply curve is almost vertical. Secondly, there is a broad class of models which provide support for "*state*" asymmetries by explicitly modelling the credit or lending channel of the monetary transmission mechanism. According to this interpretation, if financial markets face information asymmetries, credit and liquidity may be readily available in booms whilst agents may find it harder to obtain funds in recessions. Therefore, it is likely that monetary policy will have stronger effects on consumption and investment decisions during recessions than during expansions. This is the mechanism derived from the extensive research on financial market imperfections, including agency costs and debt overhang models, developed by Bernanke and Gertler (1989), Gertler (1988), Gertler and Gilchrist (1994), Kiyotaki and Moore (1997) and Lamont (1993), among others. Using the MMS modelling approach that is also employed here, García and Schaller (1995) and Dolado and María-Dolores (2001) provide favourable empirical evidence in the US and Spain, respectively, for the conjecture that monetary policy has larger effects during recessions than during expansions.[22]

2. Estimation of central bank's reaction function

In this section, we estimate a linear “forward–looking” Taylor rule for the hypothetical European Central Bank (ECB), following the arguments in Svensson (1997), and Clarida et al (1998, 1999). The first order necessary conditions for the problem of choosing an interest rate target (i_t^*) that minimises a quadratic loss function in terms of inflation and output gap subject to a set of linear constraints yield the following policy reaction function:

$$i_t^* = \bar{i} + \beta_1 \left[\mathrm{E}_t \left(\pi_{t+k} - \pi_{t+k}^* \right) \right] + \beta_2 \left[\mathrm{E}_t \left(y_{t+p} - y_{t+p}^* \right) \right] + \xi_t \qquad (1)$$

where E_t is the conditional expectation at time t, π_t and π_t^* denote the current and targeted inflation rates, y_t and y_t^* represent log output and its market clearing level, respectively, $\bar{i}$ the equilibrium nominal interest rate and ξ_t is an i.i.d. error term. Assuming that the ECB smoothes interest rate changes by adopting an AR(1) partial adjustment rule, given by[23]

$$i_t = \rho i_{t-1} + (1 - \rho) i_t^* \qquad (2)$$

leads to the following estimable specification of the Taylor rule :

$$i_t = \rho i_{t-1} + (1 - \rho) \left\{ \bar{i} + \beta_1 E_t \tilde{\pi}_{t+k} + \beta_2 \mathrm{E}_t \tilde{y}_{t+p} + \beta_3 ' \mathrm{X}_t \right\} + \varepsilon_t \qquad (3)$$

where $\tilde{\pi}_t$, $\tilde{y}_t$ denote deviations from target, X_t denotes a set of observable variables at time t, different from inflation and output gaps, that may potentially affect interest rate setting independently of their role in helping to forecast the above-mentioned variables. Since we are dealing with an open economy with a comparable size to the US economy, X_t will typically include variables such as variations in the Euro/$ real exchange rate or the evolution of a US short-term interest rate. Comparable to other models with rational expectations, estimation of (3) relies on replacing the expectations of future variables by their realized values so that the error term follows the stochastic process:

$$\varepsilon_t = (1 - \rho) \left[\xi_t - \left(\beta_1 e_{t+k/t}^{\pi} + \beta_2 e_{t+p/t}^{y} \right) \right] \qquad (4)$$

[22] There is, however, a large literature on business cycle asymmetries in output growth considered from a univariate perspective. See, e.g., Neftci (1984), Beaudry and Koop (1993), McQueen and Thorley (1993), and Pesaran and Potter (1997).

[23] See Goodfriend (1991) and Sack (1997).

where ξ_t is an i.i.d disturbance, $e^{\pi}_{t+k/t} \equiv \pi_{t+k} - E_t(\pi_{t+k})$ is the k-period ahead forecast error for inflation and $e^{y}_{t+k/t} \equiv y_{t+p} - E_t(y_{t+p})$ is the corresponding p-period ahead forecast error for the output gap.[24] Finally, let z_t be a vector of variables within the central bank's information set, such as lagged variables that help forecast inflation and output, or any other contemporaneous variables that are uncorrelated with the policy rule shock, ε_t. Then, the Generalized Method of Moments (GMM) can be used to estimate the parameter vector in (1), (2) and (3) by exploiting the set of orthogonality conditions:

$$E(\varepsilon_t / z_t) = 0 \qquad (5)$$

Further, since the composite disturbance has an MA(max{k, p}-1) representation due to the overlapping nature of the forecast errors, the weighting covariance matrix used to implement GMM is the one proposed by Newey and West (1987). Moreover, Hansen's (1982) *J* test is used to test the overidentification restrictions.

To obtain a measure of the output gap, we detrend logged GDP using the Hodrick-Prescott (HP) filter with $\lambda = 1600$[25]. A similar procedure is used to estimate the inflation target, π_t^*. Note that we depart from the assumption that the inflation target is constant, as in Clarida et al. (1998) and assume instead that it varies over time. In this respect, we follow Dolado, María-Dolores and Naveira (2000) in arguing that the use of a time-varying target inflation rate is a sensible choice for the purpose of analysing asymmetries. Because many of the Euro area countries have experienced long disinflationary periods during the period at hand, it is difficult to believe that a constant long-term inflation rate was guiding monetary policy in the short-run.

Table III.2.1 reports the results for the Taylor rule specification for k=4 and p=0. The first column offers the estimates obtained when no extra variables besides inflation and output gaps are included in the Taylor rule, whereas the second and third columns allow for the presence of either changes in the Euro/$ real exchange rate or the level of the US interest rate.

[24] Note that equation (1) is derived when the monetary authorities commit to a state contingent sequence of short-term interest rates in order to minimize an intertemporal loss function. In this framework it is supposed that interest rate affects output with p-period lag and affects inflation with a k-period lag. For a detailed description see Svensson (1997) and Clarida et al (1998, 1999).

[25] Peersman and Smets (1999) examine the estimation error impact of the output gap on the efficient feedback parameters and the performance of the Taylor rule.

Table III.2.1: Taylor rule for the Euro area

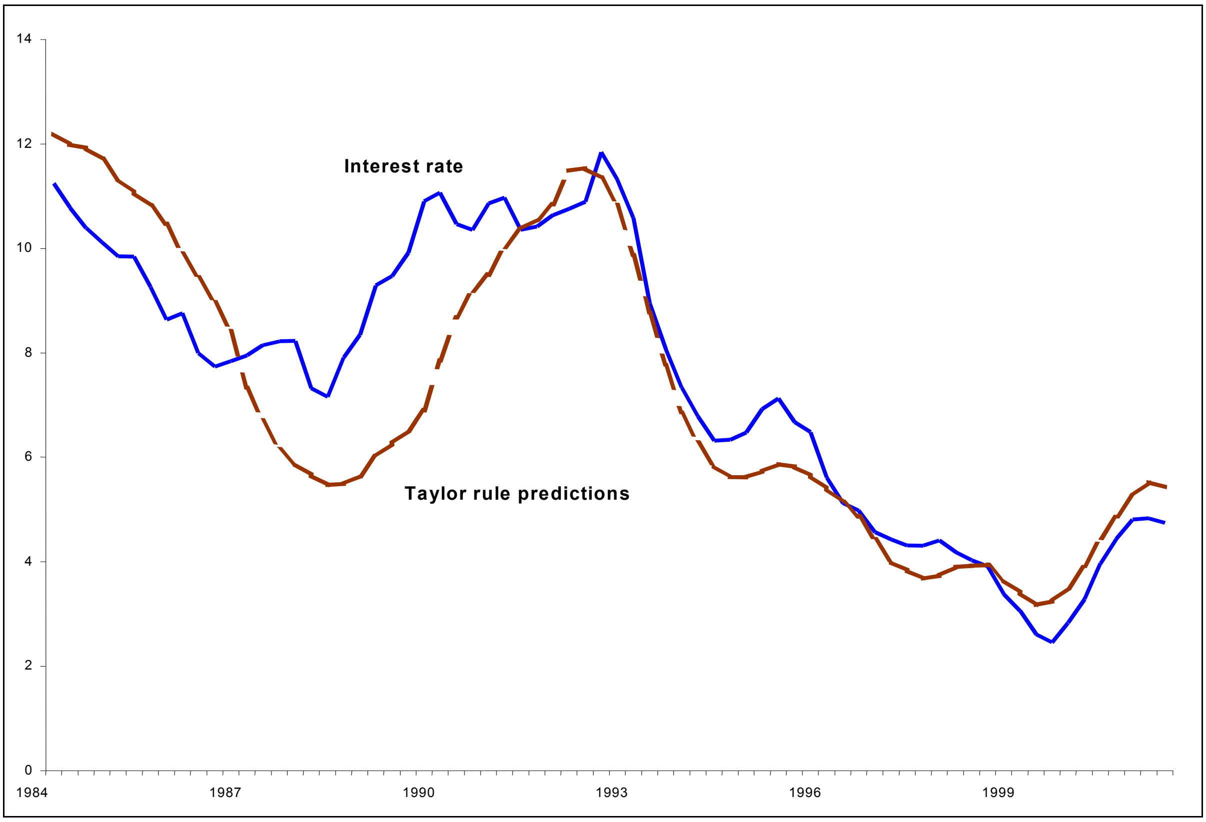
Estimated Coefficients			
ρ	0.93	0.87	0.92
	(-76.86)	(-62.79)	(-24.84)
I	4.81	6.03	6.19
	(-3.60)	(-2.76)	(-3.15)
β_1	1.65	1.07	1.37
	(-1.72)	(-3.84)	(-3.62)
β_2	0.23	0.35	0.23
	(-2.24)	(-1.78)	(-2.17)
$\beta_{3e} * \beta_{3i}$		0.82	0.38
		(-2.55)	(-2.33)
σ_ε	0.93	0.96	0.88
P	0.05	0.08	0.09

Sample period: 1984:I 2001:II. t-value in parentheses; β_{3e}:Euro/US$ real exchange rate changes (second column); β_{3i}US interest rate (third column); p is the p-value of the J-test for overidentifying restrictions.

The list of instruments z_t includes a constant term and four lags of the following variables: inflation, output gap and interest rate (in the first column of each specification) and two lags of the Euro/US$ real exchange rate change (second column), and US interest rate (third column), which are variables included in the X_t set. As can be observed, only the specifications including the X_t variables pass the *J*-test, and the standard deviation of the residuals is smaller in the specification containing the US interest rate. So, the specification contained in the third column is considered to be the best and is represented in Figure III.2.1, where the deviations between the actual evolution of the interest rate and that implied by the estimated Taylor rule correspond to the ε_t error terms described above. The results in the third column indicate that the degree of persistence is very high ($\rho \approx 0.92$) and that the surrogate ECB responds to the inflation gap more than proportionally (β_1=1.37). The estimated coefficient for the output gap is positive and significant (β_2=0.23).[26] Given the estimate of the coefficient on the US interest rate (β_3=0.38), one can interpret the policy rule as a weighted average of the US interest rate (with a weight of 0.38) and the baseline policy rule (0.62).

[26] Smets (1998) argues that estimation error in the output gap may in part explain why the actual central bank response to movements in the output gap is less than optimal control exercises suggest.

Figure III.2.1: Taylor rule in the Euro area



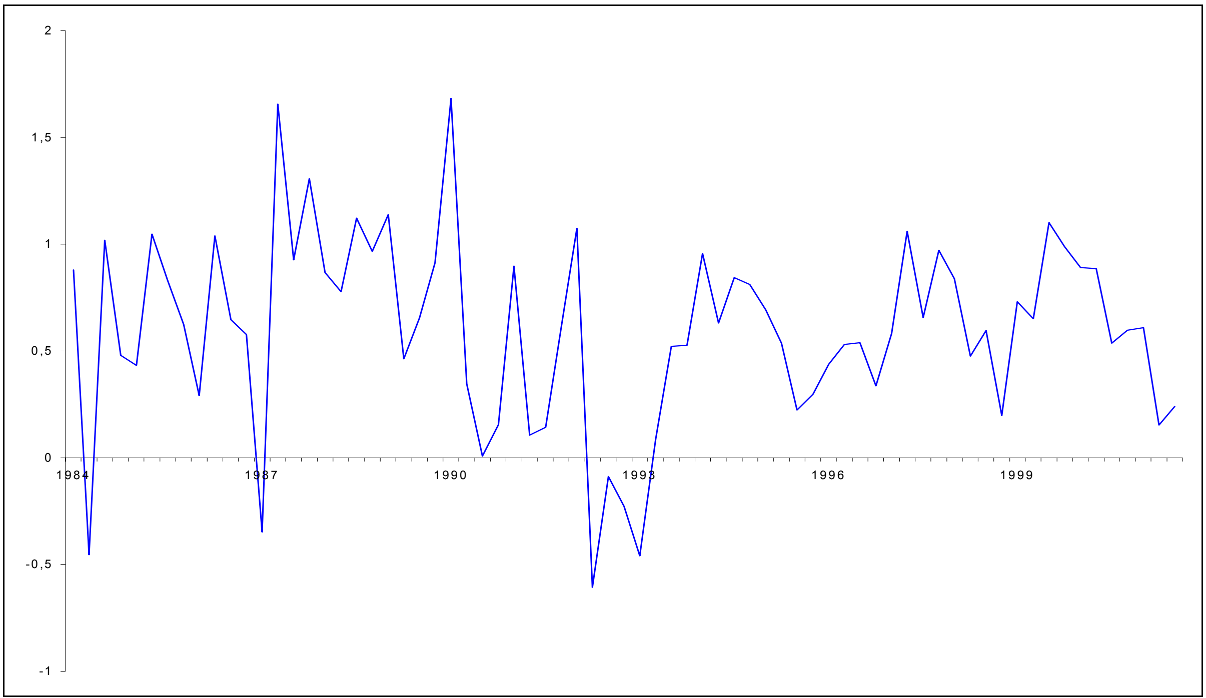
3. Markov switching models for real GDP growth

In this section, we discuss the basic principles of the econometric modelling approach which is applied to analyse the existence of business cycle asymmetries in the effects of unanticipated monetary policy changes on real activity. To do so, a brief explanation of the basic aspects of the MMS methodology in a multivariate extension of the original univariate model (see Hamilton, 1989) is offered. In particular, we explain how the existence of "*state*" asymmetries in the effects of monetary policy can be ascertained by allowing the Taylor rule shocks to affect the output growth rate.

3.1 Extended Markov-Switching model including interest rate shocks

To investigate the possibility of asymmetric effects of monetary policy shocks on output growth we rely upon the work of Garcia and Schaller (1995), Kakes (2000), Dolado and María-Dolores (2001) and Peersman and Smets (2000) in considering a multivariate extension of the MS model (MMS). We focus on a version of the MMS model where the effects of interest rate shocks on output growth depend on the state of the economy at the time when policy action was taken. Figure III.3.1 depicts the quarterly GDP growth rates in the EU.

Figure III.3.1: GDP growth in the EU-15



Source: OECD

Hamilton's (1989) approach is based on the assumption that the actual state of the economy, i.e., recession (r) or expansion (e), is determined by an unobserved latent random variable which follows a first-order Markov process. In the original version of the MS methodology the average growth rate of GDP (μ) is allowed to vary depending on whether the output growth corresponds to an expansion (μ_e) or to a recession (μ_r). The GDP growth is assumed to be determined by an Auto-Regressive process of order p (AR(p)).

To estimate the asymmetric effects of monetary policy shock on output growth depending on the business cycle phase that the economy was undergoing when the shock took place, the following MMS specification is estimated:

$$\Delta y_t = \phi_1 \Delta y_{t-1} + _{...} + \phi_p \Delta y_{t-p} + \mu_r \left(1 - \phi_1 - _{...} - \phi_p\right) +$$
$$\Delta\mu\left(S_t - \phi_1 S_{t-1} - _{...} - \phi_p S_{t-p}\right) + \beta_{or}\xi_t + \Delta\beta_{or} S_t \xi_t +$$
$$\beta_{1r}\xi_{t-1} + \Delta\beta_1 S_{t-1}\xi_{t-1} + _{...} + \beta_{pr}\xi_{t-p} + \Delta\beta_p S_{t-p}\xi_{t-p} + \sigma\eta_t \qquad (6)$$

where Δy is the quarterly growth rate of seasonally adjusted GDP, $\Delta\mu = \mu_e - \mu_r$, S_t is the state variable and η_t is assumed to be standard normally distributed. Furthermore, $\Delta\beta = \beta_e - \beta_r$, and β_r and β_e are the coefficients on the shocks (ξ_t) in recessions and expansions in each country, respectively.

The state variable S_t is assumed to follow a discrete-time first-order Markov process, which is characterized by the following transition probability matrix Π:

$$\begin{bmatrix} p_{rr} & p_{er} \\ p_{re} & p_{ee} \end{bmatrix} = \begin{bmatrix} p_{rr} & 1-p_{ee} \\ 1-p_{rr} & p_{ee} \end{bmatrix} \qquad (7)$$

where:

$$p_{ij} = \Pr\left(S_t = j / S_{t-1} = i\right), \qquad (8)$$

with

$$\sum_{j=r}^{e} p_{ij} = 1 \qquad \text{for all i}$$

and p_{ij} is the probability of going from state *i* to state *j* (e.g., p_{re} is the probability of going from a recession to an expansion, etc.). Initially, we assume that the transition probabilities are constant over time.

As Hamilton (1989) has shown, the above assumptions allow us to obtain a sequence of joint conditional probabilities $Pr(S_t=i,...,S_{t-s}=j|\Phi_t)$, which are the probabilities that the GDP growth series is in state *i* or *j* (*i, j* = *r,e*) at times *t*, *t*-1, until *t-s* respectively, conditional on the information available at time *t*, denoted by Φ_t. By adding those joint probabilities we can obtain the so-called filtered probabilities, namely, the probabilities of being in states *r* or *e* at time t, given information available at time *t*:

$$\Pr\left(S_t = j / \Phi_t\right) = \sum_{i=r}^{e} ... \sum_{j=r}^{e} \Sigma \Pr\left(S_t = i, ..., S_{t-s} = j / \Phi_t\right) \qquad i,j = e,r \qquad (9)$$

The filtered probabilities provide information about the regime which is most likely to have occurred at time *t*. Therefore, they are very useful tools for dating regime switches.

Table III.3.1 shows the results obtained from the estimation of the MMS model in (6) with p=1, since the coefficients of additional lags were not significant. The first regime corresponds to a contractionary phase with a mean quarterly growth rate of -0.13 % (-0.52% annually). The second regime corresponds to an expansionary phase with a mean quarterly growth rate of 0.71% (2.88% annually). As regards the probabilities of remaining in each regime, they are estimated to be 0.59 for a recession and 0.95 for an expansion. These probabilities imply mean durations of 2.5 and 20 quarters in phases of negative and positive growth, respectively. As expected, the estimated coefficients of the interest rate shocks are negative in both regimes and about 2.5 times larger in the recessionary regime than in the expansionary regime. Indeed, a likelihood ratio test of $H_0: \beta_{1r} = \beta_{1e}$ rejects the null hypothesis of symmetric effects with a *p*-value of 0.02. Figure III.3.2 displays the smoothed probabilities of a recession, while Figure III.3.3 depicts the impulse-response function of output growth to a one-standard-deviation shock in ξ_t.

Table III.3.1: Models for GDP growth

Estimated Coefficients			
k	4	4	4
π	0	0	0
ρ	0.93	0.87	0.92
	-76.86	-62.79	-24.84
i	4.81	6.03	6.19
	-3.60	-2.76	-3.15
β_1	1.65	1.07	1.37
	-1.72	-3.84	-3.62
β_2	0.23	0.35	0.23
	-2.24	-1.78	-2.17
$\beta_{3e} * \beta_{3i}$		0.82	0.38
		-2.55	-2.33
σ_ε	0.93	0.96	0.88
p	0.05	0.08	0.09

Sample period: 1984:I 2001:II. t -values in smaller format.

Figure III.3.2: Smoothed probabilities of a recession.

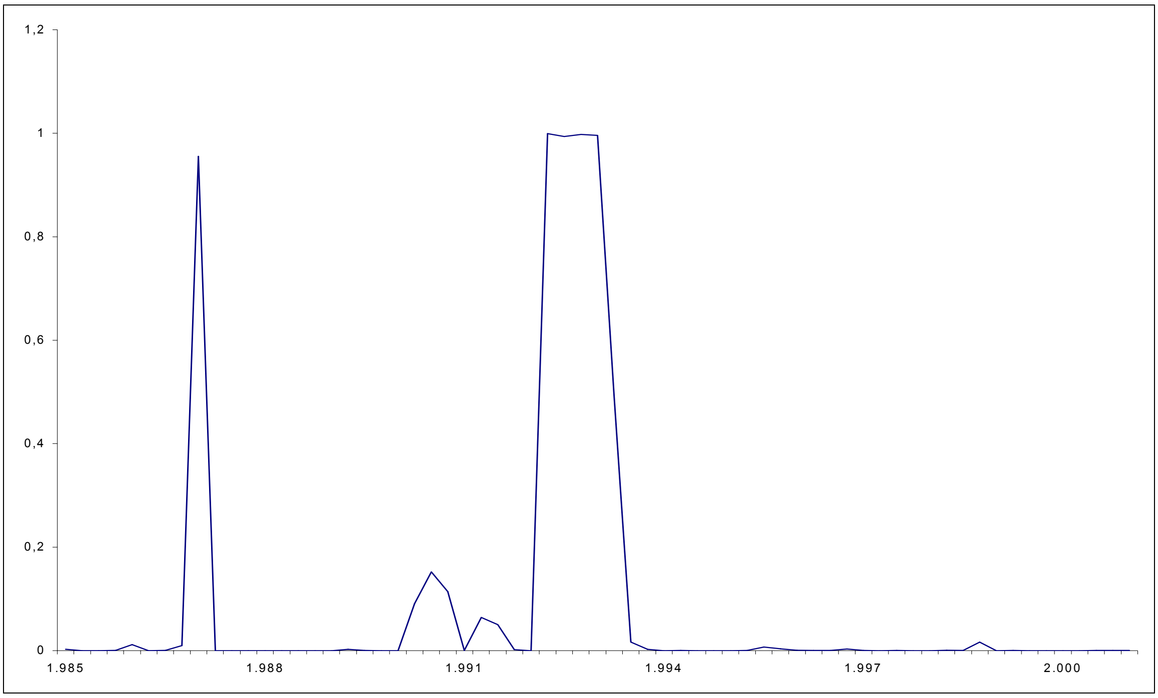
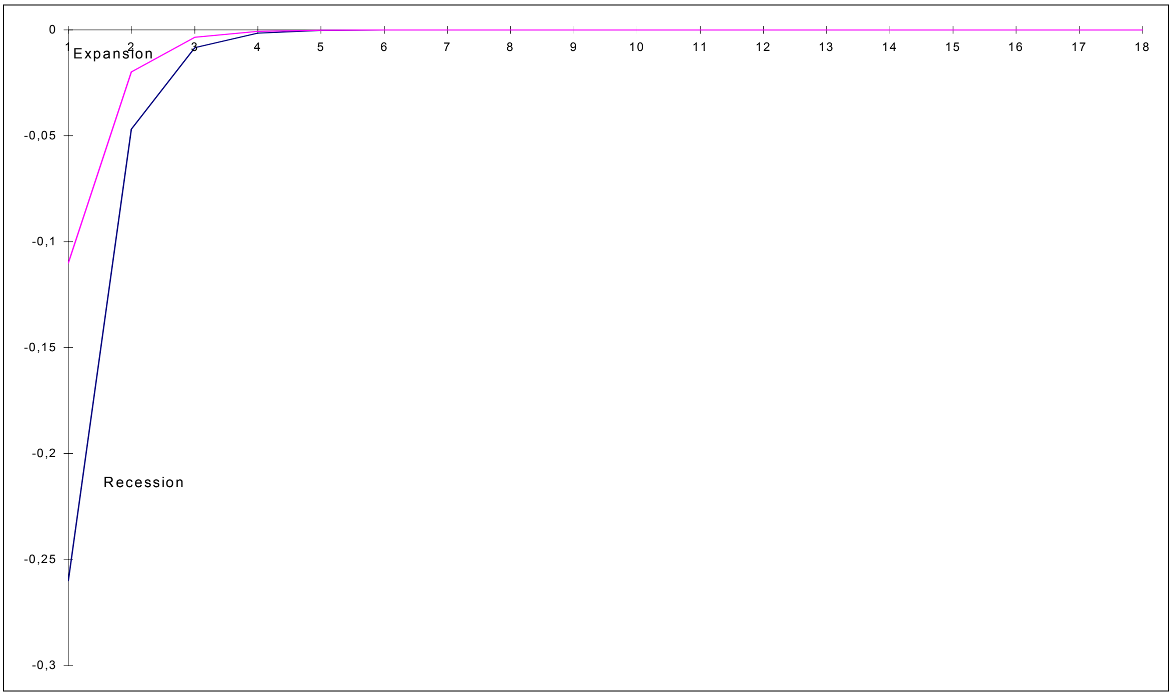


Figure III.3.3: Impulse-Response function for an unanticipated increase in the interest rate



From Figure III.3.3, it becomes clear that the effects of an unanticipated increase in the interest rate are much stronger in the recessionary regime than in the expansionary regime.

The estimated MMS model can be used to forecast output growth by writing (6) in the vector AR (1) companion form:

$\Delta \mathbf{y}_t = \Phi \Delta \mathbf{y}_{t-1} + \mu(\mathbf{I}-\Phi) + \Delta\mu \mathbf{S}_t(\mathbf{I}-\Phi) + \beta\xi_t + \Delta\beta \mathbf{S}_{t-1}\xi_{t-1} + \sigma\eta_t$

such that,

$\Delta \mathbf{y}_{t+h/t} = \Phi \Delta \mathbf{y}_{t+h-1/t} + \mu(\mathbf{I}-\Phi) + \Delta\mu \mathbf{S}_{t+h/t}(\mathbf{I}-\Phi) + \beta\xi_{t+h/t} + \Delta\beta \mathbf{S}_{t+h/t}\xi_{t+h/t}$

where $\mathbf{S}_{t+h|t} = \Pi^h \mathbf{S}_t$ and $\xi_{t+h|t}$ are computed from the dynamic forecast of the Taylor rule using ARIMA processes to compute estimates of $\tilde{\pi}_{t+h+k}$ and $\tilde{y}_{t+h+p}$.

Table III.3.2 presents the forecast and forecast errors of the quarterly growth rate of GDP for the period 2001:I to 2002:II. As can be observed, the forecasted values correspond to annual GDP growth of less than 1% though a slight recovery is appreciated in the second quarter of 2002. Note that these forecasts correspond rather closely with the forecasts discussed in the first part of this report.

Table III.3.2 Model Forecasts for GDP quarterly growth

	2001:III	2001:IV	2002:I	2002:II
Real data	0.154	0.242	-	-
Forecast	0.258	0.214	0.232	0.287
Forecast Error	-0.1032	-0.028	-	-

4. Effects of Monetary Policy on State Switches

Whereas in the previous section we allowed for state dependence in the effects of interest rate shocks on output growth, the transition probabilities from one regime to another were assumed to be constant and, in particular, were not allowed to depend on those shocks. Thus, while we were able to test whether shocks had different incremental effects on output in each state, we were not able to examine whether those shocks might have a further effect on output growth by directly affecting the probability of a regime switch. In this section, we address this issue by allowing the transition probabilities to depend directly on the shocks, according to the logit functions:[27]

$$p_{rr} = \Pr\left(S_t = r / S_{t-1} = r\right) = \frac{\exp(\theta_{0r} + \theta_{1r}\xi_{t-1})}{1 + \exp(\theta_{0r} + \theta_{1r}\xi_{t-1})} \qquad (10)$$

where only one lag of ξ_t has been chosen in (10) and (11) to keep the number of parameters manageable.[28] Further, as in García and Schaller (1995), to isolate the effect of the shocks from the linear effect examined above, the latter are constrained to be zero. Thus, we estimate the MMS specification (9) without monetary policy shocks as explanatory variables. Notice that since the probability of remaining in a

[27] The maximization algorithm with variable transition probabilities is considered in Filardo (1994).

[28] Moreover, when trying specifications with more lags, some coefficients were not significant.

recession (expansion) is increasing in the θ_{ir} (θ_{ie}) parameters, we should expect θ_{1r} to be positive and θ_{1e} to be negative. In other words, an unexpected increase in interest rates reduces the probability of remaining in an expansion and increases the probability of remaining in a recession.

The estimates of the coefficients in the MMS model allowing for variable transition probabilities are reported in Table III.4.1, where it can be observed that the signs of the θ_{ir} and θ_{ie} coefficients are in agreement with the above interpretation.

Table III.4.1: Markov Switching Model with variable transition probabilities in GDP quarterly growth

Estimated Coefficients	
μ_r	-.31
	(5.96)
μ_e	.71
	(35.07)
ϕ_1	.17
	(2.42)
σ	.11
	(37.01)
θ_{0r}	.38
	(2.16)
θ_{1r}	.66
	(2.24)
θ_{0e}	.90
	(2.34)
θ_{1e}	-.26
	(1.58)
Log-Likelihood	26.62

Sample period: 1984:I 2001:II. t-value in parentheses.

To ascertain the effects of interest rate shocks on the transition probabilities, we use a similar experiment to the one undertaken by Garcia and Schaller (1995) and Dolado and María-Dolores (2001), who use changes in the Fed Funds rate and the marginal interest rate in the interbank market to illustrate those effects in the US and Spain, respectively. Suppose that the ECB were to implement a negative (expansionary) interest rate shock of 100 basis points in a single quarter (from *t* to *t*+1) in agreement with the one-period lag with which ξ_t appears to affect p_{rr} and p_{ee} in (10) and (11). Then, the question is: "*How would that shock affect the transition probability from a recession to an expansion?*" Likewise, if instead a positive (contractionary) interest rate shock of identical magnitude were to be considered, "*How would it affect the probability of a converse switch?*"

Table III.4.2 shows the simulated changes in p_{er} (p_{re}) when a positive (negative) interest rate shock of 100 b.p. (-100 b.p.) is considered. It is found that an unanticipated interest-rate cut of such a magnitude will increase the probability of getting out of a recession (p_{re}) from 0.41 to 0.57 whereas an unanticipated rise in the interest rate will increase the probability of entering a recession (p_{er}) from 0.29 to 0.39. Note that, in accordance with the stronger real effects of monetary policy during recessions found before, the probability of escaping a recession in response to a cut in interest rates is larger than the probability of entering a recession in response to a rise in interest rates.

Table III.4.1: Effects of interest rate shocks on transition probabilities in GDP

u_t = - 100 b.p. (t to t+1)		
	Before the shock	After the shock
p_{rr}	0.59	0.43
p_{re}	0.41	0.57

u_t = + 100 b.p. (t to t+1)		
	Before the shock	After the shock
p_{ee}	0.71	0.61
p_{er}	0.29	0.39

5. Conclusions

In this paper, we have investigated the possibility of asymmetric effects of monetary policy shocks on output growth in the EU during the period 1984-2001. In particular, we have focused on the analysis of the so-called "*state*" asymmetries of monetary policy, according to which the effects of policy shocks on output growth may depend on the current phase of the business cycle. Furthermore, the possibility that policy shocks affect the transition probabilities of one cyclical phase to another has been addressed.

Our main finding is that monetary policy shocks, measured as shocks to the short-term interest rate obtained from a forward-looking Taylor rule, have significantly larger effects during recessions than during expansions. Thus, the positive effects of an expansionary monetary policy that emerged from the simulations in part II could be even larger.

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Part V. Annexes

A1. An Evaluation of Forecasts of Euro area Macroeconomic Variables

With the creation of the European Monetary Union, the focus of the economic policy debate and of macroeconomic analyses is shifting more and more from the single member countries to the Union as a whole. This poses the question of the proper econometric methods for empirical analyses in the new context, and we contribute to the debate by studying the relative forecasting performance of a set of alternative models.

First of all, we discuss the medium-scale structural model that is used to produce the forecasts in the EFN Report. The basic specification of the equations relies on economic theory, while the dynamics is formulated so that the model also provides a proper statistical representation for the variables under analysis.

Next, we consider two classes of univariate models, linear ARIMA and nonlinear threshold autoregressions (TAR). Other nonlinear models were also considered, including smooth transition autoregressions (STAR) and neural networks, but they were outperformed in forecasting by the TAR models.

We also experimented with three classes of multivariate models: VARs, factor models, and leading indicators. Small scale VARs have been often used for forecasting purposes, and are the natural generalization of the ARIMA models. Yet, only a few variables can be included in a VAR, while the available information set is rather large. To exploit all the available information we exploit dynamic factor models, where the variables are driven by a few common factors, which are estimated and then used for forecasting. An alternative statistical procedure, based on the correlation structure of the large dataset is adopted for the specification of the leading indicator models.

All models are estimated with a quarterly ECB dataset for the Euro area that includes several macroeconomic variables, such as GDP, producer and consumer prices, labour market variables, short and long interest rates, trade variables, exchange rates, etc. The sample period starts in 1991:I and ends in 2001:II. We decided to focus on such a short sample due to both data availability problems and to include only the period where the monetary union was already driving the economic policy of the future member countries. Also, series prior to 1991 do not reflect the ESA95 conventions, because they correspond to an older system of national accounts. Furthermore, series for the unified Germany are available since 1991, and given the weight of the German economy in the Euro area -which is nearly one third of overall GDP- the shift would appear in the European series as well.

The forecasting exercise is conducted in a pseudo real time framework. All models are recursively estimated over the period 1997:IV-2001:II and each quarter 2, 4 and 8 period ahead forecasts are computed. The forecast errors are computed, and the models are compared on the basis of the mean square and mean absolute forecast errors. More sophisticated forecast comparison techniques are not applicable because of the short forecast sample. We can anticipate that the structural model produces the most accurate forecasts for most variables and forecast horizons.

The structure of this Annex is the following. In Section 1 we briefly discuss the dataset. In Section 2 we provide more details on the competing forecasting models. In Section 3 we conduct the forecast comparison exercise. Section 4 provides some concluding remarks.

1. The data

The construction of aggregate data for the Euro area poses several problems. A partial list includes: interpolation of missing observations and disaggregation of annual figures into quarterly data, which are not available for all variables and countries in the Euro area for a long enough time period; seasonal adjustment, working day adjustment and treatment of major redefinitions and institutional changes, such as the German reunification; and choice of the aggregation (over countries) method.

We do not discuss these issues in detail here, or construct our own Euro area series. Instead, we analyze aggregate variables distributed mainly by the ECB, an extended and updated version of the dataset originally prepared by Fagan, Henry and Mestre (2001), to whom we refer for additional details on the Euro area data reconstruction.

The aggregation method adopted is the so-called "Index Method" where, for instance, the log of aggregate GDP is a weighted sum of the logs of the country specific GDPs. The weight for each country is constant over time, and equal to its real GDP share in 1995, see also Fagan and Henry (1998) for more details. A list of the included variables, with data source and mnemonic code, is provided in Annex 4.

The choice to focus on the period 1991-2001 is made both because of data availability constraints, (earlier values are available for few series at the Euro aggregate level) and to consider a relatively homogenous period across countries from the institutional point of view.

2 Forecasting methods

In this section we describe the forecasting methods to be compared. We start with the structural model, then consider the univariate methods, and finally the multivariate time series methods.

2.1 The structural model

The model is described in more detail in Annex 2; here we sketch its main characteristics. The underpinning theoretical framework refers to an open economy, where markets are competitive. Agents have been aggregated into the sectors of households, firms, government and foreign countries. Within each sector individuals are assumed to be homogeneous. The model includes the goods, labour and financial asset markets, financial assets consisting of money and bonds. Private households and firms maximize individual utilities or profits, respectively. Because the model is not designed to evaluate fiscal policies, government is broadly treated as exogenous. At the present stage behaviour in foreign countries is also left unexplained. This implies that the economic performance in the Euro area does not affect the rest of the world. In reality, given the weight of the Euro area in the world economy, spillovers are to be expected and to have feedbacks on the Euro area. However empirical evidence for the

US suggests that the additional impacts are small compared to the magnitude of initial shocks, see Fair (1994).

Table A1.1 provides a brief overview of the model. Most equations are fairly standard, see for example Romer (1996) for a thorough textbook discussion. On the supply side of the goods market, potential output and factor demand are explained. Potential output stems from a Cobb-Douglas production function with constant returns to scale, labour and capital as input factors and labour augmenting technological progress.[29] If potential output is realized, both inputs are employed at their effective levels. For the capital stock, this is assumed to be the actual level, while for the labour series the effective input must be estimated. This is done on the grounds of the time varying NAIRU concept, see Gordon (1997). Because of the persistent effects in the course of European unemployment, the NAIRU is a moving average of the actual unemployment rate and thus exogenous. Because of its structural determinants, the course of the NAIRU may be investigated on microeconometric grounds.

Factor demand equations are derived from profit maximisation and are modelled in a Hicksian way. They depend on the level of output and their own price, which is the real wage rate for labour and the real interest rate for capital demand. The elasticities match the restrictions of the Cobb Douglas production function. Labour supply results from an exogenous population under the assumption of a fixed labour participation rate. Technological progress is modelled as a linear time trend, which is broadly consistent with the data, see Jones (1995a, 1995b).

Because of the sluggish wage and price adjustment in the real world, the model is demand driven in the short run. Actual output (GDP) is equal to the sum of the demand components. Private consumption depends on disposable income in the long run, according to the stochastic permanent income life-cycle hypothesis, Campbell and Mankiw (1991). Because disposable income is currently unavailable for the Euro area, consumption is linked to GDP. Also government consumption is explained by GDP and the demand for investment in fixed capital is part of the supply block.

In the foreign trade sector exports and imports are modelled separately. Exports depend on the real exchange rate of the Euro and the level of world demand, while imports are explained by domestic demand and the relative price of imports, see Senhadji-Semlali (1998). The level of world demand is proxied by world imports. It is explained by weighted GDP in the three major economic regions (US, Japan, Euro area) and a linear time trend capturing the increase in globalization. Due to data availability, foreign trade variables rely on a gross concept and include intra and extra area flows. However in the aggregate, intra area trade will cancel out.

Disequilibria between supply and demand on the labour and goods market are represented by the unemployment rate and the capacity utilization rate, respectively. The former is defined as the ratio between the unemployed and the labour force, while the latter is the ratio between actual and potential output. The utilization rate serves as a proxy for the output gap.

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[29] In principle other forms of technological progress are equivalent, when a Cobb Douglas production function is assumed. However technological progress must be labour augmenting to ensure a steady-state in the neoclassical growth model, see Barro and Sala-i-Martin (1995).

Table A1.1: Structure of the Euro model

Supply Side	
YP = YP(K, L, T)	YP = Potential Output, T = Technology
L = L(Y, W/P)	L = Labour
K = (1-d)·K(-1)+I	K = Capital Stock, d = depreciation rate
I = I(Y, IR)	I = Investment
U = LF-L	U = Unemployment, LF = Labour force
CAP = Y/YP	CAP = Capacity Utilisation Rate
Λ = Y/L	Λ = Labour Productivity

Demand Side	
C = C(Y)	C = Consumption
X = X(WD, P/EP*)	X = Exports, WD = World Demand
M = M(Y, P/EP*)	M = Imports, P* = Foreign Price Index
Y = C+I+G+X-M	Y = Actual Output (GDP), G = Government

Wages, Prices, Interest and Exchange Rates	
W = W(P, Λ, U)	W = Nominal Wage
P = P(ULC, CAP, PM)	P = Price Index, PM = Import Price
ULC = WIN / Y	ULC = Unit Labour Costs
WIN = W·L	WIN = Compensation to Employees
IR = IN-ΔP	IR, IN = Real, Nominal Interest Rate
E = E(IN, IN*)	E = Exchange Rate, IN* = Foreign Interest Rate

The disequilibria are important factors in explaining the short-run adjustments of wages and prices. In the long run, wage behaviour is modelled to ensure the existence of a vertical Phillips curve, and prices are determined as a mark up over unit labour costs. The key variable in the price system is the GDP deflator at factor cost excluding indirect taxes and subsidies. Other indices are explained conditionally on the key price, see Fagan, Henry and Mestre (2001). First degree homogeneity is imposed and can be verified on empirical grounds.

The equilibrium value of the interest rate on the money market is determined by a Taylor rule which gives equal weights to the output and inflation gap, see Taylor (1993). In particular the inflation gap is the difference between actual inflation and a target level, which is determined by the ECB and exogeneous. In addition the interest rate fluctuates one to one with inflation, implying a constant short term real interest rate. The interest rate on the bond market is explained by the value of correspondending rates in the foreign countries and by the money market rate. The inclusion of the latter can be justified on the grounds of the expectations theory of the term structure, see Campbell and Shiller (1987). Thus monetary policy has an impact on the long term interest rate.

Last, apart from short run deviations, the nominal exchange rates of the Euro against the dollar and the Japanese Yen may be modelled in line with uncovered interest parity, and risk premiums have to be appropriately adjusted. Given the development of consumer prices in the two foreign countries, real exchange rates can be computed and they are utilized to explain the real effective exchange rate of the Euro. Further details of the model specification are given in Annex 2.

As far as estimation is concerned, the model is built as a simultaneous equation system, where the equations are estimated separately by OLS. Alternatively, a system estimator would not be superior. For example if only one relation does not fit the data with sufficient accuracy, the error will spread on to the other equations as well. In order to avoid such spillovers effects single equation estimation is preferred. However instrumental variables are required. Otherwise, estimators would be inconsistent due to the presence of the endogenous right hand side variables. Thus, after the OLS estimation, a static simulation of the whole model is performed and one step forecasts of the endogeneous variables are generated. The forecasts are used as instruments replacing the original series, whenever endogenous regressors occur. This procedure ensures the consistency of the estimators, see Tödter (1992).

Due to the nonstationarity of most variables, all equations are estimated in an error correction form. As a rule, the long run relationships are estimated jointly with the short run dynamics as suggested by Stock and Watson (1993). This avoids the finite sample bias arising in the two step procedure of Engle and Granger (1987), see Banerjee, Dolado, Hendry and Smith (1986). Also the estimators are more robust even in the case of structural breaks, see Kremers, Ericsson and Dolado (1992). For the test of cointegration, the critical values of Banerjee, Dolado and Mestre (1998) are appropriate. They depend on the deterministic part of the data generating process and on the number of variables in the cointegrating relationship. In the presence of a structural break, the number of variables has to be extended by one, due to the low power of the standard unit root and cointegration tests, see Perron (1989) and Hassler (2001).

Summarising, the model presented here describes the relationships between the key macroeconomic variables of the Euro area on the basis of a cointegration based approach which considers both long run relationships and also the short run dynamics. The model is estimated jointly using a recursive method, being, in this sense, quite different to old-fashioned structural models. Table A1.2 reports diagnostic tests on the residuals of the estimated equations. In particular, we computed tests for lack of serial correlation in the residuals, homoskedasticity and normality. Using a 5% significance level, the overall outcome is quite satisfying, with just a few rejections of the null hypothesis, and in sample the fit is also rather good.

Table A1.2: Diagnostic tests on the equations of the structural model

Variable	PC	GC	I	X	M	INV	EMP	IS
Adjusted R^2	0.62	0.56	0.93	0.66	0.95	0.63	0.62	0.58
Serial Correlation								
Breusch-Godfrey LM(4)	0.57	1.61	2.66	0.89	2.24	0.47	0.66	1.07
p-value	0.69	0.21	0.06	0.48	0.10	0.75	0.63	0.39
Heteroskedasticity								
White Test	1.08	0.85	1.69	1.06	0.36	0.87	2.70	1.00
p-value	0.42	0.64	0.14	0.43	0.98	0.57	0.02	0.50
Normality								
Jarque-Bera	0.26	10.31	0.04	0.28	29.86	0.11	1.32	1.22
p-value	0.88	0.01	0.98	0.87	0.00	0.95	0.52	0.54

Variable	IL	PY	HICP	W	WT	EER	EEN	M3R
Adjusted R^2	0.69	0.48	0.62	0.30	0.70	0.88	0.88	0.26
Serial Correlation								
Breusch-Godfrey LM(4)	0.54	2.03	2.81	1.72	1.11	1.05	1.43	0.71
p-value	0.70	0.12	0.07	0.18	0.37	0.40	0.25	0.59
Heteroskedasticity								
White Test	1.42	1.13	92.97	0.37	2.36	4.62	2.33	2.08
p-value	0.23	0.38	0.01	0.97	0.04	0.00	0.04	0.07
Normality								
Jarque-Bera	1.15	5.62	3.75	2.35	1.46	31.53	65.97	14.30
p-value	0.56	0.06	0.15	0.31	0.48	0.00	0.00	0.00

The exact definition of each variable is given in Annex 4.

2.2 *ARIMA models*

Since the pioneering work by Box and Jenkins (1970), the good performance of these simple univariate models for forecasting economic variables has been confirmed in several studies, see e.g. Meese and Geweke (1984), or Marcellino, Stock and Watson (2001) for the Euro area. Models with up to 4 AR and MA terms were in general the starting point of the specification search, with lags being sequentially deleted when not statistically significant according to the t-test, with decision on alternative reductions based on the BIC criterion. The statistical congruence of the starting model was also verified, and additional lags added in case of rejection. Table A1.3 reports the chosen specification for each variable.

Table A1.3: Specification of ARIMA models

Variable	Estimated Variable	Regressors
Y	dlog(Y)	c ar(4) ma(1) ma(2) ma(4)
PC	dlog(PC)	c ar(4) ar(5) ma(5)
GC	dlog(GC)	c ar(1) ar(2) ar(3) ma(1) ma(3)
I	dlog(I)	c ar(4) ma(4)
X	dlog(X)	c ar(1) ma(1)
M	dlog(M)	c ar(1) ar(2) ar(4) ma(3) ma(4)
INV	INV	c ar(1) ar(2) ar(3) ar(4) ma(1) ma(2) ma(4)
U	dlog(U)	c ar(1) ar(4) ma(1) ma(4)
ULC	dlog(ULC)	c ar(4) ma(4)
IS	d(IS)	c ar(1) ar(5) ar(8) ma(1)
IL	d(IL)	c ar(2) ma(1) ma(2) ma(3)
PY	dlog(PY)	c ar(3) ma(2)
HICP	dlog(HICP)	c ar(4) ma(1) ma(2)
W	dlog(W)	c ar(3) ma(4)
WT	dlog(WT)	c ar(2) ar(3) ar(4) ma(2) ma(3)
EER	dlog(EER)	c ma(6)
EEN	dlog(EEN)	c ma(6)
M3R	dlog(M3R)	c ma(2) ma(3) ma(5) ma(6)

d denotes the difference operator; *log* denotes the natural logarithm; *c* indicates that the ARIMA model has an intercept term; *ar(p)* indicates the order of the autoregressive component in the model; *ma(q)* indicates the order of the moving average component in the model. The exact definition of each variable is given in Annex 4.

2.3 TAR models

In the case of the ARIMA model the relationship between the current value of a variable and its lags is supposed to be linear and constant over time. Yet, in particular when modelling financial variables but also in the case of real variables such as unemployment and industrial production, non-linear and time-varying relationships are found.

We experimented with different classes of non-linear models, and the best one turned out to be the threshold autoregression (TAR). A TAR can be specified as

$$Y_t = \begin{cases} \phi_{1,0} + \phi_{1,1} y_{t-i_1} + \ldots + \phi_{1,k} y_{t-i_k} + \varepsilon_t & \text{if } q_t \le c, \\ \phi_{2,0} + \phi_{2,1} y_{t-i_1} + \ldots + \phi_{2,k} y_{t-i_k} + \varepsilon_t & \text{if } q_t > c, \end{cases} \qquad (1)$$

where $\varepsilon_t \sim N(0, \sigma^2)$. For output, private consumption, government consumption, gross fixed capital, exports, imports, labour costs, unit labour costs, world trade imports, the GDP deflator, the effective real exchange rate, the effective nominal exchange rate and M3, y_t is taken to be the quarterly growth rate y_t = 100 × *log*(y_t / y_{t-1}) with y_t denoting the level of the variable and *log* represents the natural logarithm. For inventories, the unemployment rate, the short-term interest rate, and the long-term interest rate, y_t is taken to be the level of the series. The harmonized consumer price index is not modeled due to the short sample size available.

Given the small number of available observations, only low-order models are used. In particular, we only consider TAR models with either AR(1) or AR(2) models in both regimes, i.e. either k = 1 and i_1 = 1, or k = 2 and i_1 = 1, i_2 = 2. The choice between k = 1 and k = 2 is based upon the Schwarz Information Criterion (BIC). For some variables (exports, labour costs, world trade imports, and real and nominal exchange rates), this did not render sensible models. In those cases, higher order lags were incorporated in the model based upon the (partial) autocorrelation properties of the series. The threshold variable, q_t, is taken to be the first lag of the dependent variable, i.e. $q_t = y_{t-1}$, except for the short- and long-term interest rates for which q_t is taken to be the quarterly change in the interest rate, lagged once (i.e. $q_t = y_{t-1} - y_{t-2}$). For each forecast origin, the parameters in the TAR model are estimated by conditional least squares, where the threshold *c* is assumed to be such that each regime contains at least 15% of the observations. Again, for some variables this did not produce plausible results, in which case this percentage *(π* in Table A1.4) was increased to 30%. Details are provided in Table A1.4.

Given estimates of the model based upon observations for t =1,…,T , 1- to 8-step ahead forecasts $\hat{y}_{T+h|T}$ are obtained with Monte Carlo simulation, using 10000 future paths of y_{T+i}, i =1,…,8 where the shocks ε_{t+i} are drawn from a normal distribution with standard deviation set equal to the standard deviation of the residuals. Forecasts of the *h*-quarter growth rates for *h* = 2, 4 and 8 are obtained by summing the forecasts of the relevant quarterly growth rates, i.e. $\hat{y}^h_{T+h|T} = \sum_{i=1}^{h} \hat{y}_{T+i|T}$, where $\hat{y}^h_{T+h|T}$ denotes the forecast of the *h*-quarter growth rate $\hat{y}^h_{T+h|T} = 100 \times \log(y_{T+h} / y_T)$.

2.4 VAR models

In these models, popularized by the work of Sims (1980), each variable depends on a certain number of lags of the other variables under analysis. Hence, they provide the natural extension of ARIMA models. Though less flexibility in the specification can be allowed, in particular because of the short sample size available and of numerical problems in the estimation of a multivariate MA component, the use of other variables as regressors could improve the forecasting performance. The chosen specifications of the VAR models are reported in Table A1.5.

Table A1.4: Specification of TAR models

Variable	K	$i_1 \ldots i_k$	q_t	π
Y	1	1	y_{t-1}	0.15
PC	1	1	y_{t-1}	0.30
GC	2	1,2	y_{t-1}	0.15
I	2	1,2	y_{t-1}	0.15
X	3	1,2,5	y_{t-1}	0.15
M	1	1	y_{t-1}	0.30
INV	1	1	Δy_{t-1}	0.30
U	1	1	Δy_{t-1}	0.15
ULC	1	1	y_{t-1}	0.30
IS	1	1	Δy_{t-1}	0.30
IL	1	1	Δy_{t-1}	0.30
PY	2	1,2	y_{t-1}	0.15
W	3	1,2,3	y_{t-1}	0.30
WT	3	1,2,4	y_{t-1}	0.30
EER	1	1,5	y_{t-1}	0.15
EEN	1	1,5	y_{t-1}	0.15
M3R	2	1,2	y_{t-1}	0.30

k indicates the number of regimes considered and $i_1 \ldots i_k$ indicate the order of the considered autoregressive model in each of these regimes; q_t indicates the threshold variable, the GDP (y) or the growth rate of GDP (Δy), and the considered lag (t). π is the minimum percentage of observations in each regime. The exact definition of each variable is given in Annex 4.

Table A1.5: Specification of VAR models

Variable	Specification
Y	Y(-1), Y(-2), PY(-1), PY(-2), IS(-1), IS(-2)
PC	PC(-1), PC(-2), IS(-1), IS(-2), Y(-1), Y(-2)
GC	GC(-1), GC(-2), GC(-8), PY(-1), PY(-2), PY(-8), IS(-1), IS(-2), IS(-8),Y(-1), Y(-2), Y(-8)
I	I(-1), I(-2), PY(-1), PY(-2), IS(-1), IS(-2), Y(-1), Y(-2)
X	X(-1), X(-2), WT(-1), WT(-2), Y(-1), Y(-2), EER(-1), (-2)
M	M(-1), M(-2), M(-3), WT(-1), WT(-2), WT(-3), Y(-1), Y(-2), Y(-3), EER(-1), EER(-2), EER(-3)
U	U(-1), U(-3), U(-9), PY(-1), PY(-3), PY(-9), Y(-1), Y(-3), Y(-9)
EMP	EMP(-1), EMP(-2), EMP(-3), PY(-1), PY(-2), PY(-3), Y(-1), Y(-2),Y(3)
IS	IS(-1), IS(-2), IS(-3), PY(-1), PY(-2), PY(-3), Y(-1), Y(-2), Y(-3), EER(-1), EER(-2), EER(-3)
IL	IL(-1), IL(-2), IS(-1), IS(-2), PY(-1), PY(-2), Y(-1), Y(-2), EER(-1), EER(-2)
PY	PY(-1), PY(-2), M3R(-1), M3R(-2), Y(-1), Y(2), U(-1), U(-2), EER(-1), EER(-2)
HICP	HICP(-1), HICP(-2), Y(-1), Y(-2), U(-1), U(-2), M3R(-1), M3R(-2)
W	W(-1), PY(-1), Y(-1)
EER	EER(-1), EER(-2), EER(-3), IS(-1), IS(-2), IS(-3), Y(-1), Y(-2), Y(-3)
EEN	EEN(-1), EEN(-2), EEN(-3), IS(-1), IS(-2), IS(-3), Y(-1), Y(-2), Y(-3)
M3R	M3R(-1), M3R(-2), M3R(-3), M3R(-4), IS(-1), IS(-2), IS(-3), IS(-4), Y(-1), Y(-2), Y(-3), Y(-4)

The number in brackets indicates the order of the considered lag for each variable in the different models. The exact definition of each variable is given in Annex 4.

2.5 Factor models

Since this methodology is relatively new, it is worth analyzing it in some detail. Let X_t be the *N*-macroeconomic variables to be modelled, the 53 variables in the Euro area dataset listed in the Annex 4 in our case, observed for $t=1,...,T$. X_t admits an approximate linear dynamic factor representation with $\bar{r}$ common factors, f_t, if:

$$X_{it} = \lambda_i(L) f_t + e_{it} \qquad (2)$$

for i=*1,...,N*, where e_{it} is an idiosyncratic disturbance with limited cross-sectional and temporal dependence, and $\lambda_i(L)$ are lag polynomials in non-negative powers of *L*; see for example Geweke (1977), Sargent and Sims (1977), Forni, Hallin, Lippi, and

Reichlin (1999, 2000) and, in particular, Stock and Watson (1998). If $\lambda_i(L)$ have finite orders of at most q, equation (1) can be rewritten as,

$$X_t = \Lambda F_t + e_t \tag{3}$$

where $F_t = (f_t^{'}, \ldots, f_{t-q}^{'})'$ is $r\times 1$, where $r \leq (q+1)\bar{r}$, and the *i-th* row of Λ is $(\lambda_{i0}, \ldots, \lambda_{iq})$.

The factors provide a summary of the information in the data set, and can therefore be expected to be useful for forecasting. From a more structural point of view, the factors can be considered as the driving forces of the economy. In both cases, it is extremely important to have accurate estimators of the factors.

Stock and Watson (1998) show that, under some technical assumptions (restrictions on moments and stationarity conditions), the column space spanned by the dynamic factors f_t can be estimated consistently by the principal components of the $T\times T$ covariance matrix of the X's. A condition that is worth mentioning for the latter result to hold is that the number of factors included in the estimated model has to be equal to, or larger than, the true number. In what follows, we assume the presence of at most six factors.

The principal component estimator of the factors is computationally convenient, even for very large N. Moreover, it can be generalised to handle data irregularities such as missing observations using the EM algorithm. In practice, the estimated factors from the balanced panel are used to provide an estimate of the missing observations, the factors are then extracted from the completed data set, the missing observations are re-estimated using the new set of estimated factors, and the process is iterated until the estimates of the missing observations and of the factors do not change substantially.

Finally, it is worth noting that, under additional mild restrictions on the model, the principal component based estimator remains consistent even in the presence of changes in the factor loadings, i.e. $\Lambda = \Lambda_t$. In particular, Stock and Watson (1998) allow either for a few abrupt changes, or for a smooth evolution as modelled by a multivariate random walk for Λ_t.

Once estimated factors are available, they can be used as regressors in a forecasting equation for the variable of interest. Stock and Watson (1998) provide conditions under which these estimated factors yield asymptotically efficient forecasts, in the sense that the mean square forecast error converges to the value that is obtained with known factors.

We consider three different factor-based forecasts. First, in addition to the lagged dependent variable, up to 4 factors and 3 lags of each of them are included in the model (*fdiarlag*), and the variable selection is again based on BIC. Second, up to 6 factors are included, but not their lags (*fdiar*). Third, only up to 6 factors appear as regressors, but no lagged dependent variable (*fdi*). For each of these 3 forecasts, the factors are extracted from the balanced panel, that in this application performs better than the unbalanced panel. In order to evaluate the forecasting role of each factor, we also consider forecasts using a fixed number of factors, from 1 to 4 (*fdiar_01* to *fdiar_04* and *fdi_01* to *fdi_04*). Finally, when no factors are retained in the specification, we obtain simple AR models but, possibly, with a different number of lags in each period (*far*).

Table A1.6 lists the preferred factor model for each variable, based on their forecasting performance.

Table A1.6: Factor specifications

Variable	Specification for h=2	Variable	Specification for h=2
Y	fdi_01	IS	fdiar_bic_f_01
PC	fdiarlag_02	IL	far
GC	far	PY	fdi_03
I	fdi_01	W	far
X	fdiar_04	WT	far
M	far	EER	fdi_03
INV	far	EEN	fdi_03
ULC	far	M3R	fdi_02

h denotes the forecast horizon in terms of quarters. *fdiarlag* indicates that in the dynamic factor model in addition to the lagged dependent variables up to 4 factors and 3 lags of each of them are included. *fdiar* indicates that up to 6 factors are included, but not their lags. *fdi* indicates that, only up to 6 factors appear as regressors, but no lagged dependent variable. *fdiar_01* to *fdiar_04* indicate a fixed number of factors, from 1 to 4. *far* indicates that no factors are retained in the specification (simple AR models). The exact definition of each variable is given in Annex 4.

2.6 Leading indicator models

According to Clements and Hendry (1998), p. 207 "an indicator is any variable believed informative about another variable of interest. In this context, a leading indicator is any variable whose outcome is known in advance of a related variable that it is desired to forecast. Usually, there are several leading indicators for every variable that it is desired to forecast and, for this reason, composite leading indicators are constructed. A composite leading index is a combination (e.g. a weighted average) of this set of simple leading indicators. Composite leading indicators are useful to provide estimates of the current state and short-term forecasts of the analysed economy. The main advantage of composite leading indicators in relation to other methods is that it is not necessary to obtain forecasts for exogenous variables as their lagged values are known in advance. Of course, leading indicators will only provide reasonably accurate short term forecasts. However, we extend the analysis up to two years as an additional benchmark for the results using other procedures.

The procedure for the selection of the simple leading indicators for each endogenous variable is based on the bilateral correlations between different lags of each of the variables in the ECB database and the endogenous variable. The simple leading indicators have been chosen among those with highest values of the correlation coefficient. The length of the lead has been determined by cross-correlation analysis. In this sense, as an automatic identification procedure, different values of the bilateral correlation coefficient have been explored as a limit for a variable to be considered as a leading indicator. These values range from zero (all explanatory variables would be considered as leading indicators) to 0.8 (only variables with a strong correlation with the endogenous would be considered). Eventually we fixed this limit at 0.5.

As there could be several simple leading indicators for every endogenous variable and the available sample is quite short, it is necessary to reduce the dimensionality of the exogenous variables matrix before using this information set to obtain the desired forecasts. It is also necessary to eliminate from this set of simple leading indicators, the part of their behaviour attributable to noise and that would not be useful to forecast the endogenous variables (the noise would be higher with lower values of the correlation coefficient). With this aim, we extracted the principal components of the regressors. The idea is that the first principal components capture the commonalities in the set of simple leading indicators (the relevant information to forecast the endogenous variables). After experimenting with different values, we retain as many components as necessary to explain 70% of the total variance of the simple leading indicators.

Once, the simple leading indicators have been selected and have been summarised in a few components (in most cases, the number of considered components ranges from one to three), these components are used as regressors in the forecasting equations, as in the factor method described earlier.

In Table A1.7 we report the simple leading indicators for each variable in the case of 2 step ahead forecasting models. We stress that these indicators were selected using a purely statistical procedure, so that it is not worth attributing an economic interpretation to the resulting set of variables.

3. Forecast Evaluation

In order to evaluate the relative forecasting accuracy of the models, a pseudo-real time forecasting competition was run. All models were estimated until 1997:IV and forecasts for 2, 4 and 8 period ahead were computed. The forecasts are for the growth rates of all variables (log(y_{t+h} / y_t)), except for unemployment and interest rates where levels are used. The specifications can be different for different forecast horizons in the case of factor models and leading indicators. Then models are re-estimated in each quarter, and forecasts are computed.

Given the availability of actual values until 2001:II, a series of forecast errors for each variable and forecasting method can be computed, $e_{t+h} = y_{t+h} - \hat{y}_{t+h}$. We then compute the root mean square and the mean absolute forecast error (RMSE and MAE), and use them to rank the models. More sophisticated comparison techniques are not applicable due to the short sample size.

In Tables A1.8-A1.10, we report the RMSE and the MAE for, respectively, 2, 4 and 8 period ahead forecasts. Focusing on the MSE, the structural model is the best for 11 out of the 18 variables under analysis when h=2, and for 12 and 8 when, respectively, h=4 and 8. A similar pattern emerges when the ranking is based on the MAE. Moreover, when the structural model is not the best, in general it is ranked second or third. In these cases the best model is usually either nonlinear or factor based, and both characteristics are difficult to be included in the structural model.

Table A1.7: Brief description of the variables included in the principal component leading indicators models

Variable	Specification for h=2
Y	POP (-4), GC(-4), W(-4), PPC(-4), PGC(-4), PI(-4), PX(-4), PY(-4), Y_US(-4), Y_JP(-3), P_US(-4), P_JP(-4), ULC(-4), GREV(-4), TIR (-3), GIN(-3), SPR(-4), DEBT(-4), IS(-3), IL(-3), IL_US(-4), IS_JP(-4), IL_JP(-4), DW(-4), DPPC(-4), DPGC(-3), DPI(-4), DPY(-4), DEEN(-2), DEER(-2)
PC	POP (-4), GC(-4), X(-3), W(-4), PPC(-4), PGC(-4), PI(-4), PX(-4), PM(-4), PY(-4), WT(-4), Y_US(-4), Y_JP(-4), P_US(-4), P_JP(-4), ULC(-4), TIR(-3), GIN(-4), DEBT(-4), IS(-3), IL(-3), IL_US(-4), IS_JP(-4), IL_JP(-4), DW(-4), DPGC(-4), DPY(-4), DULC(-3)
GC	INV (-4)
I	POP(-4), GC(-4), W(-4), PPC(-4), PGC(-4), PI(-4), PX(-4), PY(-4), Y_JP(-4), P_US(-4), P_JP(-4), ULC(-4), GREV(-4), GIN(-3), SPR(-4), DEBT (-4), IS(-3), IL(-3), IL_US(-4), IS_JP(-4), IL_JP(-4), U(-4), DW(-4), DPPC(-4), DPGC(-3), DPY (-3), DP_US(-3)
X	GREV (-3)
M	ULC (-4), GREV(-4), SPR(-4), DEBT(-4), IS(-2), IL(-3), IL_US(-4), IS_JP(-4), IL_JP(-4), U(-4), DW(-4), DPGC(-3), DULC(-2)
INV	RAWX (-3), IS(-4), U(-4), DX(-3), DM(-3), DY(-2), DPGC(-4), DWT(-3), DULC(-4)
U	POP(-4), CS (-4), PC(-4), GC(-4), I(-4), X(-4), M(-4), Y(-4), EEN(-4), EER(-4), US$(-4), WT(-4), Y_US(-4), Y_JP(-4), P_US(-4), M3R(-4), TDR(-4), TIR(-4), SCR(-3), GEXP(-4), SUBR(-4), GIP(-4), IL(-4), DCS(-4), DPC(-4), DM3R(-4)
ULC	GREV (-3)
W	PI(-2), PX(-4), PM(-4), ULC(-2), GREV(-4), SPR(-4), DEBT(-4), IL_US(-3), IS_JP(-3), IL_JP(-2), U(-4), DGC(-4), DW(-4), DPPC(-3), DPI (-4)
IL	PX (-4), PM(-4), WT(-4), Y_JP(-4), ULC (-2), GREV(-3), GIN(-4), SUBR(-4), DEBT(-4), IS_US(-4), DPI(-4)
PY	PI(-4), PX(-4), PM(-4), GIN(-4), SPR(-4), DEBT(-4), IL(-2), IS_US(-4), IL_US(-3), IL_JP(-2), DW(-2), DPGC(-2)
EER	YEN(-2), GIN (-2), DGC(-2), DW(-2),DPX(-2), DPM(-2)
W	GREV (-4), DGC(-3)
WT	IL_US(-4), DEEN (-2), DEER(-2)
IS	DPI (-4), DPX (-4), DWT(-4)
EEN	DPX(-4)
M3R	I(-4), X(-4), M(-4), Y(-4), INV(-4), SCR(-4), GEXP(-4), GIP(-4), IS_US(-4)

h denotes the forecast horizon in terms of quarters. *D* indicates a first difference of the variable. The number in brackets denotes the number of lags for each variable. The exact definition of each variable is given in Annex 4.

Table A1.8: 2-step ahead forecast accuracy comparison

RMSE	Y	PC	GC	I	X	M	INV	U	ULC	IS	IL	PY	HICP	W	WT	EER	EEN	M3R
STRUCTURAL	0.34	0.59	0.23	1.05	1.55	1.82	3.16	1.47E-03	0.44	0.40	0.41	0.27	0.34	0.47	1.11	2.16	2.08	1.47
ARIMA	0.49	0.45	0.58	1.53	2.47	2.17	3.69	2.00E-03	0.77	0.52	0.63	0.28	0.57	0.41	1.04	4.85	5.00	1.54
NON-LINEAR	0.50	0.75	0.26	1.20	2.48	2.34	2.56	6.46E-03	0.39	0.68	0.76	0.24	NA	0.67	1.28	3.02	4.07	2.13
VAR	0.74	0.92	0.55	1.32	2.38	2.33	NA	4.87E-03	0.61	1.19	0.66	0.31	1.46	0.66	NA	5.82	6.08	1.70
FACTOR (Best)	0.54	0.52	0.30	1.46	2.72	2.26	2.65	NA	0.45	0.59	0.61	0.15	NA	0.67	1.65	4.62	4.70	1.38
LEADING INDICATORS	0.71	0.78	0.49	2.48	3.77	3.96	4.46	1.41E-02	0.89	3.13	1.34	0.50	0.61	0.81	3.03	7.95	8.28	1.81

MAE	Y	PC	GC	I	X	M	INV	U	ULC	IS	IL	PY	HICP	W	WT	EER	EEN	M3R
STRUCTURAL	0.29	0.45	0.20	0.88	1.11	1.35	2.72	1.14E-03	0.38	0.33	0.36	0.22	0.28	0.42	0.87	1.75	1.80	1.01
ARIMA	0.42	0.41	0.51	1.38	2.25	1.80	2.93	1.84E-03	0.66	0.44	0.55	0.23	0.46	0.36	0.86	4.26	4.43	1.16
NON-LINEAR	0.39	0.64	0.20	1.08	1.97	1.81	2.12	6.37E-03	0.31	0.55	0.65	0.19	NA	0.53	1.10	2.65	3.27	1.59
VAR	0.63	0.81	0.46	1.06	2.11	1.85	NA	3.91E-03	0.45	0.81	0.56	0.26	1.12	0.58	NA	4.86	4.94	1.36
FACTOR (Best)	0.45	0.41	0.24	1.01	2.12	1.96	2.07	NA	0.37	0.49	0.52	0.13	NA	0.56	1.52	3.33	3.46	1.00
LEADING INDICATORS	0.57	0.63	0.38	2.08	3.09	3.21	3.97	1.09E-02	0.82	2.80	1.23	0.42	0.52	0.68	2.65	6.64	6.82	1.36

RMSE=Root Mean Square Error. MAE=Mean Absolute Error. NA=Not available. The exact definition of each variable is given in Annex 4.

Table A1.9: 4-step ahead forecast accuracy comparison

RMSE	Y	PC	GC	I	X	M	INV	U	ULC	IS	IL	PY	HICP	W	WT	EER	EEN	M3R
STRUCTURAL	0.59	0.83	0.20	1.90	2.39	2.36	3.50	2.01E-03	0.72	0.55	0.54	0.48	0.64	0.78	2.10	2.64	2.82	2.66
ARIMA	1.12	0.68	0.89	2.63	4.17	3.92	2.99	4.68E-03	1.55	0.99	1.22	0.75	1.01	0.54	2.44	6.33	6.87	3.18
NON-LINEAR	1.07	1.26	0.43	2.43	3.85	3.38	2.40	1.19E-02	0.47	1.34	1.67	0.49	NA	0.88	3.40	6.49	6.79	4.00
VAR	1.34	1.79	0.82	3.37	4.03	3.94	NA	7.80E-03	1.06	2.65	1.44	0.75	2.66	1.25	NA	6.38	7.03	2.91
FACTOR (Best)	0.80	1.00	0.52	2.88	4.18	3.17	3.37	NA	0.38	1.17	1.27	0.40	NA	0.59	3.90	4.87	5.29	2.29
LEADING INDICATORS	1.77	1.13	0.67	2.95	7.68	8.23	6.14	1.41E-02	1.06	2.23	2.12	0.42	0.88	0.56	6.84	8.47	7.78	3.77

MAE	Y	PC	GC	I	X	M	INV	U	ULC	IS	IL	PY	HICP	W	WT	EER	EEN	M3R
STRUCTURAL	0.51	0.78	0.15	1.56	1.85	1.78	2.99	1.39E-03	0.55	0.47	0.43	0.39	0.49	0.68	1.76	2.06	2.59	2.05
ARIMA	0.94	0.53	0.84	2.42	3.83	2.64	2.46	4.27E-03	1.37	0.79	1.05	0.64	0.84	0.44	1.90	5.36	5.83	2.56
NON-LINEAR	0.71	0.87	0.30	1.84	3.04	2.41	1.60	1.00E-02	0.35	0.87	1.21	0.35	NA	0.63	2.49	5.03	5.24	2.80
VAR	1.08	1.64	0.73	2.86	3.40	3.34	NA	4.90E-03	0.86	2.09	1.03	0.64	2.14	1.10	NA	5.72	6.44	2.40
FACTOR (Best)	0.77	1.04	0.46	2.24	5.52	2.97	3.11	NA	0.29	1.33	1.05	0.33	NA	0.46	3.45	4.30	4.58	1.86
LEADING INDICATORS	1.42	1.00	0.57	2.27	6.63	7.65	5.15	1.25E-02	0.81	1.82	2.00	0.34	0.76	0.47	5.89	7.30	6.60	3.39

RMSE=Root Mean Square Error. MAE=Mean Absolute Error. NA=Not available. The exact definition of each variable is given in Annex 4.

Table A1.10: 8-step ahead forecast accuracy comparison

RMSE	Y	PC	GC	I	X	M	INV	U	ULC	IS	IL	PY	HICP	W	WT	EER	EEN	M3R
STRUCTURAL	0.82	0.98	0.26	3.53	2.35	2.56	4.23	2.82E-03	1.51	0.53	0.23	1.31	2.47	1.40	1.85	2.35	3.19	4.68
ARIMA	2.31	1.55	1.48	5.82	5.97	7.06	2.89	1.16E-02	2.15	2.10	2.24	1.91	1.96	1.48	5.41	11.43	12.35	6.31
NON-LINEAR	2.28	2.35	1.01	5.50	4.89	7.18	2.68	2.16E-02	0.59	2.18	2.23	1.17	NA	1.27	7.09	10.86	11.05	12.24
VAR	2.68	3.16	1.44	8.94	5.76	6.92	NA	1.82E-02	2.58	5.49	1.48	2.09	3.36	2.48	NA	8.32	9.48	4.66
FACTOR (Best)	0.48	1.31	0.52	2.28	1.56	2.51	3.35	1.73E-02	0.42	1.33	1.41	0.54	NA	0.97	4.51	4.42	5.09	3.42
LEADING INDICATORS	3.57	2.37	5.64	9.18	20.50	17.02	19.31	1.00E-02	7.94	1.78	3.25	2.68	NA	4.36	9.64	16.64	15.25	7.80

MAE	Y	PC	GC	I	X	M	INV	U	ULC	IS	IL	PY	HICP	W	WT	EER	EEN	M3R
STRUCTURAL	0.72	0.82	0.24	3.24	1.94	1.88	3.82	2.35E-03	1.41	0.46	0.20	1.17	2.26	1.26	1.67	1.91	2.54	4.23
ARIMA	2.18	1.43	1.47	5.23	4.73	5.71	2.48	1.09E-02	1.72	1.87	2.06	1.79	1.65	1.30	3.97	10.18	11.20	5.83
NON-LINEAR	1.20	1.12	0.52	2.61	2.05	3.66	1.17	1.16E-02	0.28	1.00	1.19	0.52	NA	0.59	3.58	5.26	5.32	5.85
VAR	1.89	2.46	1.31	6.36	5.00	5.34	NA	1.60E-02	2.14	5.00	1.26	1.73	3.11	1.91	NA	6.77	7.76	4.04
FACTOR (Best)	0.39	1.10	1.24	5.51	2.51	5.91	3.30	NA	0.38	1.22	1.55	1.80	NA	0.78	3.93	15.58	13.55	3.19
LEADING INDICATORS	3.40	1.70	4.46	8.80	18.04	16.93	19.11	1.08E-02	7.64	1.50	3.23	2.39	NA	4.27	8.10	13.58	12.08	5.94

RMSE=Root-Mean-Square Error. MAE=Mean-Absolute Error. NA=Not available. The exact definition of each variable is given in Annex 4.

4. Conclusions

We have conducted a thorough forecast comparison exercise in order to evaluate the relative forecasting capabilities of the structural model that is used to produce the forecasts in the EFN reports. On the basis of the results on the past forecasting performance of the model, we think that it can be used to produce reliable forecasts of the future behaviour of the key macroeconomic variables in the Euro area. As it has been previously mentioned, the structural model presented in this section describes properly the relationships between the key macroeconomic variables of the Euro area from a cointegration based approach which considers the long run relationships but also the short run dynamics. The model is estimated jointly using a recursive method, being, in this sense, quite different to old-fashioned structural models.

Annex 1 References

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A2. The macroeconometric model for the Euro economy

This Annex describes the model used in the report for forecasting most Euro area macroeconomic variables, see Dreger (2002) for additional details.

Due to the growing integration in Europe manifested in the European Monetary Union (EMU), it seems reasonable to build an aggregate macroeconometric model for the Euro area economy as a whole instead of linking similar national models. As a consequence output, employment, consumption, investment and so on are explained at the Euro area wide level. They do not result by summing up the outcomes of country-specific models.

The Euro area modeling approach is important for several reasons. Since the introduction of the EMU in 1999, monetary policy has been conducted on the supra-national level, and this enforces a better understanding of the mechanisms of the Euro economy. In addition the interactions between the major poles in the world economy - the US, Europe and Japan - can be modelled more simply. This is also true for developments affecting the Euro area as a whole, for example the impact of an eastern enlargement of the European Union. Moreover, it may be argued that area wide functions outperform the national ones under several statistical criteria due to an aggregation effect, see Fagan and Henry (1998) in the case of money demand. As a drawback, heterogeneity across the euro member countries is neglected. For example the effects of fiscal policies can not be analysed in such a model. Fiscal policy remains under the control of the national authorities and differs among the member states. Also an investigation of economic convergence between the regions would require a more disaggregated framework, which has to be built on the linkage of several national models.

Currently a few other structural models aggregated either for the Euro area or the European Union exist, see Henry (1999), Fagan, Henry and Mestre (2001) and Bagnai and Carlucci (2001). As usual, empirical analysis is conducted within an error correction framework in order to capture the nonstationarity of most variables. In previous work, estimation relies on the two step procedure suggested by Engle and Granger (1987). In contrast this paper employs more robust regression techniques. As a rule, cointegrating relations are estimated jointly with the short run dynamics in one step, see Stock and Watson (1993). This avoids the bias of the two step procedure arising in finite samples, see Banerjee, Dolado, Hendry and Smith (1986). After estimation, the cointegrating relations are often restricted according to economic theory, provided that the restrictions are supported on empirical grounds.

The Annex is organized as follows. Section 1 reviews the general structure and the properties of the theoretical macroeconomic framework, while in Section 2 econometric issues are discussed. Section 3 provides estimation details for some equations. In particular factor demand equations, foreign trade relations and the wage price nexus are considered. Section 4 concludes.

1. Model structure

The underpinning theoretical framework refers to an open economy, where markets are competitive. Agents have been aggregated into the sectors of households, firms, government and foreign countries. Within each sector individuals are assumed to be homogeneous. The model includes the goods, labour and financial asset markets, and the latter consists of money and bonds. Private households and firms maximize individual utilities or profits, respectively. Because the model is not designed to evaluate fiscal policies, government is broadly treated as exogeneous. At the present stage the behaviour in the foreign countries is also left unexplained. This implies that the economic performance in Euroland does not affect the rest of the world. In reality, given the weight of the Euro area in the world economy, spillovers are expected and have feedbacks on the Euro area. However empirical evidence for the US suggests that the additional impacts are small compared to the magnitude of initial shocks, see Fair (1994).

Table A2.1 provides a brief overview of the model. Most equations are fairly standard, see for example Romer (1996) for a thorough textbook discussion. On the supply side of the goods market, potential output and factor demands are explained. Potential output stems from a Cobb-Douglas production function with constant returns of scale, labour and capital as input factors and labour augmenting technological progress.[30] If potential output is realized, both inputs are employed at their effective levels. For the capital stock, this is assumed to be the actual level, while for the labour series the effective input must be estimated. This is done on the grounds of the time varying NAIRU concept, see Gordon (1997). Because of the persistent effects in the course of European unemployment, the NAIRU is a moving average of the actual unemployment rate and thus exogenous. Because of its structural determinants, the course of the NAIRU may be investigated on microeconometric grounds.

Factor demand equations are derived from profit maximisation and are modelled in a Hicksian way. They depend on the level of output and their own price, which is the real wage rate for labour and the real interest rate for capital demand. The elasticities match the restrictions of the Cobb Douglas production function. Labour force is population times the labour participation rate and the latter depends on long term unemployment and on the temporary gap between real consumer wages and productivity. Technological progress is modelled as a linear time trend, according to Jones (1995a, 1995b).

- Because of the sluggish adjustment of wages and prices in the real world, the model is demand driven in the short run. Actual output (GDP) is equal to the sum of the demand components. Private consumption depends on disposable income in the long run, according to the stochastic permanent income life-cycle hypothesis, Campbell and Mankiw (1991). Because disposable income is currently unavailable for the Euro area, consumption is linked to GDP. Also government consumption is explained by GDP and the demand for investment in fixed capital is part of the supply block.

[30] In principle other forms of technological progress are equivalent, when a Cobb-Douglas production function is assumed. However technological progress must be labour augmenting to ensure a steady-state in the neoclassical growth model, see Barro and Sala-i-Martin (1995).

Table A2.1: Stylized structure of the Euro model

Supply Side	
YP = YP(K, L, T)	YP = Potential Output, T = Technology
L = L(Y, W/P)	L = Labour
K = (1-d)·K(-1)+I	K = Capital Stock, d = depreciation rate
I = I(Y, IR)	I = Investment
U = LF-L	U = Unemployment, LF = Labour force
CAP = Y/YP	CAP = Capacity Utilization Rate
Λ = Y/L	Λ = Labour Productivity

Demand Side	
C = C(Y)	C = Consumption
X = X(WD, P/EP*)	X = Exports, WD = World Demand
M = M(Y, P/EP*)	M = Imports, P* = Foreign Price Index
Y = C+I+G+X-M	Y = Actual Output (GDP), G = Government

Wages, Prices, Interest and Exchange Rates	
W = W(P, L, U)	W = Nominal Wage
P = P(ULC, CAP, PM)	P = Price Index, PM = Import Price
ULC = WIN / Y	ULC = Unit Labour Costs
WIN = W·L	WIN = Compensation to Employees
IR = IN-dP	IR ,IN = Real, Nominal Interest Rate
E = E(IN, IN*)	E = Exchange Rate, IN* = Foreign Interest Rate

In the foreign trade sector exports and imports are modelled separately. Exports depend on the real exchange rate of the Euro and the level of world demand, while imports are explained by domestic demand and the real exchange rate, see Senhadji-Semlali (1998). The level of world demand is proxied by world imports. It is explained by weighted GDP in the three major economic regions (US, Japan, Euroland) and a linear time trend to capture the increase in globalization. Due to data availability, foreign trade variables rely on a gross concept and include intra and extra area flows. However in the aggregate, intra area trade will cancel out.

Disequilibria between supply and demand in the labour and goods market are represented by the unemployment rate and the capacity utilization rate, respectively. The former is defined as the ratio between the unemployed and the labour force, while the latter is the ratio between actual and potential output. The utilization rate serves as a proxy for the output gap. The disequilibria are important factors in explaining the short-run adjustments of wages and prices. In the long run, wage behaviour is modelled to ensure the existence of a vertical Phillips curve, and prices are determined as a mark up over unit labour costs. The key variable in the price system is the GDP deflator at factor costs excluding indirect taxes and subsidies. Other indices are explained conditionally on the key price, see Fagan, Henry and Mestre (2001). First degree homogeneity is imposed and can be verified on empirical grounds.

The equilibrium value of the interest rate on the money market is determined by a Taylor rule which gives equal weights to the output and inflation gap, see Taylor (1993). In particular, the inflation gap is the difference between actual inflation and a target level, which is determined by the ECB and exogenous. In addition the interest rate fluctuates one to one with inflation, implying a constant short term real interest rate. The interest rate on the bond market is explained by its correspondence in the foreign countries. The interest rate on the Euro money market has an impact only in the short run.

The nominal exchange rate of the Euro against the US$ is modelled with respect to uncovered interest parity, while the rate against the Yen is modelled conditional on the former. Due to policy behaviour, UIP is more simply fulfilled for the long term interest rates (McCallum, 1994). Given the path of the consumer prices in the two foreign countries, a real exchange rate can be computed and this is utilized to explain the real effective exchange rate of the Euro.

2 Econometric methods and database

The model is built as a simultaneous equation system, where the equations are estimated separately by OLS. A system estimator would not be superior. For example if only one relation does not fit the data with sufficient accuracy, the error will spread on to the other equations as well. In order to avoid such spillover effects the single equation analysis is preferred. However instrumental variables are required. Otherwise estimators are inconsistent due to the presence of the endogenous right hand variables. Thus, after the OLS estimation, a static simulation of the whole model is performed and one step forecasts of the endogeneous variables are generated. The forecasts are used as instruments replacing the original series, whenever endogenous regressors occur. This procedure ensures the consistency of the estimators, see Tödter (1992).

Due to the nonstationarity of most variables, all equations are estimated in an error correction form. As a rule the long run relationships are estimated jointly with the short run dynamics as suggested by Stock and Watson (1993). This avoids the finite sample bias arising in the two step procedure of Engle and Granger (1987), see Banerjee, Dolado, Hendry and Smith (1986). Also the estimators are more robust even in the case of structural breaks, see Kremers, Ericsson and Dolado (1992). For the test of cointegration, the critical values of Banerjee, Dolado and Mestre (1998) are appropriate. They depend on the deterministic part of the data generating process and on the number of variables in the cointegrating relationship. In the presence of a structural break, the number of variables has to be extended by 1, due to the low power of the standard unit root and cointegration tests, see Perron (1989) and also Hassler (2001).

The model is estimated with quarterly and seasonally (Census X11) -adjusted data. Alternatively, the ECB provides some artificial data for a long time span back to 1970, see Fagan, Henry and Mestre (2001). However in this study a much shorter sample period is employed. Although there were important predecessors of the EMU like the European Monetary System, a supra-national monetary policy was conducted only recently, and data from the seventies do not match the institutional criteria. Also series prior to 1991 do not reflect the ESA95 conventions, because they correspond to an older system of national accounts. Furthermore, the entire region has changed. For example series for the unified Germany are available since 1991, and before this date variables refer only to West Germany. Given the weight of the German economy in the Euro area -which is nearly one third of overall GDP- the shift will appear in the European series as well.

Hence in the longer time period structural breaks arising from various sources are unavoidable. Thus the sample runs from 1991.1 up to 2001.3, leaving 43 observations for estimation. The model region corresponds to the current EMU member countries.[31] Major data sources are the Eurostat database and the Monthly Bulletin of the ECB. Here most series are reported backwards to 1991.

3 Key empirical relations

According to the national accounting system the income shares of labour and capital are approximately 0.6 and 0.4. Under the traditional assumptions of constant returns to scale and perfect competition, the shares are equal to the elasticities of output with respect to inputs and restrict the evaluation of the Cobb-Douglas production function. In fact only the deterministic part of the technology has to be estimated. As a result the constant growth rate of total factor productivity is about 1.5% at the annual base. Potential output is generated by taken expectations. In the analysis effective labour and capital inputs are utilized. The capital stock is determined in a recursive way where a depreciation rate of 6% per annum is assumed. Effective labour input relies on the time varying NAIRU concept, which is estimated as a 4-period moving average of the actual unemployment rate.

The Cobb-Douglas approach can be justified for several reasons. Most important empirical factor demand equations presented in table A2.2 are compatible with the specification. According to the first order conditions the marginal products of the input factors are equal to their real cost in the long run. This is captured by the error

[31]The EMU member countries are Germany, France, Italy, Netherlands, Belgium, Luxembourg, Finland, Ireland, Austria, Spain, Portugal and Greece. Currently a few variables like the index of labour costs are only available for a subgroup of countries, mostly excluding Greece.

correction terms. They show the expected sign in both equations where the appropriate restrictions have been imposed.[32]

[32] In the capital demand equation, the investment ratio is explained rather than the growth rate of the capital stock because the former is more likely to be stationary.

Table A2.2: Factor Demand Equations

LABOUR

$$\Delta\log(EMP) = -\underset{(1.70)}{0.049} + \underset{(4.59)}{0.460}*\Delta\log(Y) + \underset{(4.00)}{0.438}*\Delta\log EMP(-5)) - \underset{(1.56)}{0.125}*\Delta\log(W/PYF) - \underset{(1.67)}{0.088}*EC(-1)$$

CAPITAL

$$\Delta\log(I/Y) = -\underset{(1.58)}{0.130} + \underset{(4.63)}{0.485}*\log(I(-1)/ + \underset{(3.00)}{0.311}*\log(I(-4)/Y(-4)) + \underset{(3.23)}{1.231}*\log(CAP4) - \underset{(5.45)}{0.040}*EC(-1) - \underset{(4.31)}{0.032}*DUM961$$

LABOUR

$$EC = \log(EMP) - \log(Y) + \log(W/PYF)$$

CAPITAL

$$EC = \log(CS) - \log(Y) + \log(UCC)$$

LABOUR

R2 = 0.59 DW = 1.80

Q(6) = 1.77 WHITE = 15.79 ARCH(1) = 0.16 JB = 0.33

CAPITAL

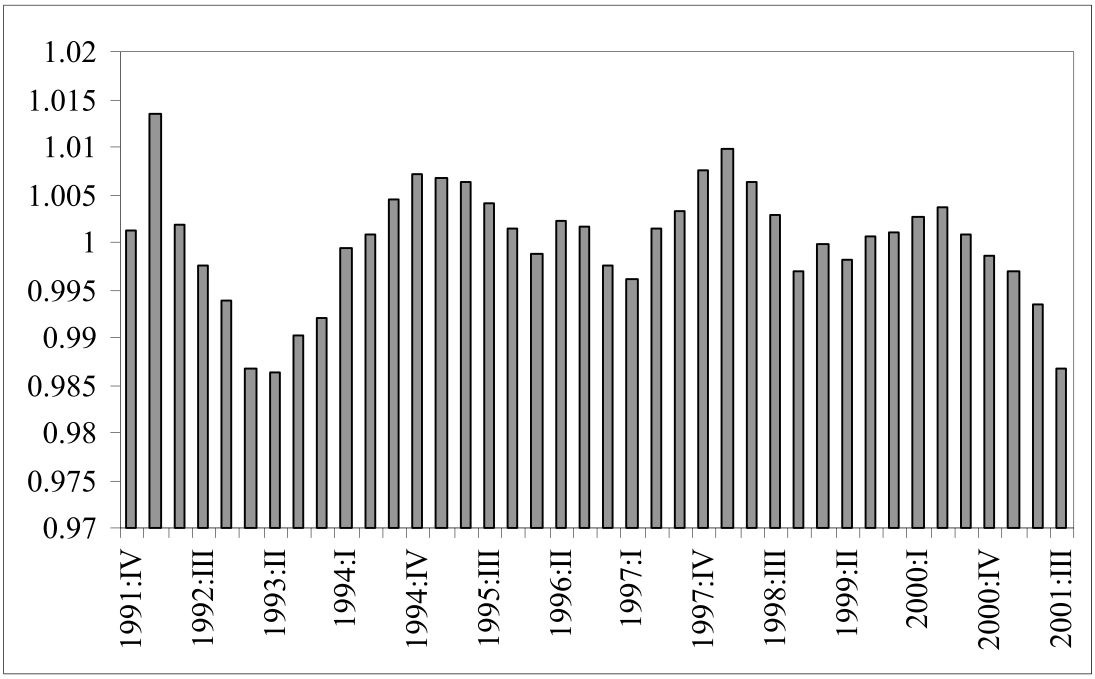
R2 = 0.92 DW = 1.66

Q(6) = 4.21 WHITE = 21.29 ARCH(1) = 1.15 JB = 1.34

EMP = number of employees, W/PYF = nominal wage (W) divided by GDP at factor cost deflator (PYF), Y = GDP, I = investment in fixed capital, CAP4 = smoothed capacity utilization rate, CS = capital stock, UCC = user costs of capital, EC = error correction term of the respective equation, and DUM961 = impulse dummy in 1996.1.
Δ is the first difference operator and numbers in parenthesis are t-statistics in absolute value. R2 is the adjusted R-square and DW the Durbin Watson statistic. Q is the Portmanteau statistic for autocorrelation, WHITE and ARCH are tests for heteroscedasticity and JB is the Jarque Bera test for normality of the residuals.
An '*' indicates a rejection of the null hypothesis at least at the 5 percent level.

The capacity utilization rate (*CAP*) is defined as the ratio between actual and potential output. The historical development of the variable is shown in figure 1.

Figure A2.1: Capacity utilization rate



Source: EFN estimates from the structural model.

The series fluctuates narrowly around its long run value. At the end of the period actual is below its potential reflecting the economic slowdown at the end of 2001. Performing an augmented Dickey-Fuller test gives a value of the statistic of -3.21. Thus the null of a nonstationary utilization rate series is rejected on the 5 percent level of significance. Obviously the estimation strategy leads to stationary deviations from potential output, supporting again the Cobb-Douglas approach.

Foreign trade relations are evaluated in table A2.3. The effective real exchange rate of the Euro against a group of currencies (*EER*) is included both in the export and import equation. Due to the implied cointegrating vectors a 1 percent real depreciation of the Euro will increase exports by roughly 0.25 percent, and lowering imports by approximately 0.2 percent in long run equilibrium.[33] Thus the Marshall-Lerner condition is fulfilled. Nevertheless some temporary J-curve effects may be expected, as indicated by the import function. The bulk of the explanation stems from aggregate demand variables reflecting the performance of the world and domestic economy. For example the long run elasticities of demand are approximately 0.9 in the export and 2 in the import equation, respectively.

[33] The effective exchange rate of the Euro is a weighted average of bilateral Euro exchange rates where weights are based on manufactured goods trade. The real exchange rate is computed by the means of consumer prices.

Table A2.3: Foreign Trade Relations

IMPORT

$$\Delta\log(M) = -\underset{(5.67)}{5{,}149} + \underset{(17.34)}{2.199}*\Delta\log(FDD) + \underset{(3.96)}{0.191}*\Delta\log M(-1)) - \underset{(3.01)}{0.078}*\Delta\log(EER(-2))$$
$$-\underset{(3.90)}{0.088} * \Delta\log(EER(-5)) - \underset{(2.25)}{0.045}*\Delta\log(EER(-6)) - \underset{(5.64)}{0.503}*\log(M(-1))$$
$$+\underset{(5.66)}{1{,}090} * \log(FDD(-1)) + \underset{(6.35)}{0.102}*\log(EER(-1)) - \underset{(5.30)}{0.016}*DUM962$$

EXPORT

$$\Delta\log(X) = \underset{(5.15)}{0.636}*\Delta\log(WD) + \underset{(2.33)}{0.202}*\Delta(\Delta\log X(-1))) - \underset{(3.54)}{0.337}*\log(X(-1))$$
$$+\underset{(3.54)}{0.284}*\log(WD(-1)) - \underset{(4.19)}{0.098}*\log(EER(-1))$$

EXPORT

R2 = 0.71	DW = 2.07		
Q(6) = 2.60	WHITE = 5.44	ARCH(1) = 1.03	JB = 0.03

IMPORT

R2 = 0.97	DW = 2.18		
Q(6) = 5.02	WHITE = 23.22	ARCH(1) = 0.05	JB = 0.90

X = Exports of goods and services, WD = World Demand, EER = Real effective exchange rate of the Euro, consumer prices, M = Imports of goods and services, FDD = Final demand for domestic goods, DUM962 = impulse dummy in 1996:II. Δ is the first difference operator and numbers in parentheses are t-statistics in absolute value. R2 is the adjusted R-square and DW the Durbin Watson statistic. Q is the Portmanteau statistic for autocorrelation, WHITE and ARCH are tests for heteroscedasticity and JB is the Jarque Bera test for normality of the residuals. An '*' indicates a rejection of the null hypothesis at least at the 5 percent level.

Key relations describing the evolution of prices and wages are shown in table A2.4. The GDP deflator at factor cost is determined by the unit labour costs in the long run. This in turn refers to a constant labour share as implied by the Cobb Douglas framework. In addition the (smoothed) capacity utilization rate and the money stock may have significant temporary impacts.

In equilibrium wages are determined solely by the consumer price and the labour productivity level. The error correction term is insignificant, but it makes the model much more stable. Also the labour cost variable is currently under construction. In the short run, temporary unemployment may have a small regressive impact on the bargaining process. Long term unemployment does not matter at all due to insider-outsider effects, see for example Blanchard and Summers (1988).

Table A2.4: Price and Wage System

GDP DEFLATOR (AT FACTOR COST)

$$\Delta\log(PYF) = \underset{(5.33)}{0.219} + \underset{(2.51)}{0.318}*\Delta\log(CAP) + \underset{(3.42)}{0.522}*\Delta\log ULT) + \underset{(5.98)}{0.806}*\Delta\log ULT(-2))$$

$$+ \underset{(3.22)}{0.496} * \Delta\log(PYF(-4)) + \underset{(2.08)}{0.281}*\Delta\log(\mathrm{PYF}(-5)) - \underset{(5.00)}{0.549}*\Delta\log(\mathrm{PYF}(-6))$$

$$- \underset{(5.84)}{0.512} * \log(PY(-3)/ULT(-3)) - \underset{(3.21)}{0.112}*\log(PY(-1)/M3Y(-1))$$

WAGES (LABOUR COSTS)

$$\Delta\log(W) = \underset{(2.02)}{0.230}*\Delta\log(W(-4)) + \underset{(2.41)}{0.258}*\Delta\log W(-8)) - \underset{(1.45)}{0.028}*\log(USH(-5)) + \underset{(2.61)}{0.005}*\log(PY(-1)/ULT(-1))$$

GDP DEFLATOR (AT FACTOR COST)

R2	= 0.65	DW	= 2.26				
Q(6)	= 2.42	WHITE	= 22.03	ARCH(1)	= 0.27	JB	= 0.13

WAGES (LABOUR COSTS)

R2	= 0.30	DW	= 1.17*				
Q(6)	= 8.22	WHITE	= 24.62*	ARCH(1)	= 2.01	JB	= 2.02

PY (PYF) = GDP Deflator (at factor cost), CAP = capacity utilization rate, M3Y = Money Stock M3 per unit GDP, ULT = Trend Unit Labour Costs, W = Wage Rate. Δ is the first difference operator and numbers in parentheses are t-statistics in absolute value. R2 is the adjusted R-square and DW the Durbin Watson statistic. Q is the Portmanteau statistic for autocorrelation, WHITE and ARCH are tests for heteroscedasticity and JB is the Jarque Bera test for normality of the residuals. An '*' indicates a rejection of the null hypothesis at least at the 5 percent level.

4 Conclusion

This Annex provides information on the structural macroeconometric model for the Euro area, see Dreger (2002) for additional details. The model relies on aggregate data obtained for the supra-national level. All equations are estimated in an error correction form using the one step procedure suggested by Stock and Watson (1993). Most relations are broadly in line with economic theory and can be justified by the means of standard specification tests. Also the validity of the aggregated approach is confirmed by several standard simulation exercises, which show reasonable outcomes, more or less. In particular a rise in commodity prices and a slower expansion of international trade are discussed.

However, macroeconometric modelling is a continuous process. Thus the current stage of model building should not be taken as the final version. The availability of Euro area data will improve in the future and so, a re-specification of some equations will be on the agenda. For example the actual foreign trade figures include extra and intra area flows. A valid specification will rule out the latter series, leading to a more realistic export and import share. Moreover disposable income will replace GDP in the consumption equation, when the series is reported.

Other improvements are recommended on theoretical grounds. Model-consistent expectations have to be integrated, and this would require a pre-determination of the steady state, for example, according to the neoclassical growth model. The steady state, which is built solely on economic theory will affect the short-run dynamics. However a conflict can arise between theoretical and empirical considerations. Also the framework can be extended by modelling relations with the US and Japan, in order to produce a consistent view of the development of the world economy.

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A3. The Multinational Marmotte Model

Marmotte is a yearly multinational model focusing on the medium term, built by the CEPII in co-operation with the CEPREMAP and is implemented on Troll software. It includes 17 industrialised countries: the 14 members of the European Union (Luxembourg and Belgium are merged), the United States, Japan and Canada. Marmotte provides both a careful description of these economies, including significant structural asymmetries, and a comprehensive description of interdependences between countries, through trade and capital flows. It is thus an appropriate tool to investigate the international transmission of shocks of different natures and the diffusion of national economic policies to the whole world.

Each country is modelled by the same system of about 50 equations. The values of the parameters of these equations, and the exchange rate system, can differ between countries. Each country produces a specific commodity, which is imperfectly substituitable with the commodities produced by other countries.

Marmotte is a dynamic model with a strong theoretical content and built under the assumption of perfect forecast/foresight. Most behaviours are based on intertemporal optimisation. Many parameters were estimated by econometric methods (in general GMM over the panel of 17 countries, with tests of the significance of the difference of values of parameters between countries).[34] Actually, Marmotte follows the same basic principles as Multimod Mark 3 (an IMF model) and Quest 2 (a model built by the European Commission). It can be used to simulate the consequences of changes in economic policies or in economic environment, over the future, and around a baseline, which was built independently of the model and which rests on forecasts given by OECD, IMF, etc.

As Marmotte has strong and clear theoretical background, the results of its simulation can be given clear and precise interpretation in non-technical terms. It is better used as an interface in discussions between applied economists, with different expertise, who are interested in analysing a medium-term problem of the European or the world economy.

Marmotte identifies four kinds of differences between countries:

- Countries differ in size and in the various ratios between national aggregates.
- Countries differ in their openness and in the geographic structure of their bilateral trade flows.
- Countries differ in their exchange rate regimes.
- Countries differ in the values taken by the different behavioural and structural parameters. These parameters are, for example, the elasticities of imports to competitiveness, of wages to unemployment, etc.

The first three types of difference can be measured with good precision. But the last set of differences rests upon macro-econometric estimation, and there is a good deal of uncertainty about them. Thus, there exist two versions of Marmotte. The first version assumes conservatively that all behavioural and structural parameters are the

[34] Most of the data used for the estimation of the equations and the building of the baseline account come from the OECD data bank.

same between countries. Simulation results obtained with this version are easy to interpret. The second version emphasises structural asymmetries and is well designed to tackle related issues: it gives to these parameters the values estimated by econometrics and provides results underscoring new dilemmas faced by economic policy.

Accordingly, Marmotte is especially well adapted to investigate the effects of asymmetric shocks (originating in a specific European country), symmetric shocks (originating outside the EU), and asymmetries in the economic structures of European countries (of the various kinds identified above). The autonomy and the co-ordination of national fiscal policies, the role of a common monetary policy and of the exchange rate system implied by EMU have important consequences on the effects of these shocks and asymmetries.

The most original feature of Marmotte rests on the supply side, which is modelled by a putty-clay technology: capital can be substituted by labour only in the long run. In each period, a new vintage of capital is installed, whose capital-labour ratio chosen in the menu of technology available remains unchanged until its scrapping. The capital intensity and the expected lifetime of the new production unit result from an inter-temporal optimisation of its expected discounted profitability.

This technology is especially well suited to the analysis of medium-term movements in the allocation of national income between wages and profits. It can explain the stickiness of employment and investment and the way a change in the structure of the labour market will progressively change production technology and the working of the economy. According to this specification, output can increase because of a rise in the age of the oldest production units kept in activity, and because of past investments.

Another specific feature of Marmotte is that consumers optimise intertemporally with a non separable utility function which takes into account habit formation. This introduces some stickiness in consumption behaviour.

Other features of the model (imports, exports, wages and prices equations with some stickiness of nominal values, interest rate parities, monetary rules, etc.) are quite classical. In the wage curve (the pseudo-supply of labour), the real cost of labour decreases with the inflation rate (the stickiness of the nominal wage rate), and with the ratio between production and consumption prices, while it increases with the rate of employment and the current productivity of labour.

The model assumes inter-temporal equilibrium for both the budgets of governments and the balance of payments of nations. To stabilise the model, the uncovered interest rate parity has been amended by adding a risk premium that will “punish” (or “reward”) a country for its greater (or lesser) impatience, and so for its tendency to over-borrow (over-lend). This premium is related to the external asset position of the country. If the external indebtedness of a country increases, a higher risk premium will be attached to the currency of that country. In the dynamic model, as the exchange rate affects the import and export equations, any increase in external indebtedness will have a depressing effect on imports and the opposite effect on exports.[35]

In the simulations, a decrease in tax rates is financed by an increase in lump sum taxes. So, distortionary taxes are substituted by non distortionary taxes, and Government spending stays unchanged. The time profile of the raise in lump sum taxes does not matter, because of the Ricardian equivalence assumed by Marmotte. Thus, postponing these taxes to a far future, and using public indebtedness in the short and the medium runs are possible options.

Monetary policy is implemented by the central bank of each non-Euro area country and by the European Central Bank for the Euro zone countries. The central banks' goal is to stabilise inflation around a target according to a Taylor-type monetary rule.[36]

Finally, Marmotte assumes some stickiness of production prices. In each country the rate of variation of this price is positively related to the ratio between the demand and the supply of goods produced by the national private sector (*i.e.* to the output gap). Current production is assumed to be equal to demand. Supply determines potential production. In the long run, effective and potential outputs are equal. The stickiness of prices was introduced in Marmotte to provide some Keynesian features in the short run.

1. The specification of the technology of firms

Macroeconometric models usually assume a putty-putty technology: the capital intensity of the production process can be changed instantaneously and without cost. Thus, in a competitive framework, the factors of production fully and instantaneously adjust to current economic conditions. This means that "realistic" changes in real wages or in the cost of capital lead to very significant and fast moves in the demand for labour and capital. Moreover, the quick adjustment of the capital stock should cause huge variations in the flows of investment.

However, actual employment and capital stock exhibit much weaker movements than those predicted above. Hence, the integration of this theoretical framework in a realistic model requires some improvements. One way to decrease the cost-sensitivity of production factors consists in assuming nonlinear adjustment costs (usually quadratic costs). This results in smoother dynamic adjustments of labour and capital. However, this specification rests upon an *ad hoc* assumption without wholly rigorous microeconomic foundations and empirical verification. Moreover, it is not a fully convincing way to model the irreversibility of investment and the firing costs of labour. Finally, the putty-putty framework is unable to give simple, acceptable explanations for the medium term movements in the wage share in value added,

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[35] In the case of the US, since the dollar is used as reference currency in the interest parities, the premium is introduced in the Taylor rule of the Fed. So, it is assumed that in addition to inflation the Fed also cares about the US net foreign asset position. In the dynamic model, as interest rate enters the consumption function, any increase in external indebtedness (reflecting greater impatience from the US consumers) will have a depressing effect on consumption.

[36] The fact that central banks use Taylor rules, where the nominal interest rate is related to the inflation rate, introduces a hysteresis into the model. The nominal anchors, which determine the output deflators in the various countries, are prices inherited from the past.

which are observed in some European countries (see for instance Blanchard, 1997, Prigent, 1999). Although adjustment costs smooth the dynamics of factor demands in the short run, they are far from sufficient to produce medium term changes in the income distribution between capital and labour.

A key feature of the putty-putty specification, that is central to its empirical failure, is that all the vintages of capital have the same capital intensity. On the contrary, we would expect the current technology menu to be only available to the newly created units of production. This is precisely what the putty-clay specification does. In this framework, current economic conditions affect the capital intensity of the new production units (their technological choice) and the number of these units created (investment in the economy). The other production units keep the technology they were given at their creation. However, current economic conditions affect their profitability and lead to the scrapping of non-profitable units. Hence, the aggregate capital-labour ratio changes gradually with the flows of investment and the scrapping of old obsolete production units. Putty-clay investment may thus provide medium term dynamics in the distribution of income.

This specification has some other advantages. The irreversibility of investment is embedded in the model and firing costs can easily be introduced. This gives a convincing foundation to the stickiness of employment.

Despite all its advantages, the putty-clay technology suffers from a serious drawback. Its implementation in a macroeconomic model is cumbersome for two reasons. First, the model has a long memory since it keeps track of all the vintages of capital created in the past, that are still in working order. Thus, the model has "variables with long lags". Second, the planning horizon of investors stretches far into the future. More precisely, the decision concerning new production units involves forward variables that cover the expected lifetime of these units. The model has then "variables with long leads".

However, these problems can be easily overcome nowadays. Models with variables presenting long leads and lags can be solved with powerful algorithms (for instance those implemented in Troll), and simulation time is decreasing with the improvement of personal computers.

The specification of the technology of firms can be described as follow. At each date, firms build a number of new production units, which will start to produce one period later. They have to choose the capital intensity embodied in these units. Since this capital intensity cannot change in the future, the expected lifetime of the new production units is part of the decision-making. Both capital intensity and expected lifetime are set to maximise the expected discounted cash flows minus installation costs. Moreover, firms reassess the profit that each older unit would make during the current period if it were kept into activity. When this profit is negative the unit is scrapped. Then, we can aggregate the decisions of firms and get the investment, the employment and the production of the current period.

2. Consumption behaviour

Macro-econometric studies of consumption often rely on extensions of the permanent income model. Even if we owe the concept of permanent income to Friedman (1957), the model used in recent literature is due to Hall (1978). It implies that aggregated time series is interpreted as the solution to the infinite-living representative consumer's program. It considers a representative consumer who maximises the discounted sum of his instantaneous utilities. Taking his preferences into account, each individual chooses between consuming today and saving to consume later by comparing the effects of each of these two choices on his welfare.

The strong conclusion of the infinite-horizon model, which is that changes in consumption follow a martingale difference, was challenged by empirical studies. Hall's model seems to underestimate both the inertia of consumption relative to the permanent income (the 'excess smoothness' of consumption which was first identified by Deaton, 1988) and the "excess sensitivity" of consumption to current income (which was investigated by Flavin, 1981 and Campbell and Mankiw, 1989). This second limit is related to the existence of liquidity constraints that undermine the model's assumption of competitive financial markets. In spite of the financial deregulation implemented in the past two decades in almost all the industrialised countries, part of households may still be unable to borrow against their future income. Finally, the infinite life framework has also often been criticised for the lack of realism of its assumption concerning the agent's horizon, which avoids taking into account life cycle features and the distribution of income across generations.

An extension to a finite life horizon is due to Blanchard (1985). It enables us to analyse some intergenerational distribution issues, such as the burden of public debt. The main feature of this approach is to account for the uncertainty that an individual agent faces relative to the date of its death. Although life expectancy is perfectly known, this uncertainty leads to unexpected bequests. With a perfectly competitive life insurance system, this introduces a distinction between the individual and the national rate of return. The real interest rate of the economy can then differ from each agent's time preference rate, within a range limited by the probability of dying. An important consequence of this framework is to rule out pure Ricardian equivalence: households anticipate that part of the burden of an increase in public debt will falls on younger households and future generations. However, the flexibility given by Blanchard's specification should not be overstated. Uncertainty about life horizon increases the private discount factor by the probability of dying. This gives some flexibility in setting the interest rate, which has not to be strictly equal to the time preference rate. But the rate of death is very low in industrialised countries (less than 0.5% per annum), so this flexibility and the departure from pure Ricardian equivalence are quantitatively limited. Other sources of non Ricardian equivalence seems more relevant, especially the imperfection on financial markets.

The implementation of a Blanchard-style consumption function in a macro-econometric model is also not straightforward. First, the estimation of the model's parameters requires building data for unobserved variables, such as human wealth (i.e. the permanent income) and the expectations of the future path of real interest rates. This is a non trivial problem. As we know the motion law of the two unobserved data, it is tempting to compute them by assuming starting values far enough in the past. However, one can be very sceptical about the use of "home-made" data in the estimation of "deep" parameters of the economy. A natural way to avoid computing human capital is to estimate directly the arbitrage equation of the consumer. But it is not possible to do so in the Blanchard's framework because this equation does not hold at the aggregate level, although it does for individual agents.

Considering all these difficulties, we decided to choose for Marmotte a more traditional framework based on an extension of the Hall's model. The capital asset pricing model considers that households have access to complete financial markets without transaction cost. Hence, any kind of financial asset can be used as a means of saving. The arbitrage condition builds up a relationship between the asset's expected return and the marginal rate of intertemporal substitution, i.e. the relative importance given by the individual between consuming today and consuming at the next period. Keeping an infinite-horizon framework is convenient and econometric estimation much easier. Furthermore, we attempt to deal with the two empirical limits of the Hall's model: (a) excess smoothness of consumption relative to permanent income and (b) liquidity constraint.

To account for the excess smoothness of consumption, we have reconsidered the assumption of a time separable utility function and introduced habit formation into the model. By including habits in the consumption function, we get reasonable values for the parameters, especially for the degree of risk aversion of consumers. In a macro-econometric model, accounting for the inertia of households' behaviour will induce slower responses of consumption to shocks and will avoid the large, unrealistic volatility of consumption that more traditional Euler equation specifications produce.

To account for liquidity constraints, we assumed two different types of households whose proportion in the economy is constant over time. The households of the first group are liquidity-constrained whereas the households of the second group have free access to financial markets and behave according to the above arbitrage equation. To estimate econometrically the share of the liquidity-constrained agents, we included it directly in the Euler equation by assuming that the unconstrained households know this share and account for it in the optimisation.

The results obtained by the econometric estimation are reasonable. The share of liquidity constrained households is in line with recent studies on this topic. The presence of habits in the consumption decisions is empirically verified, hence supporting the specification choice. Finally, the combination of the parameters is consistent with reasonable consumers' preferences and the properties of the consumption function are likely to produce responses to shocks that are consistent with those observed.

The estimations on a panel of countries allowed us to get both more data to make our empirical evidence more robust and to study what are the sources of structural differences across countries. By estimating the "deep" parameters of the consumption function (degree of risk aversion, degree of inertia in the consumption process, presence of habits in the consumers' preference, etc.), we provided evidence on the roots of differences. Only the habits parameter seems to differ across countries. This implies some slight differences in terms of the degree of smoothness of consumption. However, the main result is that differences across the 17 countries of Marmotte are not large enough to imply significant differences in terms of consumption responses to shocks in the simulations of the model.

3. The wage curve

Wage behaviour is estimated on the panel of countries of Marmotte. Using panel estimation helps us to get more robust and precise empirical findings: as countries share some common structural features, each country estimation benefits from information brought by its partners. Second, panel estimation allows to identify deep structural differences between countries. This kind of analysis is particularly important as industrialised countries' labour markets display great heterogeneity concerning wage bargaining processes, degrees of job protection, and provision of replacement incomes, etc. (See OECD (1994), Cadiou and Guichard (1999)).

Wage behaviour is based on a simple formalisation of wages setting. Labour cost depends on labour productivity, prices, the wedge between real labour cost for firms and the purchasing power of nominal wages for wage earners, and the employment rate. We also introduce nominal rigidities in this equation: some wage contracts are longer than one year and depend not only on current prices but also on anticipated ones.

4. Foreign trade

The foreign trade block of Marmotte is based on very classical theoretical foundations. The usual framework for empirical works on foreign trade is derived from the model with imperfect substitution due to Armington (1969). In an open economy, the volumes of imports and exports come from the maximisation of consumers' utility under their budget constraint. The solution of this program makes the volumes of trade dependent on demand terms and price competitiveness indicators. This model was improved by several authors such as Dixit and Stiglitz (1977), Helpman and Krugman (1985) or more recently Erkel-Rousse (1997). In Marmotte, the model with imperfect substitutes enables us to explain the persistence of price gaps between countries.

The export volumes and prices equations were estimated on the panel countries. Calibrated parameters were selected for the imports equation to stabilise the model.[37]

Marmotte does not include a model of the rest of the world. Currently, the imports and exports prices of the rest of the world are measured in dollars and exogenous.[38] The volume of imports measured in constant dollars is fixed. The volume of exports has a positive elasticity in relation to the ratio of the production price in the US and the production price in the rest of the world, which is exogenous. Thus, a price increase in the US improves the trade balance of the rest of the world, measured in current dollars or in constant dollars. These assumptions are far from satisfactory, and may creates unwanted features in simulation results. In the future we will introduce a model of the rest of the world, based on the choices made by Multimod Mark 3.

5. Interest rate and exchange rates

In Marmotte, there are three interest rates per country: the short term rate, the long term rate, linked to the previous one by a term structure equation, and the firms' discount rate. The latter is equal to the short term interest rate augmented by an exogenous risk premium. The short term interest rate is fixed by a monetary rule. The

[37] Estimated parameters for import equations highlight strong structural differences between countries both in the short and in the long run. These parameters introduced some stability problems in Marmotte; they have thus been discarded and replaced by calibrated parameters.

[38] Thus, the prices of the rest of the world are a nominal anchor for the US, and American prices do not present an hysteresis. This reduces the number of unitary eigenvalues in the dynamic model and the dimension of the space of indeterminacy of the steady state model, by one.

central bank goal is to stabilise the inflation rate around a target according to a Taylor monetary rule.[39]

More precisely, central banks react to changes in expected inflation and the output gap (the difference between potential and effective productions). As the output gap and past inflation are negatively related in Marmotte, interest rates actually react to past and expected future inflation rates. Under a Taylor rule the nominal interest rate overreacts to a change in inflation and the real interest rate varies in the same direction as the inflation rate. The baseline simulations of Marmotte assume that the nominal interest rate is only sensitive to the variations of the most recent observation of inflation with a coefficient of 1.5.[40]

The exchange rates of the currencies of countries outside the Euro area are perfectly flexible vis-à-vis the US dollar, which is the reference currency of the model. Between the Euro area countries, exchange rates are fixed and a single exchange rate is defined with the dollar. Exchange rates are determined by the uncovered parities, which include a country-specific risk premium. This risk premium will "punish" (or "reward") a country for its greater (or smaller) impatience, and so for its tendency to accumulate foreign debt (assets).

Annex 3 References

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[39] The fact that central banks use Taylor rules, where the nominal interest rate is related to the inflation rate, introduces an hysteresis in the model. The nominal anchors which determine the output deflators in the different countries are prices inherited from the past. The hysteresis property implies that the number of unitary eigenvalues in Marmotte is equal to the number of independent central banks less one. The equations which determine the steady state of Marmotte have an infinity of solutions for prices, exchange rates and the levels of nominal variables. These solutions belong to a linear variety with a dimension equal to the number of independent central banks less one.

[40] This choice was made out of simplicity. Introducing more lags and some leads in the Taylor rule would be very easy. The econometric estimations of the Taylor rule introduce lagged interest rates, which sum up the stickiness of the nominal interest rate. This would also be easy to introduce in Marmotte. However, the fact that Marmotte is a yearly model implies that the dynamic features of its Taylor rule could not be as precise as for estimated rules based on monthly data.

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A4. Data description

Table A4.1: Data description for structural forecasting model (1/3)

Code	Euro area data	Source
CAA	Capital Account, EUR (ECU) billions	ECB
CS	Capital Stock, Depreciation rate 1.5% per quarter	DEF[a]
CUA	Current Account, EUR (ECU) billions	ECB
DEBT	Government Debt (% of nominal GDP)	ECB
EEN	Effective Exchange Rate, nominal; 99-1=1, Narrow Group	ECB
EER	Effective Exchange Rate, real (Consumer prices); 99-1=1, Narrow Group	ECB
EMP	Employment in Million. (including self employment)	EUROSTAT (DEF); ECB (91-92)
GC	Government Consumption at 1995 prices	EUROSTAT
GEXP	Government Expenditure (% of nominal GDP)	ECB
GIN	Government Investment (% of nominal GDP)	ECB
GIP	Interest Payments (% of nominal GDP)	ECB
GREV	Government Revenue (% of nominal GDP)	ECB
HICP	Harmonized Index Consumer Prices, 1996=1	EUROSTAT, OECD (91-94)
I	Gross Fixed Capital Formation at 1995 prices	EUROSTAT
IL	10-Year Interest Rate, Euro area	EUROSTAT
IL_JP	10-Year Interest Rate, Japan	OECD (91-93)

(a) DEF: Definition.

Table A4.2: Data description for structural forecasting model (2/3)

Code	Euro area data	Source
IL_US	10-Year Interest Rate, US	ECB, OECD (91-93)
INV	Changes in Inventories at 1995 prices	EUROSTAT (DEF)
IS	3-Month Interest Rate, Euro area	EUROSTAT
IS_JP	3-Month Interest Rate, Japan	ECB
IS_US	3-Month Interest Rate, US	ECB
M	Imports at 1995 prices	EUROSTAT
M3	Money M3, End of Quarter	EUROSTAT
M3R	Real Money M3, End of Quarter	M3 / PY
M3_US	Money M3, End of Quarter, US, Billion US$	OECD
OIL	Oil Price, US$ / Barrel	FFC[b], IEA[c]
P_JP	Consumer Price Index Japan, All Items	OECD
P_US	Consumer Price Index US, All Items	OECD
PC	Private Consumption at 1995 prices	EUROSTAT
PGC	Deflator Government Consumption, 1995=1	EUROSTAT
PI	Deflator Gross Investment, 1995=1	EUROSTAT
PM	Deflator Imports, 1995=1	EUROSTAT
POP	Population in Million.	OXFORD[d]
PPC	Deflator Private Consumption, 1995=1	EUROSTAT

(a) DEF: Definition.
(b) FFC: Financial Forecast Center.
(c) IEA: International Energy.
(d) OXFORD: Oxford Economic Forecasting.

Table A4.3: Data description for structural forecasting model (3/3)

Code	Euro area data	Source
PX	Deflator Exports, 1995=1	EUROSTAT
PY	Deflator GDP, 1995=1	EUROSTAT
RAW	Prices Raw Materials, All Commodities, 1990 = 1	ECB (HWWA[e])
RAW X	Prices Raw Materials, Excluding Energy, 1990 = 1	ECB (HWWA)
SCR	Social Contributions (% of nominal GDP)	ECB
SI	Stock Market Indices, Euro Stoxx 50, End of Quarter	ECB
SI_JP	Stock Market Indices, Nikkei 225, End of Quarter	ECB
SI_U S	Stock Market Indices, Standard & Poors 500, End of Quarter	ECB
SPR	Social Payments (% of nominal GDP)	ECB
SUB R	Subsidies (% of nominal GDP)	ECB
TDR	Direct Taxes (% of nominal GDP)	ECB
TIR	Indirect Taxes (% of nominal GDP)	ECB
UN	Unemployment in Million.	EUROSTAT
US$	Exchange Rate, Euro / US$	EUROSTAT
W	Total nominal hourly labour costs, whole economy	ECB
WT	World Trade; World Imports (Billion US$) at 1995 prices	OECD
X	Exports at 1995 prices	EUROSTAT
Y	GDP at 1995 prices	EUROSTAT
Y_JP	GDP Japan (Billion 100 Yen) at 1995 prices, annual level	OECD
Y_US	GDP US (Billion US$) at 1996 prices, annual level	OECD
YEN	Exchange Rate, Euro / 100 Yen	EUROSTAT

(e) HWWA: Hamburg Institute of International Economics.

A5. Exogenous variables

Table A5.1: Exogenous variables in the EFN forecasting model

	2002:II	2002:IV	2003:IV
Depreciation rate (dep)	6.4	6.4	6.4
Japan Consumer Price Inflation[b] (gp_jp)	-0.3	0.9	1.6
Japan GDP Growth Rate[b] (gy_jp)	-0.9	-1.0	0.2
Japan Long Term Interest Rates[b] (il_jp)	1.36	1.36	1.36
Japan Short Term Interest Rates[b] (is_jp)	0.07	0.07	0.07
Oil Price, US$ / Barrel[c] (oil)	20	20	20
Population (in million)[d] (pop)	298	298	298
US Consumer Price Inflation[b] (gp_us)	2.1	1.7	2.1
US GDP Growth rate[b] (gy_us)	0.0	0.7	2.7
US Long Term Interest rates[b] (il_us)	5.00	5.25	6.25
US Short Term Interest rates[b] (is_us)	2.00	2.25	3.25

(a) Source: EUROSTAT
(b) Source: IMF
(c) Source: Financial Forecast Center, International Energy Agency
(d) Source: Oxford Economic Forecasting
(e) Source: OECD