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An indicator-based short-term forecast for quarterly GDP in the euro area

by

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Table of contents

Page

ABSTRACT

The present paper presents an approach to estimate euro area GDP quarterly growth over two quarters ahead. The estimates are derived from separate single equations for each quarter to be forecast using OLS including a moving error term. The explanatory variables describe real economic activity (car sales) or its assessment in opinion surveys, and financial variables, both of the euro area and the US. The euro area opinion survey variables are the present business situation in the retail sector and the construction confidence indicator, while the US National Association of Purchasing Managers index of the manufacturing industry reflects the importance of international economic links. There are two financial variables. First, the relative yield spread between the euro area and the US. Second, the real effective exchange rate is an indication of the competitive position of euro area exporters.

The estimates show a good match of actual GDP development over the past 10 years and should allow producing reasonably reliable forecasts. The mean absolute forecast error does not exceed 0.15 % and is used to calculate the forecast ranges. The success rate in forecasting acceleration/deceleration/no change in the coincident quarter is 76 %; it is 68 % in the following quarter.

1. INTRODUCTION

The euro area is growing in importance as an economic identity. The single market and the single currency are driving forces behind this development. They produce ever greater integration.

It has consequences for the framework in which economic policies are conducted, which tend to be more co-ordinated or centrally designed. Fiscal policy is an example of the former, monetary policy of the latter.

In order to meet the reality of the euro area as an identity, a lot of effort is put into the economic analysis of the euro area as a whole. Tracking recent economic and financial developments in a timely manner is important for all economic agents, both private and public.

The basis of such an analysis is the availability of economic indicators covering the euro area. These indicators can take several forms:

- Data referring to observations on just one variable (interest rates, inflation, industrial production, money supply, balance of payments, ...). Important producers of this type of statistics are Eurostat (European Commission) and the ECB.
- Qualitative information on opinions (surveys conducted with households, firms,…). DG ECFIN (European Commission) harmonises at the euro area level the opinion surveys done by national institutes and calculates several Confidence Indicators (industry, consumer, construction, retail). The recently developed Business Climate Indicator tracks well industrial production.
- Composite indicators combine different types of data (both on observed facts and opinions). An example is the OECD leading indicator (presumed to anticipate industrial production by about 6 month).
- National Accounts forecasts exclusively based on statistical techniques. Based on work done by group of several national research institutes, the Financial Times publishes regularly a prediction for quarterly GDP in the euro area. The forecast horizon is 2 quarters. Following a similar approach INSEE presented a method to foresee besides GDP also private consumption, investment and exports.

The work presented here belongs to the fourth category of indicators. Compared to composite indicators where the link with the underlying series is indirect and which are often presented as an index, it has the advantage of producing a key economic figure, namely a projection for GDP.

Compared to the Commission Forecasts, released twice a year (Spring and Autumn), there are a number of differences. The Commission Forecasts cover a two-year prediction horizon and focus on annual data, but recently also a quarterly GDP profile has been published. These quarterly growth rates, however, are not derived from an econometric model, but are based on a judgemental approach.

By contrast, the here presented GDP forecast is not conditional on policy assumptions, but derived from an estimated econometric relation. Some of the confidence indicators and financial variables resulted in a good fit with GDP. The forecast horizon is two quarters, as it appears that the reliability of such predictions drops from then onwards.

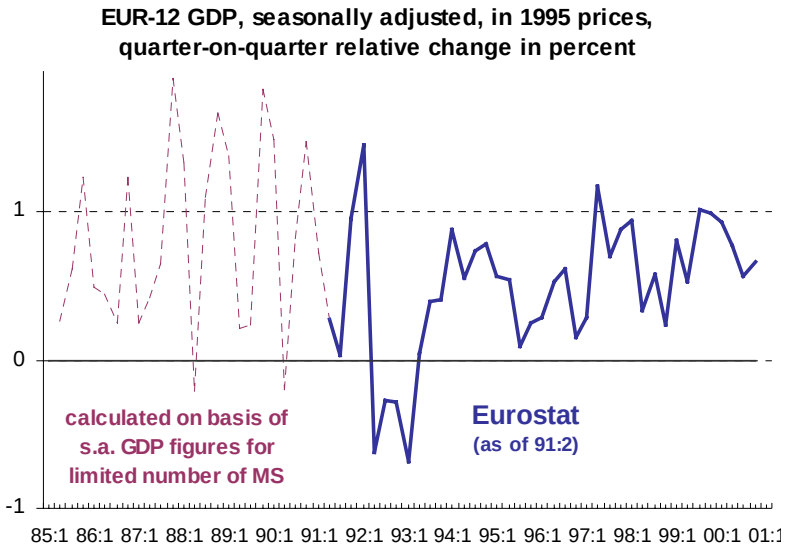
One of the main advantages of the new forecasts is that it could facilitate the monitoring of the EU economy in-between two forecasting rounds. The timely availability of these data allows for a prompt update of GDP forecasts, taking into account the latest developments. They are to be considered as a complement to the two full-scale prediction exercises that the Commission is carrying out each year.

2. DATA

2.1. DEPENDENT VARIABLE

The forecasts derived from the equations described below apply to the quarterly percentage change of the euro area GDP, ESA95, seasonally adjusted and in real terms (1995 prices), as compiled and reported[1] by Eurostat.

Hence, the quarterly GDP growth rate, rather than the corresponding annual variation, is used as dependent variable. The reason is that the quarterly change is the more telling number for assessing short-term economic activity, as annual changes reflect a moving average of the past four quarterly changes and thus reflects economic conditions over the past year rather than more specifically in the latest quarter.



However, also for these reasons quarterly changes are relatively more volatile than annual changes which poses a challenge to forecasting. Between the 1st quarter of 1992 and the 4th quarter of 2000 (36 observations), the standard deviation of the quarterly GDP change (0.46) is of very similar magnitude as

[1] These numbers are compiled on the basis of the European System of Accounts 1995 (ESA1995). The first estimate is published around 70 days after the end of the respective quarter, the second estimate around 100 days and the third one around 120 days. However, even after that, revisions of the whole series happen regularly. In principle, the final reports on GDP are used for the estimates, and are therefore forecast.

the mean (0.49), whereas for annual changes the situation is slightly different with a standard deviation of 1.29 for a mean of 1.97.

2.2. SAMPLE PERIOD SELECTION

Independent variables are available back in time to different degrees. The shortest one is the series on the retail sector, with data starting in November 1985. That would in principle allow an estimate over a sample starting in 1986.

However, the underlying series of the dependent variable, real euro area GDP, is available only as of the beginning of 1991, thus the quarterly change as of the 2nd quarter of 1991[2].

GDP data for differently long periods before 1991 exist for several Member States. In addition GDP figures exist for some other countries, in particular for Germany, on the basis of ESA79. Hence, it could be envisaged to compile an artificial longer time series for GDP growth starting in the mid eighties.

However, the quarterly pattern of that series is quite distinct from the later Eurostat series. It shows much higher volatility and a distinct element of seasonality (see chart). One might possibly deal with this phenomenon with different kinds of statistical methods[3].

Yet, in order to avoid such complications estimates were finally confined to the period for which official Eurostat figures for the euro area exist. Hence, for the present estimations 39 observations, from the 2nd quarter of 1991 to the 4th quarter of 2000, were used.

Such a limitation tends to dramatically increase the correlation coefficient of the estimates as compared to estimates using a range starting in 1986. And despite the smaller sample the statistical significance of parameters is hardly affected. A more substantive drawback of that approach might lie in the fact that the estimates were derived from a period with only one serious slowdown, at the beginning of the sample period. Hence the behaviour of the equations in downturns might be considered to be insufficiently established. Therefore, the estimates will have to be properly monitored, in particular during a possible future period of a major slowdown of economic activity.

2.3. INDEPENDENT VARIABLES

The independent variables were chosen by a classical trial and error two stage process: in a first step, those variable were identified which due to economic reasoning were supposed to

[2] Germany is the limiting Member State, whose series on GDP on the basis of ESA95 starts only with the quarter after reunification. However, some improvements in this respect are planned, and the Eurostat Action plan foresees for 2002 the compilation of aggregate GDP figures starting in 1981.

[3] The use of dummy variables and seasonal autoregressive error specification were tested. In particular the latter addresses quite effectively the volatility in the series. However, their overall performance was not conducive to the extension of the sample period.

show a close correlation to the dependent variable, either coincident or lagged. The second step consisted in retaining those variables that delivered the best test results.

The box below givens the description, name, units and sources of the time series used.

Series

Name	Series description	Unit of series	Underlying series				
			Unit	Frequency	s.a.	Source	Release date (approximat.)
GDP_Q	**Gross domestic product**, in 1995	percent	95 Bn. EUR	quarterly	yes	Eurostat	T+70 (1st
CAR_Q	Initial **car registrations**, EUR-12, quarterly average	percent	number of units	monthly	yes	ACEA	end of following month
RETAILPRB_D	Business surveys, **retail present business situation**, euro area, balance of positive and negative answers, quarterly average by shifting one month forward (e.g. 2nd qu. 2001: Mar - May 2001)	points	balance	monthly	yes	ECFIN	1st week of follwing month
CONSTRUCT_D	Business surveys: **construction confidence** indicator, euro area, quarterly average	points	balance	monthly	yes	ECFIN	1st week of following month
NAPM_D	**US National Association of Purchasing Managers Index** (Manufacturing), quarterly average	points	balance	monthly	yes	NAPM	beginning of following month
NAPMA_D	see above, but quarterly average calculated by first two months only			monthly			
SPREAD_D	**German interest spread - US interest spread**, quarterly average	percent	percent	daily	no	(calculated)	daily
(DEU long-term interest rates - DEU short-term interest rates) - (US long-term interest rates - US short-term interest rates)							
- German long-term rates: 10- year government bond yields					no	Datastream	daily
- German short-term rates: 3 month money market rates					no	Datastream	daily
- US long-term interest rates: 10-year government bond yields					no	US Fed	daily
- US short-term interest rates: 3-month T bill rates					no	US Fed	daily
REER_Q	**Real effective exchange rate**, deflated by export deflator for goods and services	percent	percent	quarterly	no	ECFIN	

Suffix: quarterly change

D absolute change vis-à-vis previous quarter (t - t-1)

QOQ relative change vis-à-vis previous quarter in percent ((t - t-1)/t-1 * 100)

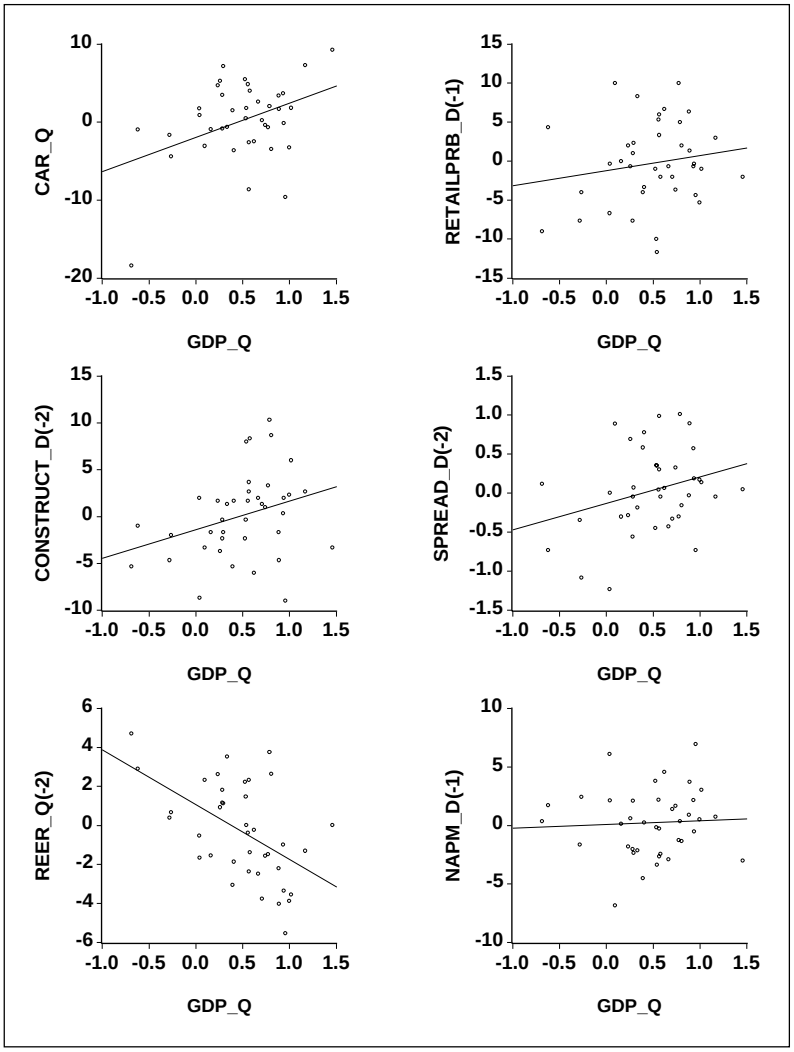
The seasonally adjusted car sales were derived by seasonally adjusting the non-seasonally adjusted monthly series by the ACEA, using the multiplicative version of the Census X-11 method. The next two variables, on the assessment of the present business situation in the retail sector and the construction confidence indicator, stem directly from the monthly ECFIN business surveys. The seasonally adjusted US NAPM index is directly provided by the US National Association of Purchasing Managers. The series on the difference between the yield spreads of Germany[4] and the US are calculated on the basis of quarterly averages

[4] Alternatively estimates were carried out, using EUR-12 GDP weighted averages instead of German rates. The estimate results were somewhat inferior to the ones using the German rates. This is probably due to the fact that German rate spreads were less affected by the EMS currency turmoils in the early nineties and the fact that in some euro area Member States in the beginning of the nineties still some controls on short-term capital movements were in place. Furthermore, in the run-up to EMU interest rate developments may have

of daily data provided by Datastream. The real effective exchange rate is calculated by ECFIN. It is calculated vis-à-vis 12 other, double-export weighted, industrialized countries by using the respective export deflators for goods and services[5].

Annex 1 contains the values for the regressors, as well as some series statistics and partial correlation coefficients between the series.

Furthermore, the Annex contains the results of the Philips-Perron unit root tests[6] in the regressors. According to these, the null hypothesis of unit roots in the series can be rejected for all variables with 99 % probability. In other words, all the series are stationary. These series are all in absolute or relative first differences of the underlying original series. Non-stationarity for the underlying series can be rejected. This is one of the reasons why this specific approach with differences rather than levels was chosen.



The partial correlation of those variables used as regressors in the equations below with quarterly GDP growth is generally not very strong (see chart to the right). The strongest correlation exists for car sales (positive) and real effective exchange rates (negative). The other variables have a much weaker isolated correlation with GDP quarterly growth, and the US Purchasing Managers index hardly any at all. However, jointly, as described below, they yield a significant influence.

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been driven more by expectations surrounding this event rather than reflecting expectations about real economic activity.

[5] See for these data DG ECFIN's quarterly "Price and Competitiveness report" which can also be found on DG ECFIN's website.

[6] The augmented Dickey-Fuller comes to the same conclusion.

The Granger causality test applied on the relationship between GDP growth and the independent variables gives a similar picture. The null hypothesis of no Granger causality from the independent variables on the dependent variable can be rejected with reasonable probability, except for the retail sales. The complete set of pairwise Granger causality tests between all regressors is given in Annex 1.

Granger Causality Tests

Sample: 1991:2 2000:4

Lags: 4

Null Hypothesis: Variable does not Granger cause GDP_Q

Variable	F-Statistic	Probability
CAR_Q	2.035	0.115
RETAILPRB_D	0.261	0.901
CONSTRUCT_D	2.269	0.085
SPREAD_D	1.714	0.173
REER_Q	3.380	0.021
NAPM_D	2.717	0.048

2.4. EURO AREA

The estimates apply to the area of 12 Member States, forming the euro area since 1 January 2001, after the admission of Greece. In other words, for the estimates, both for the dependent variable as well as the independent variables applying to the euro area (car sales, retail survey - present business situation, construction confidence indicator, real effective exchange rate) the respective time series applying to the euro area in the present scope (EUR-12) were used, including for the period before 1 January 2001, when the euro area was composed of only 11 Member States.

2.5. DATA AVAILABILITY AND FORECAST TIMING

The paper presents a set of equations that allow the forecast of the quarterly GDP change for the "coincident quarter" and the "quarter ahead" at all instants of the cycle of data releases.

"Coincident quarter" describes that quarter for which no official Eurostat release has been made yet. Due to the usual lags this could actually mean the previous calendar quarter (at present the "coincident quarter" is the 1st quarter 2001). Consequently, "one quarter ahead" is defined as the quarter following the coincident quarter.

The "roll-over" of quarters (e.g. from "quarter ahead to "coincident quarter") occurs therefore at the time when a first official Eurostat estimate for a respective quarter is released (around 70 days after the end of the respective quarter).

During the 3 months between two official releases of two consecutive quarters obviously independent data for further months or quarters become gradually available which have not necessarily been available at the first release for a given quarter.

Therefore, for the two estimates of the coincident quarter and the quarter ahead no two unique equations are necessarily the best estimate approach for different times of estimates. This paper looked at possible equations for best forecasts of the two quarters at all three release dates for the GDP of one quarter, that is 70 days, 100 days and 120 days after a quarter.

DATA AVAILABILITY AND FORECASTS

Time		Data availability[1]		Estimate equations for …	
Quarter / month	*Day*	*GDP*	*independent variables*	*coincident quarter*	*quarter ahead*
Quarter T / month 1	1		interest rates previous month		
	2				
	3		survey indicators[2] previous month		
	↓				
	10	**2nd release T-2**		**Coincident quarter equation: GDP quarter T-1**	**Quarter ahead equation: GDP quarter T**
	↓				
	29		car sales prev. month		
	↓				
	30				
Quarter T / month 2	**31**	**3rd release T-2**	interest rates previous month	**Coincident quarter equation: GDP quarter T-1**	**Quarter ahead equation: GDP quarter T**
	32				
	33		survey indicators previous month		
	↓				
	59		car sales prev. month		
	60				
Quarter T / month 3	61		interest rates previous month		
	62				
	63		survey indicators previous month		
	↓				
	70	**1st release T-1**		**Quarter ahead equation: GDP quarter T**	**Adapted quarter ahead equation: GDP quarter T+1**
	↓				
	89		car sales prev. month		
	90				

1: Dates for data releases are indicative and approximate only
2: Retail sector present business situation, construction confidence indicator, US NAPM index

As will be seen below, it turned out as a result of this search process, rather than as an a priori condition, that instead of 6 (2 * 3) different equations, only three different equations are used and turned out to be superior than other possible specifications, which might have even allowed the use of additional information: the two basic equations for the coincident quarter ("coincident quarter equation") and the quarter ahead ("quarter ahead equation") can be used at the time of the 2nd and the 3rd Eurostat GDP release. Only at the time of the 1st release, independent variables are not yet fully available, in order to allow forecasting based on these equations. Hence, for the coincident quarter, the equation for the quarter ahead is used, whereas for the quarter ahead, the original quarter ahead equation is slightly

adapted in order to reflect the partial lack of data at that time ("adapted quarter ahead equation").

At the time of the finalization of this paper, mid May 2001, the 3rd Eurostat estimate for the 4th quarter 2000 was released. Therefore, the forecasts for the 1st and 2nd quarter of 2001 are indeed based on the "standard set" of equations, the coincident quarter equation (for the 1st quarter 2001) and the (regular) quarter ahead equation (for the 2nd quarter of 2001).

3. COINCIDENT QUARTER ESTIMATE

3.1. ESTIMATES

As mentioned above, "Coincident quarter" describes that quarter for which no official Eurostat release has been made yet. Due to the usual lags this could actually mean the previous calendar quarter (at present the "coincident quarter" is the 1st quarter of 2001).

For the GDP change in the coincident quarter the following estimate was derived:

Coincident quarter equation

Dependent Variable: GDP_Q
Method: Least Squares
Backcast: 1990:2 1991:1
Sample(adjusted): 1991:2 2000:4
Included observations: 39 after adjusting endpoints

Variable	Coefficient	t-Statistic	Prob.		
CAR_Q	0.015	2.78	0.009	R-squared	0.88
RETAILPRB_D(-1)	0.010	1.86	0.072	Adjusted R-squared	0.85
CONSTRUCT_D(-2)	0.048	6.07	0.000	S.E. of regression	0.18
SPREAD_D(-2)	0.314	4.47	0.000	Durbin-Watson stat	1.89
REER_Q(-2)	-0.088	-7.45	0.000	F-statistic	31.99
NAPM_D(-1)	0.047	5.71	0.000		
C	0.360	6.97	0.000		
MA(4)	0.960	7379.86	0.000		

Numbers in brackets ( ) after variables: number of quarterly lags in the variable

In other words, the estimated equation takes the form

GDP_Q = 0.015*CAR_Q + 0.01*RETAILPRB_D(-1) + 0.048*CONSTRUCT_D(-2)
+ 0.314*SPREAD_D(-2) - 0.088*REER_Q(-2) + 0.047*NAPM_D(-1) + 0.36
+ MA error term (see below)

3.2. DISCUSSION OF THE EQUATION

Variables

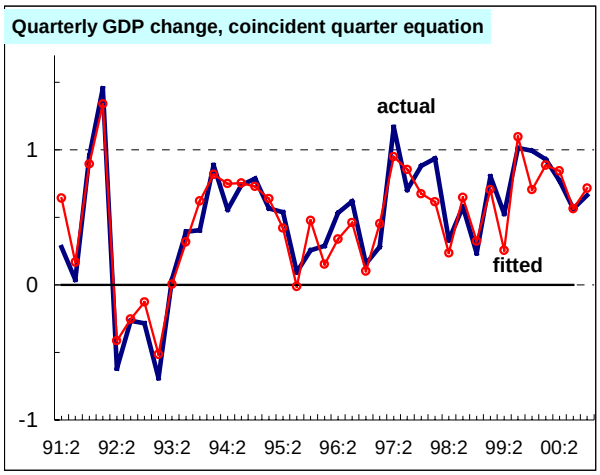
The estimate is based on a mix of variables describing real economic activity, or its assessment, on the one hand, and variables describing financial markets activity on the other hand. Their respective contribution to the explanation of GDP change is discussed further down.

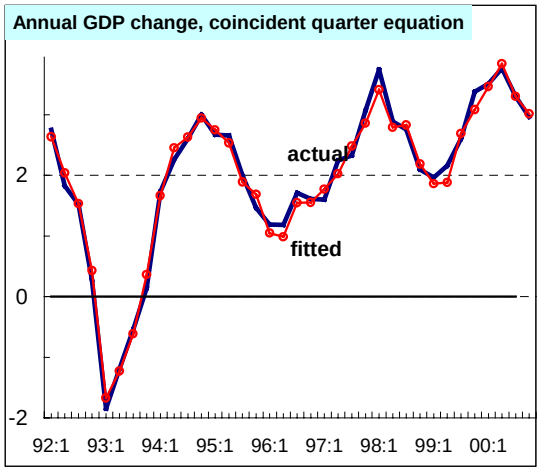
It is noteworthy that, with the exception of car sales, no independent variable coincides with the dependent variable. This was no a priori restriction on the identification of a well performing equation but the result of a search. However, as to be discussed further below, it allows a specification of an equation for the quarter ahead which follows the basic structure of the equation for the present quarter.

The equation underlines the importance of international economic and financial links for the development of the euro area GDP, by the US NAPM index as explanatory variable, the spread variable, which is a the difference of the spreads between Germany and the US and the real effective exchange rate. As regards the spread, a simple variable of the euro area or German spread did not show any significance in this context.

Correlation coefficient, F-test

The estimated values have a correlation coefficient of 88 %. The F-statistics, with 32.2, shows a significant contribution of the independent variables to the explanation of the dependent variables.





Estimates and actual results

The estimates derived from this equation give a quite close fit with actual data (see charts). The forecasts showed a relatively high error in the 2nd quarter of 1996, which marked the slowdown following the Mexico crisis.

MA process

The MA(4) term[7] describes a moving average process in the error term.

The specification includes a so-called MA(4) term. It describes the fact that the model to be estimated was specified in the sense that the residuals in one period are a linear function of the residuals of four quarters back.

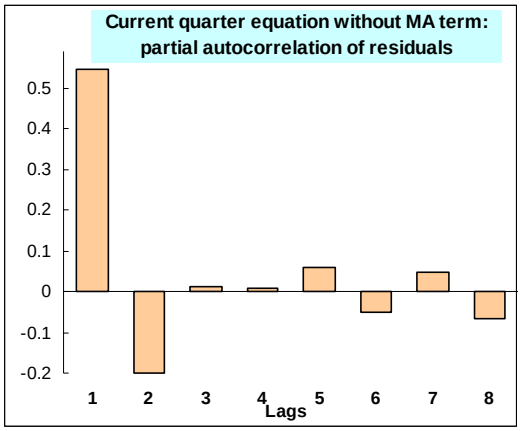
In other words, the error term υ_t is a linear function of the error term four quarters back.
$\upsilon_t = \varepsilon_t + \omega * \varepsilon_{t-4}$

The model estimated this relationship as
$\upsilon_t = \varepsilon_t + 0.96\ \varepsilon_{t-4}$

Thus, the model takes the form of
$Y_t = \beta * X_t + \varepsilon_t + 0.96\ \varepsilon_{t-4}$

The t-test statistics suggests that the parameter estimate for ω of 0.96 is highly significant.

The main reason for the significance of that specification of the error term probably lies in the seasonality structure of the model, a mix of seasonally adjusted (real variables) and not seasonally adjusted (financial variables) independent variables. Furthermore, it might not be excluded that this term also picks up some remaining sesonality in the dependent variables. The latter is in principle seasonally adjusted, but by individual Member States with different methods.



The model specification and estimation without the MA error term shows persistent autocorrelation and partial autocorrelation in the residuals (see chart) which also suggests that such a specification without the MA term is not fully correct.

For the estimation of the parameters a backcast procedure of residuals[8] is used, "backcasting"

[7] With only one lagged error term, the process cannot be described anymore as "average" forming. Nevertheless the expression is used, as it is an extreme form of true MA processes.

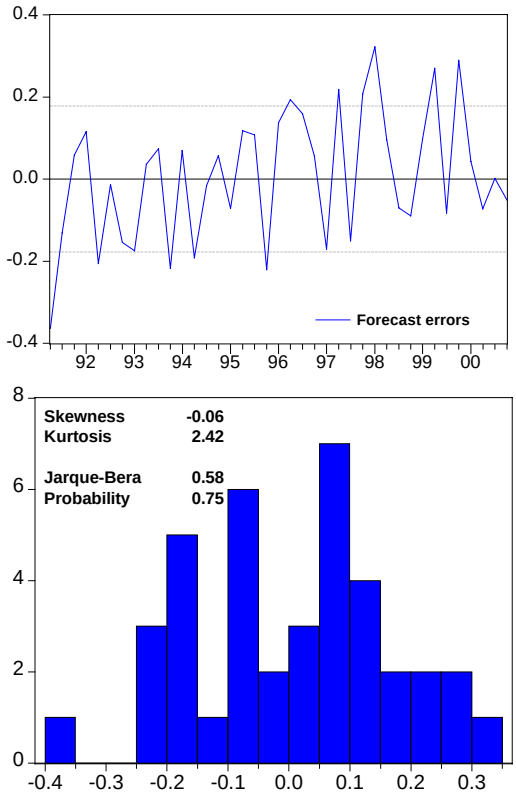
[8] The backcast procedure is the following:

(1) With initial values for the variable parameters and the MA(4) parameter unconditional residuals for t = 1 ,..., T are computed. From these, residuals for the periods preceding the sample period are calculated by backward recursion.

(2) A forward recursion is used to estimate the values of the error terms at the beginning of the sample period, with the use of the backcast error terms before the sample period.

(3) The sum of squared residuals (SSR) is formed as a function of the variable parameters and the MA(4) parameter, using the fitted values of the lagged innovations. This expression is minimized with respect to the variable parameters and the MA(4) parameter.

the residuals for that period before the actual sample, which, according to the model specification influences via its error terms the sample period.



Distribution of the error

For a good fit and a reliable forecast, the residuals from the regression should be small and normally distributed random variables having a zero mean. It is the case, although in the first half of the nineties there may be a slight tendency to overestimate, while in the second half, there could be some underestimation, but it remains within the 1 standard error margin.

Absence of skewness (no fat tails) and kurtosis below 3 (no peakedness in the distribution) suggest a normal distribution and the Jarque-Bera test point in the same direction, but the sample is small.

3.3. DISCUSSION OF THE PARAMETERS

Parameters, t-test

All estimated parameters are significant at least at 95%, except for the retail sector variable. The parameters have the a-priori expected sign: GDP growth is positively correlated to the change in the assessment in retail and construction and to the change in car sales, as well as the spread difference between Germany and the US and the assessment of US purchasing mangers of the US economy. A negative correlation is found for the real effective exchange rates, a real appreciation for the euro area leads with a lag of several months to a slowdown of growth.

The parameter estimate for the MA process is 0.96. It is thus close to one. A unit root of one would indeed point to a random walk in the error term and, henceforth, a misspecification of the model and the breakdown of the assumptions made for this estimate method.

However, the standard error of this parameter estimate is very small and the range of one standard error around the parameter point estimate clearly excludes the value of one. More formally, the Wald test on this parameter being one clearly rejects this hypothesis of unit roots.

Steps 1 to 3 are repeated until the estimates converge.

3.4. RELIABILITY OF THE FORECAST

There are several ways to assess the degree of reliability or, with other words, the unavoidable uncertainty surrounding every prediction. Below they are regrouped under three headings: quantitative error indicators, qualitative error indicators and the error compared to alternative prediction procedures.

Quantitative error indicators

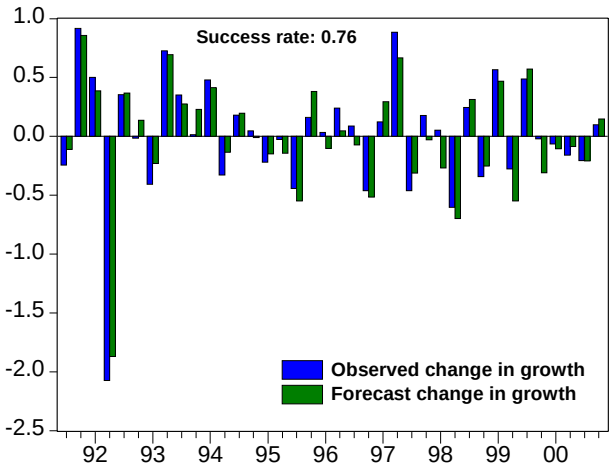
A straightforward error indication is the mean absolute forecast error: 0.13 can be considered small. The root mean squared error penalises large prediction mistakes and is 0.16. The mean squared error can be decomposed in a bias and variance proportion which represent systematic errors and should be as small as possible. The random errors are in the covariance proportion and should ideally account for 100 % of the error. These in-sample error statistics can be considered acceptable.

A real-life error is, however, better mimicked with an out-of-sample testing procedure. In this case a one step ahead forecast is made based on a regression run on a moving sub-period of the total sample. The first sub-period goes until 1997q4 and the last until 2000q3. It permits to perform 12 one-step forecasts and calculate the out-of-sample accuracy. The so calculated mean absolute error is not different from the in-sample corresponding statistic, while the root mean squared error only slightly increased.

In-sample forecast error statistics	
Mean absolute error	0.13
Root mean squared error	0.16
Mean squared error decomposition	
Bias proportion	0.00
Variance proportion	0.11
Covariance proportion	0.89
Out-of-sample forecast error statistics	
Mean absolute error	0.13
Root mean squared error	0.19
(Out-of-sample: 1998q1 to 2000q4)	

Qualitative error indicators: the success rate

Often one is less interested in the quantitative point estimate and its error margin, but more in directional accuracy as it gives an indication on the reliability of a predicted acceleration or deceleration of GDP growth. The success rate is 76 %, which can be considered good, given the high volatility of the underlying series.



This success rate was obtained following a severe approach. A situation like in 1995q2, when a 0.03 percentage point deceleration was forecast correctly as far as the sign was concerned by a 0.14 % percentage point deceleration, was nevertheless marked as a

failure. The observed deceleration of 0.03 % was rounded to suggest no change in growth. A less strict approach would result in a success rate of 84 %.

The errors in the quarterly GDP forecast occurred mainly in 1996 and 1997, in the aftermath of the Mexico crisis. During the emerging market crisis of 1998/99 the foreseen GDP dynamics proved to be better.

Directional accuracy in 1996 and 1997				
	Q1	Q2	Q3	Q4
1996				
Observed change	0.04	0.24	0.09	-0.46
Predicted change	-0.10	0.05	-0.07	-0.52
1997				
Observed change	0.12	0.89	-0.46	0.18
Predicted change	0.30	0.67	-0.31	-0.03

Naïve alternative forecasts

Outperforming naïve alternative forecasting procedures is a minimum quality requirement.

The root mean squared error of the present approach is compared to the ones obtained from three simple prediction rules. These are: a no-change forecast, a forecast based on the mean and a forecast based on a simple autoregressive scheme[9]. The smaller the ratio of the root mean squared errors, the greater the accuracy compared to the alternative forecasting procedures. If the ratio is larger than one, the forecast error of the alternative procedure is smaller than the one obtained in the present approach. This does not appear to be the case.

Root mean squared error compared to	
No-change forecast	0.24
Average forecast	0.34
Autoregressive forecast	0.57

3.5. SENSITIVITY OF GDP FORECAST TO THE EXPLANATORY VARIABLES

The influence of changes in the real or financial indicators can be inferred from the estimated elasticities[10].

Sensitivity of GDP forecast: coincident quarter						
	Car sales	Retail sector Pres. Bus. Sit.	Construction Conf. Ind.	(iltD-istD) – (iltUS-istUS)	REEREXP	NAPM
	Impact on quarterly GDP growth rate of change in indicator					
1 % point change	0.02	0.01	0.05	0.31	-0.09	0.05
1 mean absolute change	0.09	0.06	0.21	0.13	-0.21	0.13
1 standard deviation	0.08	0.05	0.22	0.17	-0.22	0.13
Lag in quarters	0	1	2	2	2	1
	Pro memori					
Mean absolute change	5.94	6.10	4.36	0.41	2.42	2.72
Standard deviation	5.03	5.37	4.51	0.53	2.49	2.85
Largest quarterly decrease	-16.76	-15.00	-11.33	-0.87	-6.36	-9.93
Largest quarterly increase	19.25	21.67	9.33	0.78	6.86	8.10

In order to understand the table, take as an example the interest rate spread. It is estimated that a one percentage point increase of the European yield differential above the US one

[9] The scheme contains a 4-quarter autoregressive term and a 4-quarter moving average term.

[10] In the case of the variables in first differences (the interest rate spread and the survey opinions) it is a partial elasticity as the shock has to be interpreted as a percentage point change rather than as percentage change

increases quarterly GDP by 0.31 % after two quarters. However, a one percentage point change in the "double" spread is a rare event. In the nineties the largest quarterly decline was 0.87 percentage point and largest increase was 0.78. Therefore, simulations based on the mean absolute quarterly change or the standard deviation are a better indication of the average impact.

4. EQUATION FOR ONE QUARTER AHEAD

4.1. ESTIMATES

As mentioned above, "one quarter ahead" denotes the quarter following the coincident quarter. For GDP change in the quarter ahead the following estimate was derived:

Quarter ahead equation

Dependent Variable: GDP_Q
Method: Least Squares
Backcast: 1990:2 1991:1
Sample(adjusted): 1991:2 2000:4
Included observations: 39 after adjusting endpoints

Variable	Coefficient	t-Statistic	Prob.		
RETAILPRB_D(-1)	0.009	1.47	0.150	R-squared	0.85
CONSTRUCT_D(-2)	0.047	5.40	0.000	Adjusted R-squared	0.82
SPREAD_D(-2)	0.248	3.61	0.001	S.E. of regression	0.19
REER_Q(-2)	-0.109	-10.36	0.000	Durbin-Watson stat	1.68
NAPM_D(-1)	0.044	5.04	0.000	F-statistic	30.08
C	0.345	6.09	0.000		
MA(4)	0.960	8134.21	0.000		

Numbers in brackets ( ) after variables: number of quarterly lags in the variable

In other words the estimated equation takes the form

GDP_Q = 0.009*RETAILPRB_D(-1) + 0.047*CONSTRUCT_D(-2) + 0.248*SPREAD_D(-2)
- 0.109*REER_Q(-2) + 0.044*NAPM_D(-1) + 0.345 + MA error term

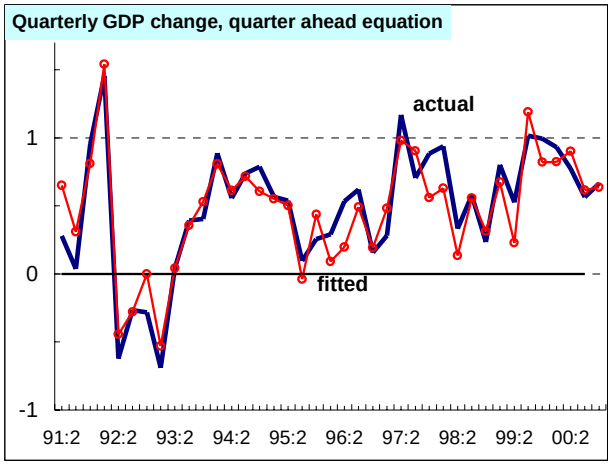
4.2. DISCUSSION OF THE EQUATION

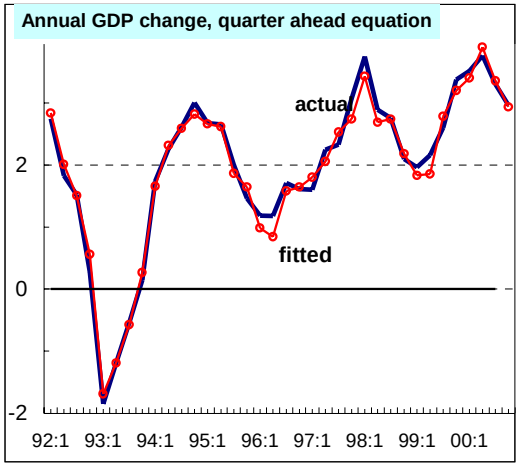
Correlation coefficient, F-test

The estimated values have a correlation coefficient of 85 %. The F-statistics, with 30.1, shows a significant contribution of the independent variables to the explanation of the dependent variables

Estimates and actual results

The estimates derived from this equation equally give a quite close fit with actual data (see charts). As for the first equation, the forecast errors are the relatively highest in the 2nd quarter of 1996 during the slowdown following the Mexican financial crisis.



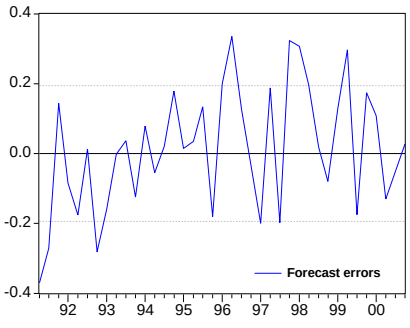


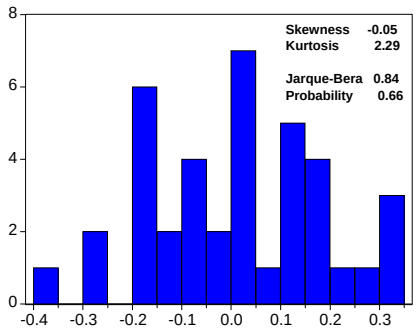
MA process

The MA process was specified as in the equation for the coincident quarter and lead again to a very significant contribution to the quality of the estimates. The estimated parameter for the relationship of the present quarter residual with the one of four quarters back is the same as in the coincident quarter estimate.

Distribution of the error

The residual chart and the histogram give a similar message of randomly and normally distributed forecast errors.





4.3. DISCUSSION OF THE PARAMETERS

Parameters, t-test

With the exception of the variable for the retail sector, all estimated parameters are significant at least at 95%. The parameters have, as in the equation for the present quarter, the a-priori expected sign: GDP growth is positively correlated to the change in the assessment in retail and construction, as well as the spread difference between Germany and the US and the assessment of US purchasing mangers of the US economy. A negative correlation is found for the real effective exchange rates, a real appreciation for the euro area leads with a lag of several months to a slowdown of growth.

Most parameters have furthermore a very similar magnitude to those in the present quarter equation. Only the parameter for the spread is somewhat lower and the one for the real effective exchange rate moderately higher than the ones in the coincident quarter equation.

Variables

The variables are the same as in the coincident quarter estimate, with the exception of the car sales, which were dropped and not replaced by any other variable. Thus the quarter ahead equation has one independent variable less than the present quarter equation.

This fact that the variables are a subset of the coincident quarter equation was not a precondition imposed but the result of an independent search for two different appropriate equations for both quarters.

4.4. RELIABILITY OF THE FORECAST

Using the same techniques, the reliability of the quarter ahead forecast deteriorates somewhat compared to the one of the coincident quarter.

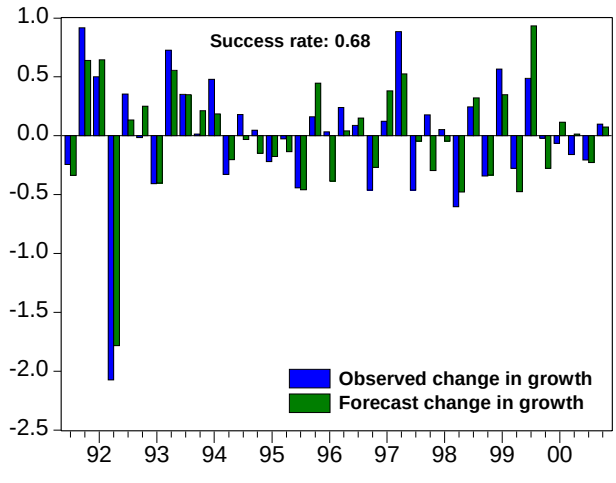
Quantitative error indicators

Compared to the coincident equation, the mean absolute error and the root mean squared worsen only marginally, while the variance proportion in the mean squared error decomposition even improves a bit. However, the out-of-sample error statistics point to a worse forecast performance.

In-sample forecast error statistics	
Mean absolute error	0.15
Root mean squared error	0.18
Mean squared error decomposition	
Bias proportion	0.00
Variance proportion	0.06
Covariance proportion	0.94
Out-of-sample forecast error statistics	
Mean absolute error	0.26
Root mean squared error	0.35
(Out-of-sample: 1998q1 to 2000q4)	

Qualitative error indicators: the success rate

The success rate drops to 68 % in predicting correctly acceleration/deceleration from the previously forecasted quarter. If a less severe rounding approach would be followed, the success rate would be 79 %.



The success rate in forecasting the dynamics correctly in two successive quarters is 52 % (= 0.76 x 0.68). This score has to be appreciated against a success rate of only 25 % (= 0.50 x 0.50) obtained by simple coin flipping in both quarters as a forecasting strategy.

Naïve alternative forecasts

Also for the quarter ahead equation, naïve alternative forecasting procedures are worse. The deterioration in the quality of the auto-regressive scheme, compared to the

Root mean squared error compared to	
No-change forecast	0.24
Average forecast	0.39
Autoregressive forecast	0.33

coincident equation, may not come as a surprise as it involves a two-step ahead dynamic forecast. It is explained by the influence of the forecast error made in the coincident quarter on the prediction. The small improvement of the average forecast, compared to the coincident quarter, can be rationalised by the performance of the mean as a predictor when the forecast horizon lengthens

4.5. SENSITIVITY OF GDP FORECAST TO THE EXPLANATORY VARIABLES

Over longer forecasting horizons real variables become less important, while financial variables increase in importance. The variable on car sales has been dropped from the equation and the parameters for the other real indicators marginally declined. The elasticity of the yield spread also decreased, but the exchange rate elasticity increased, further enhancing the influence of that variable in the determination of the GDP forecast.

Sensitivity of GDP forecast: one quarter ahead						
	Car sales	Retail sector Pres. Bus. Sit.	Construction Conf. Ind.	(iltD-istD) - (iltUS-istUS)	REER	NAPM
	Impact on quarterly GDP growth rate of change in indicator					
1 % point change	-	0.01	0.05	0.25	-0.11	0.04
1 mean absolute change	-	0.05	0.20	0.10	-0.26	0.12
1 standard deviation	-	0.05	0.21	0.13	-0.27	0.12
Lag in quarters	-	1	2	2	2	1
	Pro memori					
Mean absolute change	-	6.10	4.36	0.41	2.42	2.72
Standard deviation	-	5.37	4.51	0.53	2.49	2.85
Largest quarterly decrease	-	-15.00	-11.33	-0.87	-6.36	-9.93
Largest quarterly increase	-	21.67	9.33	0.78	6.86	8.10

5. ADAPTED QUARTER AHEAD EQUATION

As explained above, the standard quarter ahead equation cannot be used for estimates in certain periods during the year: after the first release of a Eurostat GDP estimate, the quarter ahead equation is used for forecasting GDP two quarters later than the quarter for which Eurostat released data. However, for around 3 to 4 weeks the US NAPM index necessary for doing so is not available yet. Hence, for estimates during this period, the NAPM quarterly values are calculated by only using the respective first two months of a quarter. For example the NAPM index for the 2nd quarter of 2001 would be the average of the values for April and May 2001, instead of the average of April - June, as used in the standard quarter ahead equation. For all the other variables the same specification as in the standard quarter ahead equation is used. The thus adapted equation is called in this paper the Adapted quarter ahead equation.

The table below gives the test results for this equation.

Adapted quarter ahead equation

Dependent Variable: GDP_Q — Sample(adjusted): 1991:2 2000:4
Method: Least Squares — Included observations: 39 after adjusting endpoints
Backcast: 1990:2 1991:1

Variable	Coefficient	t-Statistic	Prob.		
RETAILPRB_D(-1)	0.011	1.82	0.078	R-squared	0.85
CONSTRUCT_D(-2)	0.041	4.78	0.000	Adjusted R-squared	0.82
SPREAD_D(-2)	0.252	3.70	0.001	S.E. of regression	0.19
REER_Q(-2)	-0.104	-9.87	0.000	Durbin-Watson stat	1.53
NAPMA_D(-1)	0.045	5.21	0.000	F-statistic	30.82
C	0.345	6.17	0.000		
MA(4)	0.960	8069.07	0.000		

Numbers in brackets ( ) after variables: number of quarterly lags in the variable

The parameter estimates are significant and very similar to the standard quarter ahead equation (see previous section). Therefore, only the estimate results for this equation are given here.

6. FORECASTS

6.1. 1ST QUARTER OF 2001

Forecast

Based on the coincident equation, the forecast for the quarter-on-quarter GDP change in the 1st quarter of 2001 amounts to 0.34 %, which is a sharp deceleration from the last quarter of 2000. Compared to the same quarter of last year, the growth rate is still 2.4 %.

Forecast uncertainty and stability

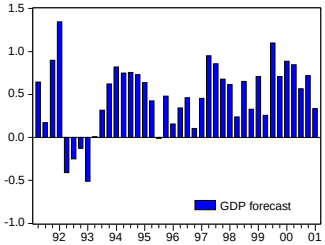
Several statistics can be used to give expression to the unavoidable forecast uncertainty. The standard error of the regression, which is 0.18, allows calculating confidence intervals around the point forecast. The 95 % confidence interval (= 2 standard errors) gives for 2001q1 a forecast range of –0.02 % to 0.70%. A forecast range based on the mean absolute error is smaller, but no probability can be attributed to it. The success rate of 76 % in forecasting acceleration/acceleration permits to evaluate the suggestion of a strong drop in economic dynamism in the beginning of 2001.

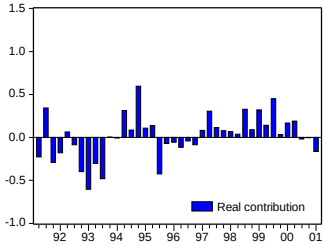
Forecast stability and sample size

Sample	Forecast 2001q1
91q2 - 00q4	0.34
91q2 - 00q3	0.32
91q2 - 00q2	0.33
91q2 - 00q1	0.34

The stability of the forecast can be assessed by redoing the regression on a sub-sample and comparing the so derived predictions with those of the full sample. Stability requires that

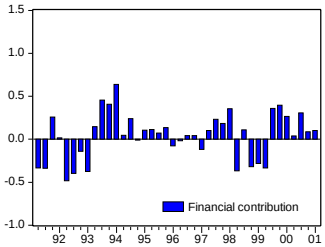
there is not a significant difference. In consequence, predictions based on different sample periods will be similar. This appears to be the case.

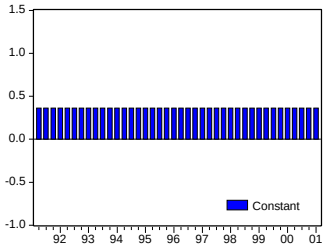


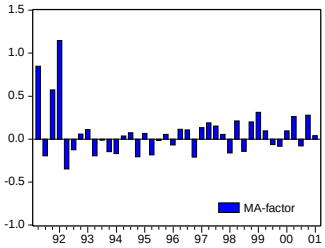


Contribution of different variables to change in GDP

In order to have an idea of the driving forces underlying the quarterly growth rate, it is useful to regroup the relevant regressors in real and financial variables.







The present situation in the retail sector, the construction confidence indicator and the index of the US National Association of Purchasing Managers are lumped together to represent the influences coming from the real sector. The difference between the European spread (represented by the German one) and the US spread on the one hand and the real effective exchange rate (based on export prices) on the other hand, represent the financial impulses.

The importance of the constant for the final result is big and, by definition, does not vary. The graphs would suggest a marginally larger contribution from the financial indicators than from the real variables in shaping the quarterly growth rate. The MA-factor appears to be smaller, leaving apart a few large numbers in the early nineties, which may be due to estimating problems linked to the beginning of the sample when the described backcasting procedure was used. With respect to the last quarter of 2000 and the first quarter of 2001, one observes the waning positive contribution from the real side, while mainly the financial signals supported growth.

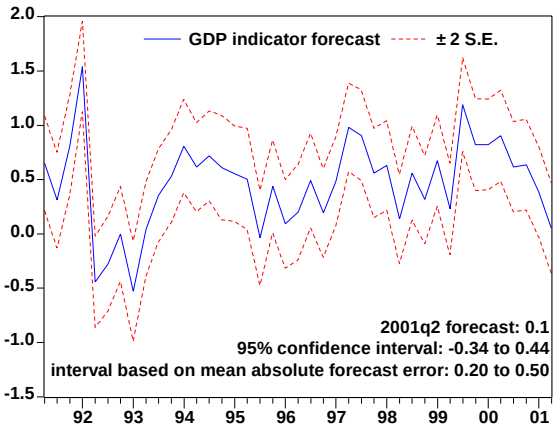
Contributions to quarterly GDP growth in 2000and 2001

	Q1	Q2	Q3	Q4	average
2000					
GDP forecast	0.89	0.84	0.56	0.72	0.75
Real contribution	0.17	0.19	-0.02	-0.01	0.08
Fin. contribution	0.27	0.04	0.30	0.08	0.17
Constant	0.36	0.36	0.36	0.36	0.36
MA-factor	0.09	0.26	-0.08	0.28	0.14
2001	*forecast*				
GDP forecast	0.34				
Real contribution	-0.17				
Fin. contribution	0.10				
Constant	0.36				
MA-factor	0.04				

6.2. 2ND QUARTER OF 2001

Forecast

Based on the quarter ahead equation, economic activity would further decelerate; the point estimate is 0.05 % for quarterly GDP growth. The growth rate compared to the same quarter of last year is 1.6 %.



Forecast uncertainty and stability

The standard error of the regression is 0.19 and allows calculating a 95 % confidence interval around the point forecast for 2001q2 from –0.34 % to 0.44%. The forecast range based on the mean absolute error is smaller, but no probability can be attributed to it. As the less good quarter ahead equation is used to forecast, the success rate in predicting acceleration/deceleration declines to 68 %.

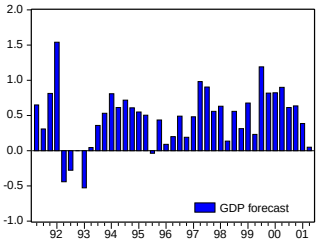
Forecast stability and sample size

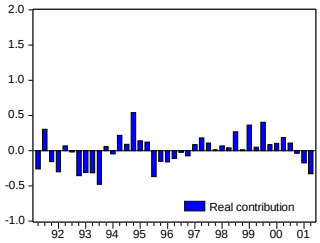
Sample	Forecast 2001q2
91q2 - 00q4	0.05
91q2 - 00q3	0.11
91q2 - 00q2	0.01
91q2 - 00q1	-0.03

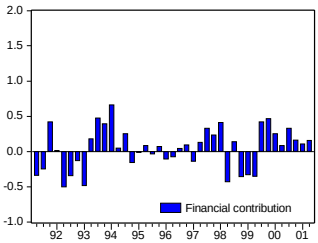
Re-doing the regression on a sub-sample, results in forecasts that are stable, but somewhat lower than the one from the full sample.

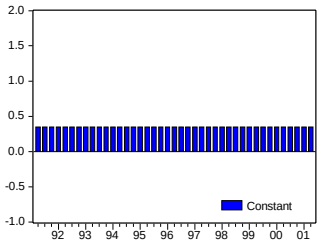
Contribution of different variables to change in GDP

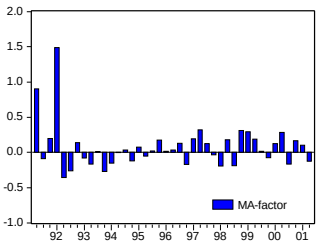
As the equation for one quarter ahead is not very different from the coincident quarter, the contribution from the various











Contributions to quarterly GDP growth in 2000 and 2001

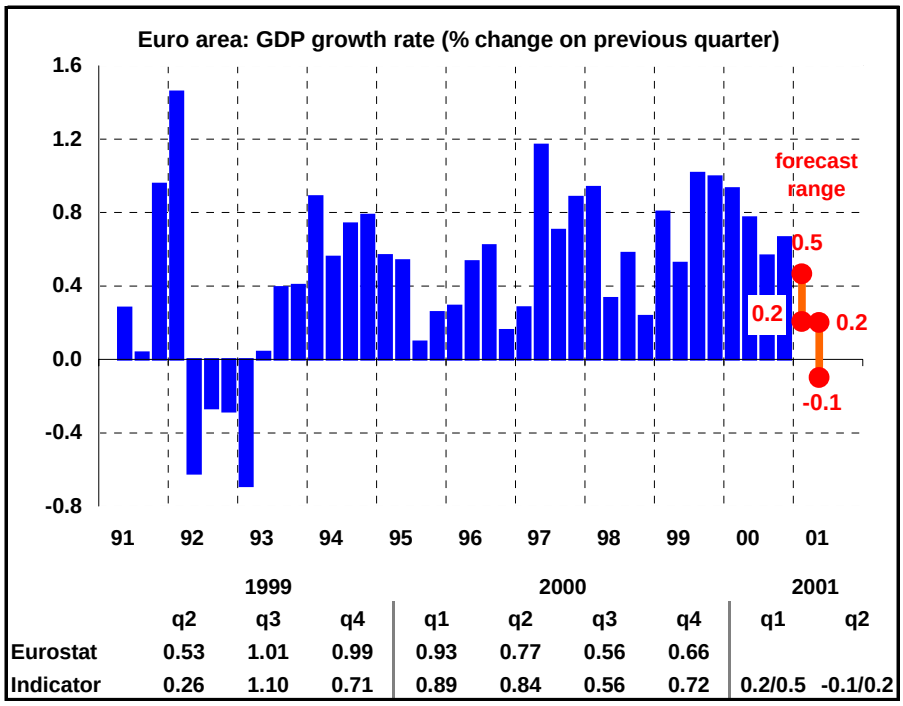
	Q1	Q2	Q3	Q4	average
2000					
GDP forecast	0.82	0.90	0.62	0.64	0.74
Real contributior	0.10	0.19	0.11	-0.04	0.09
Financial contr.	0.25	0.09	0.33	0.16	0.21
Constant	0.34	0.34	0.34	0.34	0.34
MA-factor	0.12	0.28	-0.17	0.17	0.10
2001	*forecast*				
GDP forecast	0.38	0.05	-	-	-
Real contributior	-0.17	-0.33	-	-	-
Financial contr.	0.11	0.16	-	-	-
Constant	0.34	0.34	-	-	-
MA-factor	0.10	-0.13	-	-	-

variables will be similar. Comparing the graphs presenting the influences coming from the real side and the financial side with the analogous graphs for the coincident quarter, differences are not obvious.

In the second quarter of 2001, the negative influence of the real side, mainly the deterioration of the business climate in the US, continued to increase.

6.3. APPLICATION TO THE PRESENT SITUATION

The above described estimate approaches and point estimates are subject to the indicated forecast errors. The present situation with a possible turning point is subject to additional uncertainty. Therefore, the estimates should, particularly for the present situation, be interpreted as giving a forecast range, rather than a point estimate. On the basis of the respective standard errors of regression the following conclusions can be drawn:



	1999			2000				2001	
	q2	q3	q4	q1	q2	q3	q4	q1	q2
Eurostat	0.53	1.01	0.99	0.93	0.77	0.56	0.66		
Indicator	0.26	1.10	0.71	0.89	0.84	0.56	0.72	0.2/0.5	-0.1/0.2

After a relatively strong year-end, the quarterly growth rate in the first quarter of 2001 is expected to fall into the range 0.2/0.5 %. The prediction range shifts further down to –0.1/0.2 % in the first quarter of 2001. The real side of the economy made the outlook bleaker, mainly as a consequence of the slowdown in the US, while financial conditions have continued to support activity. Given the specific phase of the business cycle, likely outcomes would rather be towards the top of these ranges.

7. POSSIBLE EXTENSION ON FURTHER QUARTERS AHEAD

Possible specifications to estimate the quarterly GDP change two quarters ahead would have to rely to a lesser degree on variables on the real activity, as most of these do not sufficiently lead GDP. They would, instead have to be based accordingly more on financial variables which normally do provide a sufficient lead over GDP growth.

First attempts in that direction lead to sufficiently good estimates with high correlation coefficients and low average forecast errors. However, these financial variables are relatively closely interrelated, which leads to problems of serial correlation of the errors and less stable forecasts. Further work will have to be devoted in order to reach sufficiently reliable forecasts for two quarter ahead.

8. COMPARISON TO OTHER FORECASTS

Several other researchers or groups of researchers have developed comparable single equation approaches in order to forecast EUR-12 GDP:

- an OLS estimate of annual GDP change of the OFCE together with 8 other European research institutes, the results of which are regularly published in the Financial Times,
- an autoregressive approach by researchers of the French INSEE,
- van Rooij, M.C.J. and A.C.J. Stokman of the Dutch Central Bank, who, however do not focus on the euro area, but on individual countries. They make forecasts for 7 Member States (B, D, E, F, I, NL, UK), aggregate them and present results for EU-7.

The approaches are not strictly comparable, due to differences in the dependent and independent variables and sample periods. Furthermore, not all relevant test information is available in order to do a thorough comparison, but the present specification performs well. The table in Annex 2 gives a more detailed comparison to the three other approaches.

Quarterly GDP forecasts: a comparison

Publi-cation	Final ization	Source	Type	2001 Q1	2001 Q2	2001 Q3	2001 Q4	2002 Q1	2002 Q2	2002 Q3	2002 Q4	Comment
Forecasts only based on estimated parameters												
-	30/04/01	PG/FK	qoq	0.3	0.1							
			yoy	2.4	1.6							
10/05/01	09/04/01	OFCE & C°	yoy	2.6	2.2							Commented in FT
			qoq	0.6	0.6							(Own calculation)
Forecasts including judgmental elements												
09/04/01	09/04/01	Consensus Forecasts	yoy	2.6	2.5	2.6	2.6	2.7	2.8	2.8	2.9	D, F, E, I, NL only (aggregation: ECFIN)
25/04/01	06/04/01	DG ECFIN	yoy	2.9	2.7	2.8	2.9	2.9	3.0	3.0	2.9	Spring 2001
			qoq	0.7	0.6	0.8	0.8	0.7	0.7	0.8	0.7	Forecasts

As a similar approach is followed, the forecast made by the OFCE is directly comparable to the above presented new short-term forecast. Both predictions point to a slowdown, but differ as to its extent and duration. According to the OFCE indicator, GDP growth stabilizes in the second quarter of 2001, while according to the new indicator, GDP decelerates sharper in the first quarter and continues to do so in the second quarter.

The message given by Consensus Forecasts is similar to the one of the OFCE. DG ECFIN's Spring 2001 Forecasts were released in April and suggest a stronger start in the current year.

Compared to some other approaches, less variables are used, and despite that, only a somewhat smaller correlation is observed, which points to a possibly overall higher F-statistic, and the standard errors seem slightly smaller. Furthermore, the problem of non-stationarity in some series has been fully eliminated. Hence, the indicated test statistics can be properly relied upon. The INSEE approach has lower correlation coefficients and higher standard errors, but they attempt to estimate also the components of GDP. The mean absolute errors in the Dutch Central Bank approach appear large, but their method allows going 4 quarters ahead.

ANNEX 1: REGRESSORS

Data

	Dependent variable	Independent variables						
	GDP	New car registrations (first two months per quarter)	Retail sector survey: pres. business situation	Consturction sector survey: confidence indicator	Difference DEU - US long-term/ short-term interest rate spreads	Real effective exchange rate, export deflator deflated	US National Assoc. of Purchasing Managers (NAPM) Index	US NAPM Index (first two months per quarter)
Lag (quarters)	-	-	1	2	2	2	1	1
Trans-formation	(T - T-1) / T-1 *100	(T - T-1) / T-1 *100	T - T-1	T - T-1	T - T-1	(T - T-1) / T-1 *100	T - T-1	T - T-1
Name	GDP_Q	CAR_Q	RETAILPRB_D(-1)	CONSTRUCT D(-2)	SPREAD_D (-2)	REER_Q(-2)	NAPM_D(-1)	NAPMA_D(-1)
1991q2	0.280	3.490	-7.667	-2.333	-0.557	1.826	-2.000	-2.950
1991q3	0.037	1.763	-6.667	2.000	-1.229	-0.524	6.100	4.350
1991q4	0.955	-9.631	-4.333	-9.000	-0.732	-5.532	6.933	8.100
1992q1	1.457	9.241	-2.000	-3.333	0.052	0.015	-3.000	-0.450
1992q2	-0.620	-0.919	4.333	-1.000	-0.732	2.912	1.733	-1.300
1992q3	-0.266	-4.398	-4.000	-2.000	-1.082	0.673	2.433	4.150
1992q4	-0.282	-1.624	-7.667	-4.667	-0.345	0.399	-1.633	-0.500
1993q1	-0.689	-18.379	-9.000	-5.333	0.121	4.706	0.367	-1.700
1993q2	0.040	0.874	-0.333	-8.667	0.004	-1.649	2.133	3.550
1993q3	0.392	1.497	-4.000	-5.333	0.586	-3.051	-4.500	-4.800
1993q4	0.405	-3.630	-3.333	1.667	0.778	-1.856	0.233	-0.250
1994q1	0.887	1.681	1.333	-4.667	0.896	-4.023	3.700	3.150
1994q2	0.558	4.847	5.333	1.667	0.044	-0.364	2.200	2.650
1994q3	0.739	-0.375	-3.667	1.000	0.326	-1.552	1.667	1.550
1994q4	0.787	2.033	5.000	10.333	1.015	3.759	0.367	0.450
1995q1	0.566	-2.617	3.333	2.667	0.988	2.338	-0.267	1.050
1995q2	0.539	1.776	-11.667	8.000	0.354	0.017	-3.367	-3.050
1995q3	0.095	-3.064	10.000	-3.333	0.890	2.341	-6.833	-7.150
1995q4	0.256	5.287	-0.667	-3.667	0.692	0.929	0.600	-0.200
1996q1	0.291	7.169	2.333	-1.667	0.070	1.135	-2.367	-2.600
1996q2	0.533	0.505	-10.000	-0.333	0.356	1.472	-0.167	-0.600
1996q3	0.620	-2.461	6.667	-6.000	0.065	-0.231	4.567	3.500
1996q4	0.158	-0.916	0.000	-1.667	-0.301	-1.539	0.133	1.450
1997q1	0.283	-0.819	1.000	-0.333	-0.048	1.171	2.100	1.100
1997q2	1.168	7.314	3.000	2.667	-0.044	-1.301	0.733	1.650
1997q3	0.705	0.233	-2.000	1.333	-0.328	-3.765	1.400	1.450
1997q4	0.884	3.386	6.333	-1.667	-0.029	-2.200	0.900	2.100
1998q1	0.937	-0.134	-0.333	2.000	0.187	-3.338	-0.533	-1.050
1998q2	0.333	-0.609	8.333	1.333	-0.186	3.517	-2.133	-2.650
1998q3	0.578	4.030	-2.000	8.333	-0.044	-1.375	-2.433	-1.700
1998q4	0.235	4.712	2.000	1.667	-0.285	2.627	-1.800	-2.350
1999q1	0.803	-3.440	2.000	8.667	-0.155	2.651	-1.333	-1.000
1999q2	0.525	5.478	-1.000	-2.333	-0.449	2.225	3.800	2.600
1999q3	1.015	1.809	-1.000	6.000	0.138	-3.558	3.033	2.650
1999q4	0.995	-3.239	-5.333	2.333	0.172	-3.879	0.533	0.600
2000q1	0.931	3.686	-0.667	0.333	0.574	-0.988	2.167	3.000
2000q2	0.772	-0.666	10.000	3.333	-0.297	-1.468	-1.267	-0.750
2000q3	0.565	-8.601	6.000	3.667	0.306	-2.364	-2.667	-2.400
2000q4	0.664	2.616	-0.667	2.000	-0.426	-2.471	-2.900	-3.100
2001q1		1.606	-4.000	0.333	0.102	-0.784	-3.567	-2.700
2001q2			0.667	-2.667	-0.106	-1.698	-4.767	-6.550
Mean	0.491	0.238	-0.350	0.033	0.033	-0.361	0.007	-0.017
Minimum	-0.689	-18.379	-11.667	-9.000	-1.229	-5.532	-6.833	-7.150
Maximum	1.457	9.241	10.000	10.333	1.015	4.706	6.933	8.100
Std dev	0.460	4.967	5.264	4.417	0.522	2.442	2.941	3.046
Skewness	-0.640	-1.403	-0.016	0.266	-0.127	0.080	0.121	-0.007
Kurtosis	0.663	4.189	-0.323	0.142	0.138	-0.679	0.053	0.512

Correlation (2nd quarter 1991 - 4th quarter 2000)

	GDP_Q	CAR_Q	RETAILPRB_D(-1)	CONSTRUCT_D(-2)	SPREAD_D(-2)	REER_Q(-2)	NAPM_D(-1)	NAPMA_D(-1)
GDP_Q	1							
CAR_Q	0.40	1						
RETAILPRB_D(-1)	0.17	0.13	1					
CONSTRUCT_D(-2)	0.31	0.18	0.11	1				
SPREAD_D(-2)	0.29	0.03	0.18	0.14	1			
REER_Q(-2)	-0.52	-0.05	0.11	0.11	0.02	1		
NAPM_D(-1)	0.05	-0.12	-0.11	-0.24	-0.33	-0.26	1	
NAPMA_D(-1)	0.22	-0.05	-0.09	-0.23	-0.30	-0.38	0.93	1

Philips-Perron tests on unit roots

Variable	Test statistics	Period	Obs.
GDP_Q	-4.091	1991:2 - 2000:4	39
CAR_Q	-7.122	1991:2 - 2001:1	40
RETAILPRB_D(-1)	-8.043	1991:2 - 2001:2	41
CONSTRUCT_D(-2)	-4.769	1991:2 - 2001:2	41
SPREAD_D(-2)	-3.090	1991:2 - 2001:2	41
REER_Q(-2)	-4.916	1991:2 - 2001:2	41
NAPM_D(-1)	-4.648	1991:2 - 2001:2	41
NAPMA_D(-1)	-4.472	1991:2 - 2001:2	41

MacKinnon critical values for rejection of hypothesis of a unit

		Observations		
		39	40	41
Probability	1%	-3.607	-3.602	-3.597
	5%	-2.938	-2.936	-2.934
	10%	-2.607	-2.606	-2.605

Pairwise Granger Causality Tests

Sample: 1991:2 2001:1
Lags: 4

Null Hypothesis:	F-Statistic	Probability
CAR_Q does not Granger Cause GDP_Q	2.035	0.11468
GDP_Q does not Granger Cause CAR_Q	2.362	0.07558
RETAILPRB_D does not Granger Cause GDP_Q	0.261	0.90083
GDP_Q does not Granger Cause RETAILPRB_D	1.366	0.26922
CONSTRUCT_D does not Granger Cause GDP_Q	2.269	0.08504
GDP_Q does not Granger Cause CONSTRUCT_D	0.859	0.4997
SPREAD_D does not Granger Cause GDP_Q	1.714	0.17292
GDP_Q does not Granger Cause SPREAD_D	1.081	0.38357
REER_Q does not Granger Cause GDP_Q	3.380	0.02135
GDP_Q does not Granger Cause REER_Q	0.917	0.46705
NAPM_D does not Granger Cause GDP_Q	2.717	0.04831
GDP_Q does not Granger Cause NAPM_D	1.055	0.39566
RETAILPRB_D does not Granger Cause CAR_Q	0.988	0.4288
CAR_Q does not Granger Cause RETAILPRB_D	0.339	0.84955
CONSTRUCT_D does not Granger Cause CAR_Q	2.479	0.06445
CAR_Q does not Granger Cause CONSTRUCT_D	0.634	0.64225
SPREAD_D does not Granger Cause CAR_Q	1.194	0.33317
CAR_Q does not Granger Cause SPREAD_D	0.399	0.80812
REER_Q does not Granger Cause CAR_Q	0.079	0.98828
CAR_Q does not Granger Cause REER_Q	1.466	0.23645
NAPM_D does not Granger Cause CAR_Q	0.276	0.89134
CAR_Q does not Granger Cause NAPM_D	0.768	0.55438
CONSTRUCT_D does not Granger Cause RETAILPRB_	0.932	0.4582
RETAILPRB_D does not Granger Cause CONSTRUCT_	2.225	0.08918
SPREAD_D does not Granger Cause RETAILPRB_D	0.900	0.47599
RETAILPRB_D does not Granger Cause SPREAD_D	1.028	0.40856
REER_Q does not Granger Cause RETAILPRB_D	2.143	0.09909
RETAILPRB_D does not Granger Cause REER_Q	0.234	0.91714
NAPM_D does not Granger Cause RETAILPRB_D	1.040	0.40242
RETAILPRB_D does not Granger Cause NAPM_D	0.881	0.4864
SPREAD_D does not Granger Cause CONSTRUCT_D	0.491	0.74249
CONSTRUCT_D does not Granger Cause SPREAD_D	0.255	0.90453
REER_Q does not Granger Cause CONSTRUCT_D	1.937	0.12914
CONSTRUCT_D does not Granger Cause REER_Q	0.589	0.67339
NAPM_D does not Granger Cause CONSTRUCT_D	1.645	0.18798
CONSTRUCT_D does not Granger Cause NAPM_D	2.259	0.0854
REER_Q does not Granger Cause SPREAD_D	2.250	0.08636
SPREAD_D does not Granger Cause REER_Q	1.060	0.3929
NAPM_D does not Granger Cause SPREAD_D	1.070	0.38783
SPREAD_D does not Granger Cause NAPM_D	1.070	0.38796
NAPM_D does not Granger Cause REER_Q	0.521	0.7208
REER_Q does not Granger Cause NAPM_D	1.046	0.39961

ANNEX 2: COMPARISON OF DIFFERENT ESTIMATE SPECIFICATIONS

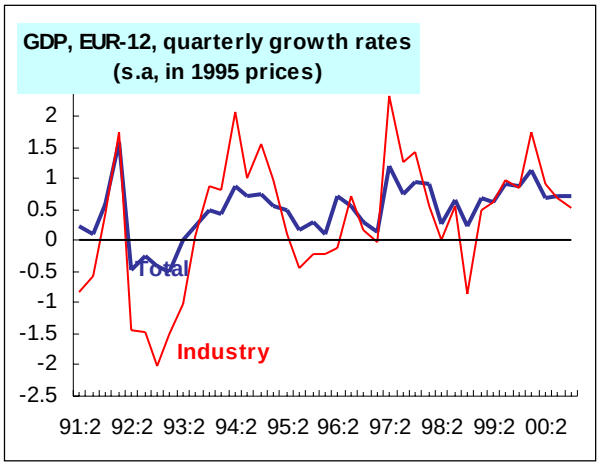
Researchers	Dependent variable: GDP	Independent variables	No	Sample period	Estimate method	R^2	Standard error of regression	Mean absolute forecast error
Coincident quarter								
Grasmann / Keereman	Quarterly percentage change	- Car sales, - retail present business situation, - construction confidence, - yield spreads, - real effective exchange rate, - US NAPM index, - constant	7	1991:2 - 2000:4	OLS + MA	0.87	0.19	0.13
INSEE		- Lagged dependent variables (2 per.), - industry survey factor (2 per.), - retail industry factor (2 per.), - constant	7	1991:2- 2000:2	OLS + AR	0.81	0.21	
OFCE, and others	Annual percentage change	- Industry survey factor, - retail survey factor, - construction survey factor, car sales, - real short-term interest rates, - real EUR/USD rate, - US NAPM index, - oil price, - dummy, - trend, - constant	11	1989:1 - 2000:2	OLS + forecast of some independent variables	0.975	0.20	
Dutch Central Bank	Annual percentage change (EU-7: B, D, E, F, I, NL, UK)	- Dependent variable, - trend-restored business cycle indicator, - real money supply, - real share prices, - yield curve in various lags and combinations	8 - 10	1972:1 - 1999:2	OLS + AR applied to individual countries	0.59 - 0.97		0.4 (EU-7; 1997:1-2000:2)
Quarter ahead								
Grasmann / Keereman	Quarterly percentage change	- Retail present business situat., - construction confidence, - yield spreads, - real effective exchange rate, - US NAPM index , - constant		1991:2 - 2000:4	OLS + MA		0.21	0.14
OFCE, and others	Same as above							
Dutch Central Bank	Same as above		8 - 10	1972:1 - 1999:2	OLS + AR applied to individual countries	0.59 - 0.97		0.4 (EU-7; 1997:1-2000:2)

ANNEX 3: INDUSTRIAL CONFIDENCE

The identification of the equations omitted many economic variables for the equations, which a priori were conceivable as adding information to the estimates or are even systematically used for GDP forecasting in other contexts.

Below is given a short discussion of the omission, or possible inclusion, of variables describing industrial activity. This set of variables is chosen, because, conceptually, it constitutes an important element in business cycle analysis, and, statistically, it constitutes a more borderline case than most other assessed and excluded variables.

Value added in industry in the euro area amounted in 1999 only to 22.5 % of total value added, and it showed a falling trends (in 1991 nearly 26 %). However, its share in value added is considerably larger than construction (5.5 %), which is represented in the estimate equations, and it is more directly correlated to the business cycle than other sectors of the economy. Intuition would suggest an indicator on industrial activity to be among the list of explanatory variables for growth in GDP.



Nevertheless, times series on industrial activity in the euro area are not used for the estimates. The index of industrial production is available only at a relatively late moment (around 50 days after the end of the month). However, industry survey data, stemming from the monthly industry surveys organized for the European Commission, are readily available at an earlier point in time. Yet, these do not add information to the estimate of quarterly GDP change, as the tables below show.

The tables below give the results of the coincident quarter equation and quarter ahead

Coincident quarter equation, with industrial confidence

Dependent Variable: GDP_Q — Sample(adjusted): 1991:2 2000:4
Method: Least Squares — Included observations: 39 after adjusting endpoints
Backcast: 1990:2 1991:1

Variable	Coefficient	t-Statistic	Prob.		
INDUSTRY_D(-1)	-0.016	-1.640	0.112	R-squared	0.89
CAR_Q	0.013	2.426	0.022	Adjusted R-squared	0.86
RETAILPRB_D(-1)	0.015	2.457	0.020	S.E. of regression	0.17
CONSTRUCT_D(-2)	0.057	5.965	0.000	Durbin-Watson stat	2.01
SPREAD_D(-2)	0.353	5.008	0.000	F-statistic	30.41
REER_Q(-2)	-0.101	-7.458	0.000		
NAPM_D(-1)	0.056	5.896	0.000		
C	0.365	7.297	0.000		
MA(4)	0.960	7765.891	0.000		

Numbers in brackets ( ) after variables: number of quarterly lags in the variable

Quarter ahead equation, with industrial confidence

Dependent Variable: GDP_Q
Method: Least Squares
Backcast: 1990:2 1991:1
Sample(adjusted): 1991:2 2000:4
Included observations: 39 after adjusting endpoints

Variable	Coefficient	t-Statistic	Prob.		
INDUSTRY_D(-1)	-0.019	-1.890	0.068	R-squared	0.87
RETAILPRB_D(-1)	0.015	2.169	0.038	Adjusted R-squared	0.84
CONSTRUCT_D(-2)	0.058	5.535	0.000	S.E. of regression	0.19
SPREAD_D(-2)	0.313	4.317	0.000	Durbin-Watson stat	1.975
REER_Q(-2)	-0.119	-10.321	0.000	F-statistic	0.00
NAPM_D(-1)	0.056	5.400	0.000		
C	0.357	6.586	0.000		
MA(4)	0.960	8499.444	0.000		

Numbers in brackets ( ) after variables: number of quarterly lags in the variable

equation estimates, both including the absolute change of the industrial confidence indicator. The parameters for industrial confidence in both equations are not significant at the 5 error interval and, furthermore and more troubling, negative. Using the European Commission business climate indicator instead of industrial confidence, levels instead of changes or changing the lag structure does not significantly alter these findings.

There are some tentative reasons why the variables on industrial confidence do not yield a larger impact in the estimate of GDP growth in above equations:

- Change in industrial activity seems to react more strongly to changes in GDP in economic downturns. In other words, the elasticity of growth in industry to growth in GDP seems to be asymmetric. Yet, the estimate period has mostly seen economic upswings, during which the elasticity of industry is partly overlaid by the trend decline of the share industrial activity in the total economy.
- The signals of industrial activity are captured by other variables. This seems, judging from cross-correlation between dependent variables and Granger causality tests particularly be the case for the US NAPM
- The survey variables themselves are partly questions on changes over one year (past recorded or future expected ones). These might therefore not fit into the frequency domain of quarterly GDP forecasts and perform better in contexts of forecasting annual changes.

Pairwise Granger Causality Tests

Sample: 1991:2 2000:4
Lags: 4
Null Hypothesis: var. 1 does not Granger Cause var. 2

Variable 1	Variable 2	F-Statistics	Probability
INDUSTRY_D	GDP_Q	0.653	0.630
GDP_Q	INDUSTRY_D	2.917	0.040
INDUSTRY_D	CAR_D	0.971	0.439
CAR_D	INDUSTRY_D	0.205	0.934
INDUSTRY_D	RETAILPRB_D	1.476	0.236
RETAILPRB_D	INDUSTRY_D	0.799	0.536
INDUSTRY_D	CONSTRUCTION_D	1.493	0.231
CONSTRUCTION_D	INDUSTRY_D	0.609	0.659
INDUSTRY_D	SPREAD_D	1.266	0.307
SPREAD_D	INDUSTRY_D	1.286	0.299
INDUSTRY_D	REER_Q	0.965	0.442
REER_Q	INDUSTRY_D	1.085	0.383
INDUSTRY_D	NAPM_D	3.218	0.027
NAPM_D	INDUSTRY_D	0.808	0.531

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