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OFCE QUARTERLY GDP GROWTH INDICATORS*

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Abstract

This paper presents the quarterly GDP growth indicators constructed at OFCE for several countries (USA, UK, euro zone, Germany and France). These indicators provide forecasts of the real GDP growth rate for the current and next quarters. The forecasts are obtained following a regression approach and using rapidly-available monthly data. First, an equation giving the quarterly GDP growth rate is estimated using coincident and leading series. Second, in order to obtain the GDP growth rate two quarters ahead, some monthly series have to be forecast. This is carried out using monthly equations.

Coincident and leading indicators can designate different tools. Originally, coincident and leading indicators were latent variables reflecting the business cycle and allowing current and future assessments of the position of the economy in the cycle. More recently, indicators have been developed with a view to provide a quantitative assessment of current and next quarters' GDP growth. The common point between these tools is that they are constructed using monthly data for evaluating the next future.

The historical tool starts with an attempt to define the cycle. Next, a chronology of the cycle is established which permitted a classification of individual monthly series into three groups: leading, coincident and lagging. Finally, a composite index for each group is built by aggregating some representatives of each group. The output of this approach is a graph representing the reference cycle and the leading index.

The more recent tools focus on the GDP growth rate instead of the business cycle and try to give a growth coincident estimate and, sometimes in addition, a growth forecast for the next quarter, making use of monthly series in all cases. When the objective is to estimate the coincident GDP growth rate, the methods using principal component analysis applied to a large number of series seem particularly appropriate. This allows the determination of the few structural shocks which generate economic fluctuations and, especially those of the GDP growth rate. The most sophisticated representative of this class is the eurocoin[1] indicator. But, when the objective is also to forecast GDP growth rates, it is less obvious that the previous method remains relevant. The problem comes from the fact that all monthly series are not released at the same dates. For example, the index of production of January is published in March whereas the business climate index of January is known at the beginning of February. A two-quarter ahead forecast will be all the more accurate since it is based on the most recent series. In fact these series are not so numerous. So, mixing these few series with a large number of other ones, leads to a loss of the most useful part of the information.

The aim of OFCE indicators is to estimate the quarterly GDP growth rate for the current and following quarters (equivalently, to forecast the quarterly GDP growth rate over a two-quarter horizon). For this, we adopt a conventional regression approach in order to use the most recent monthly information. The dependent variable is the quarterly GDP growth rate. We have already constructed indicators for the USA (Charpin, 2001), the euro zone (Charpin,

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[1] Altissimo, Bassanetti, Cristadoro, Forni, Lippi, Reichlin, Veronese, 2001: "eurocoin: a real time coincident indicator of the euro zone business cycle", *CEPR working paper n°3108*, December. The indicator is available at www.cepr.org/Data/eurocoin. The objective of the indicator is not to estimate the GDP growth rate in real time but merely to indicate its current tendency.

2002), France (Heyer and Péléraux, 2004), the UK (Charpin and Mathieu, 2004) and very recently for Germany. The corresponding papers are quoted in the bibliography, except for Germany whose indicator is just carried out. The euro zone indicator presented hereafter differs slightly from the publication. The differences are detailed in appendix 1.

The method consists in determining a regression giving the quarterly GDP growth rate calculated using monthly series that are rapidly available, mainly monthly survey data and financial series. The monthly data are converted to a quarterly basis using either the average of the quarter or the data for the end of the quarter. Some of them are leading series and could help to forecast growth. However, they are not sufficient to give a proper explanation of growth and the introduction of coincident series is then necessary. Many monthly coincident series are possible candidates for inclusion in the regression. We favor those that are rapidly available and subject to only minor revision, i.e. survey data. Thus, at the date of the forecast, these series are partially known for the current quarter and possibly for the coming quarter. They will have to be forecast but for a short time-horizon, always shorter than 6 months. We will also have to forecast the series with a relatively short lead (less than two quarters). All these forecasts will be made using monthly regressions.

Table 1 indicates the forecast dates for year 2005 and the forecast quarters at these dates for each country. In the United States and the United Kingdom, the first estimate of the GDP is published one month after the end of the quarter. Thus, at the beginning of February 2005, the GDP of the fourth quarter 2004 is known and the quarters to forecast are the two first quarters 2005. For the three other countries, the GDP of the fourth quarter 2004 is not known at the beginning of February and the quarters to forecast are then the last quarter 2004 and the first quarter 2005. The forecast task is easier for these three countries. The use of monthly series allows a monthly revision of forecasts. For the USA and the UK, the most unfavourable forecast dates are February, April, August and October, and the most favourable are January, March, July and September. For the other countries, the unfavourable/favourable dates are one month later.

Table 1: Forecast quarters according to forecast dates and countries

Forecast dates: *at the beginning*(*) *of…*	*Forecast quarters* **USA and UK**	*Forecast quarters* **Germany, France, eurozone**
January 2005	2004Q4 – 2005Q1	2004Q4 – 2005Q1
February 2005	2005Q1 – 2005Q2	2004Q4 – 2005Q1
March 2005	2005Q1 – 2005Q2	2005Q1 – 2005Q2
April 2005	2005Q1 – 2005Q2	2005Q1 – 2005Q2
May 2005	2005Q2 – 2005Q3	2005Q1 – 2005Q2
June 2005	2005Q2 – 2005Q3	2005Q2 – 2005Q3
July 2005	2005Q2 – 2005Q3	2005Q2 – 2005Q3
August 2005	2005Q3 – 2005Q4	2005Q2 – 2005Q3
September 2005	2005Q3 – 2005Q4	2005Q3 – 2005Q4
October 2005	2005Q3 – 2005Q4	2005Q3 – 2005Q4
November 2005	2005Q4 – 2006Q1	2005Q3 – 2005Q4
December 2005	2005Q4 – 2006Q1	2005Q4 – 2006Q1

(*) Forecasts are run during the first week of the month except for UK where they are run in the second.

The quarterly GDP growth rate equation

The lists of coincident and leading series entering the GDP equation in each country are presented in Table 2 and 3. For each series, the conversion to quarterly data (quarter average or end-quarter) and the transformation operated on the variable (first difference, growth rate, none) are indicated in Tables 2 and 3. For leading series, the lead in quarters is reported.

In all countries under review, the main coincident variable is an indicator of industrial activity (see Table 2) either an indicator issued from the monthly business survey, or the change in capacity utilization rate, or the industrial production index. A consumption indicator is also found coincidently in three countries (either a consumer confidence index or a retail sales index).

Table 2: Coincident variables used in the indicators

Country	Coincident variables	Quarterly conversion	Transformation
USA	Capacity utilization rate	End	First diff.
	Consumer confidence, TCB index	End	None
UK	Index of production	Average	Growth rate
	Retail sales index	Average	Growth rate
	Capacity utilization (manufacturing industry)	–	First diff.
euro zone	Industrial activity indicator(*)	Average	First diff.
	Consumer confidence indicator	Average	None
Germany	Manufacturing new orders	Average	Growth rate
France	Industrial activity indicator(*)	End	First diff.

(*) This indicator is the first principal component of a PCA carried out on the series of the monthly business survey.

Concerning the leading series (Table 3), an interest rate variable is found everywhere, either the interest rate spread or the change in the 3-month interest rate. For the euro zone Germany and France, the real dollar/euro exchange rate and the real oil price are leading variables. The construction activity is represented in three countries (USA, Germany, France) and the stock prices, in two countries (USA, Germany).

Table 3: Leading variables used in the indicators

Country	Leading variables	Lead in quarters	Quarterly conversion	Transformation
USA	Building permits	1	Average	Growth rate
	Manufacturing new orders	2	Average	Growth rate
	Nahb index	2	End	First diff.
	ISM index ~ Vendor performance	2	End	None
	Stock prices (SP500 index), in constant dollars	3	End	Growth rate
	Interest rate spread (10-year T-bonds ~ 3-month T-bills)	4	Average	None
UK	Activity indicator in wholesale trade(*)	2	Average	None
	Activity indicator in financial services(*)	2	–	None
	Three-month interbank rate	3	Average	First diff.
euro zone	euro zone interest spread – US interest spread(**)	2	End	First diff.
	Real dollar/euro exchange rate	2	Average	Growth rate
	Real oil price in euro	3	Average	Growth rate
Germany	Limit to activity (labour), construction survey	1	Average	None
	Real dollar/euro exchange rate	2	Average	Growth rate
	Real oil price in euro	3	Average	Growth rate
	Stock prices (DAX index), in constant euros	3	Average	Growth rate
	Three-month interest rate	4	End	First diff.
France	Construction activity indicator(*)	2	Average	First diff.
	Services activity indicator(*)	2	–	None
	Real dollar/euro exchange rate	2	End	Growth rate
	Interest rate spread (10 years ~ 3 months)	3	End	None

(*) This indicator is the first principal component of a PCA carried out on the series of the corresponding survey.

(**) Interest rate spread (10 years ~ 3 months).

None of the GDP equations includes a time trend. Two are autoregressive of order 1 (USA and Germany, see Table 4) with a negative coefficient for lagged GDP growth. One has errors following an AR1 process, with a negative autocorrelation coefficient (France). All equations include at least one dummy variable (listed in Table 4). The standard error of the equations are stand around 0.3% (except for the UK where it is close to 0.2%). The beginning of the estimation period is not chosen but imposed by data availability. For the USA, the NAHB index has existed since 1985; for the UK, the financial services survey, since 1989Q4; for Germany and the euro zone, the GDP series, since 1991. The stability of the equations has been checked (see the bibliographical references papers on each country under review).

Table 4: Some characteristics of the GDP equation

Country	*Autoregressive equation (order 1)*	*Dummies*	*Beginning date for estimation*	*SEE (%)*
USA	yes	2003Q3	1985Q4	0.29
UK	no	1990Q3	1990Q2	0.23
euro zone	no	1992Q1	1991Q2	0.27
Germany	yes	1992Q1	1991Q3	0.32
France	AR1 process for error term	2001Q4 2002Q4	1988Q3	0.29

The forecast of coincident and leading variables

In order to obtain the GDP growth rate two quarters ahead, all coincident series have to be forecast and, also, the series showing a lead of one quarter. Only one leading series is in this case, the US Building permits, with a lead of one quarter in the US GDP equation. Table 5 provide the equations used to forecast the coincident variables and this leading variable. All these equations (except one, pointed out in Table 5) are estimated with monthly data. They are all autoregressive without time trend and with a constant term. Some coincident variables are modelled using their dependence with monthly variables that do not enter GDP equations. These new monthly variables must then be predicted. For example, the change in capacity utilization rate (USA) is modelled using the ISM index, thus an equation to forecast this index is added in Table 5. The same occurs for the consumer confidence index (USA), which is predicted together with the consumer expectations index. The UK industrial activity indicator appears in Table 5 because it is used to forecast the retail sales index and the change in

capacity utilisation rate. The same happens for the German business climate index which enters the manufacturing new orders equation. It can be observed that the American ISM index is present in all equations that represent the industrial activity of the country.

Table 5: Forecast equations for coincident and leading variables

Country	*Variables*	*AR order*	*RHS variables*
USA	Capa. util. rate (change)	1	ISM index (lags 1 to 3).
	ISM index	1	Change in 3-months interest rate (lag 5), Nahb index (lag 5).
	Consumer confidence	2	Consumer expectations (lag 2), ISM index (lags 1 to 2).
	Consumer expectations	1	Consumer confidence (lag 1), ISM index (lags 1 to 2).
	Building permits	3	Nahb index (lags 2 to 3),
			Change in 10-Years interest rate (lag 4).
UK	Index of Prod. (Growth rate)	2	ISM index (lag 1).
	Retail Sales index (Growth rate)	2	Change in the UK industrial activity indicator (lag 1), Activity indicator in retail trade (lag 4).
	UK industrial activity indicator	3	ISM index (lag 1), interest rates spread (10Y–3M) (lag 4).
	Change in capa. utilisation (*)	1	Change in the UK industrial activity indicator (lag 1),
			Interest rates spread (10Y–3M) (lag 3),
			Real oil price, quarterly growth (lag 3).
euro zone	Industrial activity indicator	4	ISM index (lags 1 to 2).
	Consumer confidence indicator	4	Industrial activity indicator (lag 1).
Germany	Manufacturing new orders	2	Business climate index (lag 1),
			Real exchange rate, monthly growth (lag 4),
			Real oil price, monthly growth (lag 4).
	Business climate index	4	Change in ISM index (lags 1 to 2).
France	Industrial activity indic.	2	Leading indicator (Conference Board), USA (lag 5).

(*) This is a quarterly variable.

Fitted values and forecasts at the beginning of March 2005

In this section we present, for each country, the most recent fit (here, with the data available at the beginning of March 2005) and the forecasts made at this date for the two first quarters 2005. In Figure 1 the actual and fitted US GDP growth rates are plotted. A vertical line is drawn at the end of the estimation period (2004Q4). After this line, our forecasts for 2005Q1 and 2005Q2 are plotted (their values are given in Appendix 3). The estimate of the third quarter 2003 is that given by the model, very far from the actual value. This shows the necessity of introducing a dummy variable in the GDP equation.

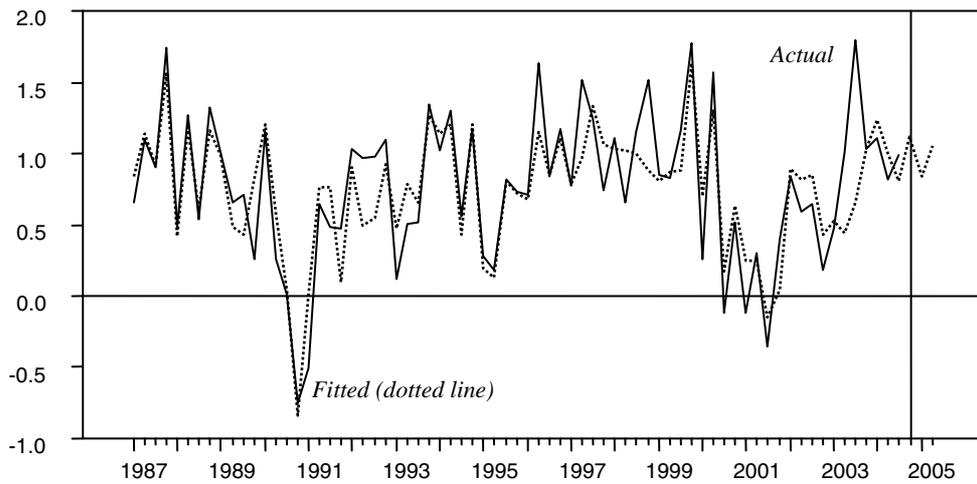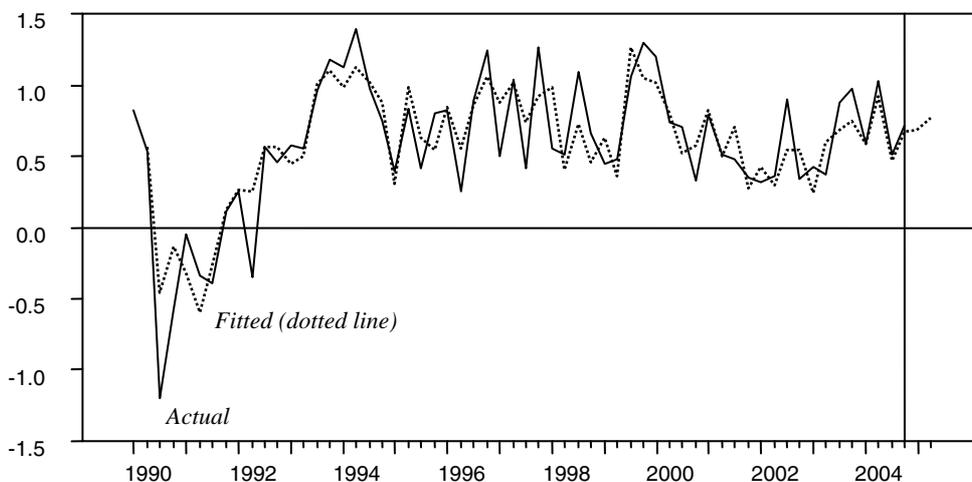**Figure 1: Actual and fitted US GDP growth rates (as of March 2005)**

Figure 2 shows actual and fitted UK GDP growth rates at the beginning of March 2005 and our forecasts for 2005Q1 and 2005Q2 (Appendix 3). The estimation period begins in 1990Q2 because the financial services survey starts in 1989Q4. The estimate plotted for 1990Q3 does not account for the dummy variable introduced in the GDP equation. Figure 2 shows that GDP growth fluctuations are not perfectly estimated. For instance, growth is underestimated in the first half of 1994, and slowdowns earlier than actual growth at the turn of 1999/2000. GDP growth is also underestimated in the first half of 2002. The estimate frequently minors actual fluctuations, leading residuals to switch alternatively from negative to positive signs. This implies a certain negative residual autocorrelation.

Figure 2: Actual, fitted and forecast UK GDP growth rates (as of March 2005)

In Figure 3, the actual and fitted GDP growth rates for the euro zone are plotted. Our forecasts for 2005Q1 and 2005Q2 are shown after the vertical line and are given in Appendix 3. For the observation corresponding to the dummy variable (1992Q1), it is the value given by the GDP equation that is shown. We observe that the fluctuations of the GDP growth rate are not properly described: the fit in most cases goes through the fluctuations. Large estimation errors are found for three consecutive quarters (1996Q4 to 1997Q2) and also for the fourth quarter of 2001.

Figure 3: Actual and fitted euro zone GDP growth rates (as of March 2005)
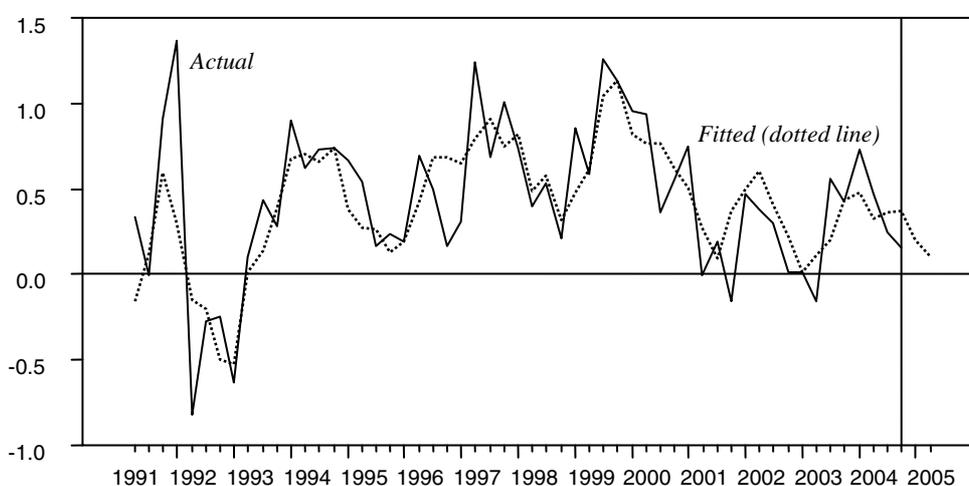
Figure 4 shows German fitted and forecast GDP growth rates at the beginning of March 2005. Our forecasts for 2005Q1 and 2005Q2 are drawn after the vertical line and are given in Appendix 3. The estimate plotted for 1992Q1 does not account for the dummy variable introduced in the GDP equation. The figure shows that GDP growth fluctuations are rather well estimated, with only two quarters not properly estimated, 1994Q1 and 1996Q1.

Figure 4: Actual, fitted and forecast German GDP growth rates (as of March 2005)
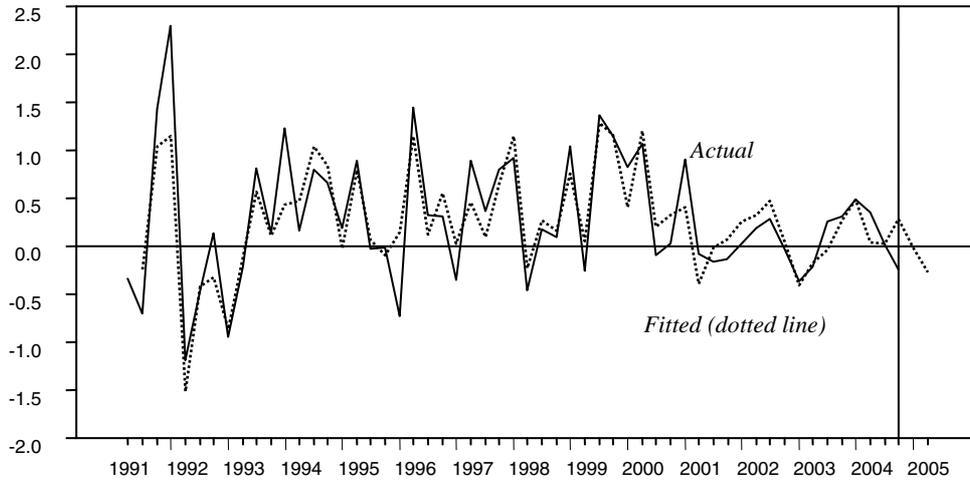

Figure 5 shows actual and fitted French GDP growth rates at the beginning of March 2005, and our forecasts for 2005Q1 and 2005Q2 after the vertical line (given in Appendix 3). The indicator has been constructed recently and the GDP equation is still temporary. As it can be seen, the recent period is not properly estimated which will lead us to reconsider the GDP equation.

***Figure 5: Actual and fitted French GDP growth rates (as of March 2005)***
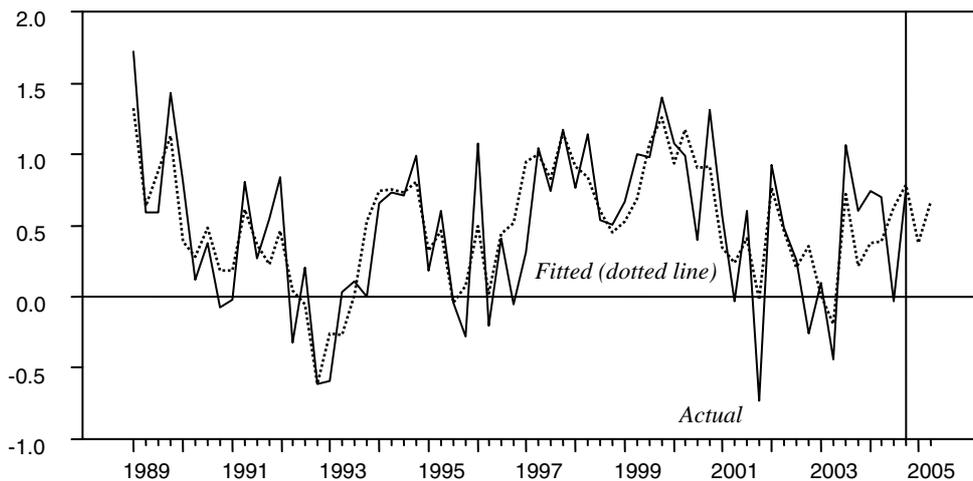
The forecasting errors

This section examines forecasting errors that have been made[2] for the USA, the euro zone and the UK. For the USA, forecasts over the three last years are available, since the indicator was existing at the end 2001. For the euro zone, two years of forecasts are now known and, for the UK, only one year.

Figures 6 and 7 report US GDP growth forecasts for the current and next quarters, when the forecast dates are early March, June, September and December (neither the most unfavourable date, nor the most favourable, as it can be seen in Table 1). For the current quarter (Figure 6), the forecasting errors are very small eight times out of twelve, which is rather satisfying. Two times, they are large (between 0.4% and 0.5% in absolute value) and, two times, they are very large, respectively equal to 0.8% and 1.3%, for the second and the third quarters 2003. Many forecasters had underestimated the 2003Q3 GDP growth. Even now, this exceptionally high growth remains unexplained by the right hand side variables of our GDP equation and makes necessary the introduction of a dummy variable in order to eliminate this quarter from the estimation period.
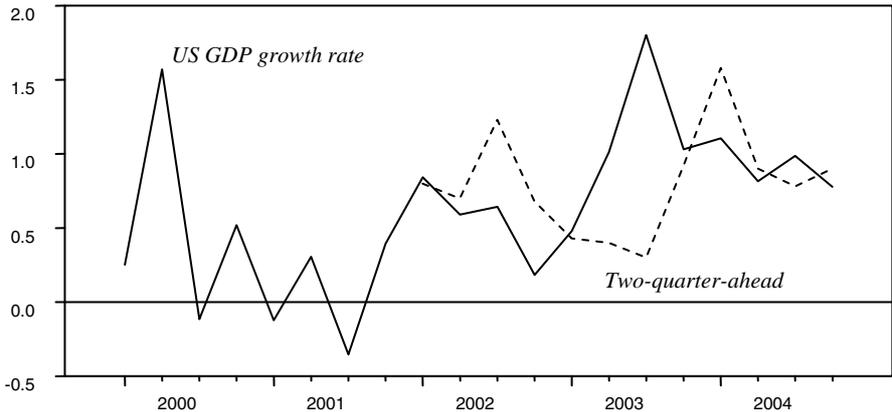
Figure 6: One-quarter-ahead forecasts of US GDP growth rate over the last three years (middle date)


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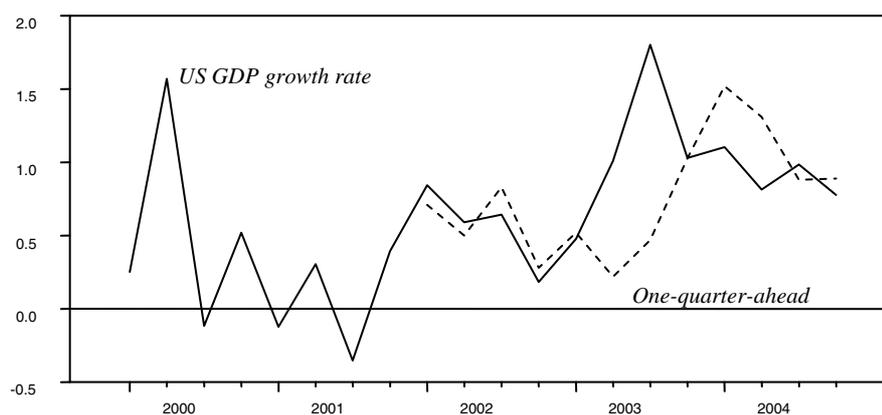
[2] These are real forecasts.

Now, if we look at the two-quarters ahead forecasts (Fig. 7), we see that forecasts are very closed to the observed data seven times out of twelve, which is not too bad. For the five other quarters, among them 2003Q3, the forecasting errors are large, exceeding 0.4% in absolute value.

Figure 7: Two-quarter-ahead forecasts of US GDP growth rate over the last three years (middle date)


The euro zone growth forecasts are reported in Fig. 8 (one-quarter ahead) and Fig. 9 (two-quarter ahead). The forecast dates are early January, April, July and October (neither the most unfavourable date, nor the most favourable). The largest forecasting errors are found in 2003Q2 (–0.3%) and 2003Q3 (0.4%) (Fig. 8). All other are in absolute value below or equal to 0.2%.

Figure 8: One-quarter-ahead forecasts of euro zone GDP growth rate over the last two years (middle date)
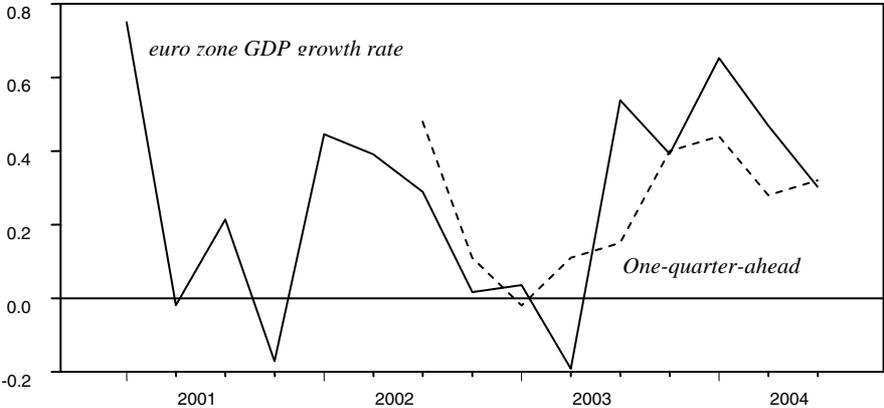
If we look at the two-quarter ahead forecasts (Figure 9), we find again a large error in 2003Q3, the largest being in 2004Q2 (0.4%).

Figure 9: Two-quarter-ahead forecasts of euro zone GDP growth rate over the last two years (middle date)
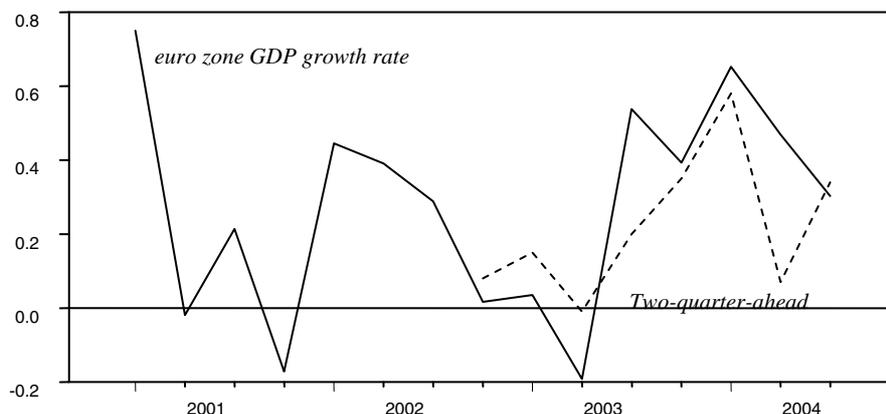
The UK one-quarter ahead growth forecasts are shown in Figure 10. Here, we choose to present forecasts made in January, April, July and October, just after the release of the index of production, and about three weeks before the GDP first estimate release. For our indicator, it is the most favourable date. The forecasting errors are small, below 0.1% in absolute value. At these same dates, the NIESR does not give a GDP estimate of the whole quarter. It is only one month later, i.e., two weeks after the release of the official GDP first estimate, that the NIESR provides its estimate. These estimations are shown in Figure 10.

Figure 10: One-quarter-ahead forecasts of UK GDP growth rate over the last year (favourable date)
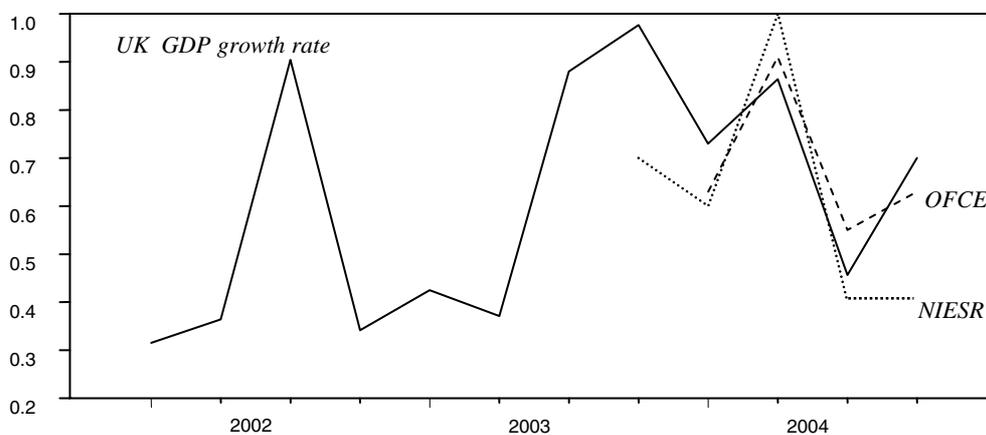
Conclusion

The method used to build our indicators is simple in comparison with some other methods recently developed. In particular, we prefer basing our forecasts on a limited number of series. This allows us to calculate the contribution to growth for each variable and, thus, to understand and comment easily the forecasts. This is the advantage of our method over those using a large set of series or over those using no series, like ARMA(p,q) models. The accuracy of our forecasts is very dependent on the performance of the GDP equation. The latter could be improved if more monthly series were rapidly available, especially for the euro zone, where the lack of series is a problem.

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Appendix 1: Revisions in some indicators

Euro zone

The equation giving the quarterly GDP growth rate is modified as followed: the time trend is removed, only one dummy variable is present (1992Q1), the consumer confidence indicator is now coincident.

USA

The equation giving the quarterly GDP growth rate has now: no time trend, only one dummy variable in 2003Q3, and a lag of 4 quarters (instead of 3) for the interest rate spread. The time trend has been removed in monthly equations when it was included. The monthly equation giving the ISM index has changed (see the list of RHS variable in Table 5).

France

The equation giving the quarterly GDP growth rate has now: no real oil price, two dummy variables in 2001Q4, 2002Q4.

Appendix 2: Data source and datastream mnemonic

USA

Source Federal Reserve

Treasury bill - 3 months, USTRB3AV

Treasury bill - 10 years, USTRCN10

Capacity utilisation rate, USCAPUTLQ

Source Institute for Supply Management

Purchasing managers index (ISM), USCNFBUSQ

Vendor performance index, USVENDOR

Source Bureau of Labor Statistics

Consumer price index, seasonally adjusted, USCP....E

Source The Conference Board

Consumer confidence indicator, USCNFCONQ

Consumer expectation indicator, USCNEXPT

Manufacturing new orders, USNOIDN.D

Source National of Association of Home Builders

NAHB index, USNAHBMI

Source Department of commerce – Bureau of census

Building permits, USHOUSATE

Source Standard and Poors

SP500 index, US500STK

Source Bureau of Economic Analysis

GDP, chain index, USGDP…D

Euro zone

Source eurostat

GDP constant prices, EAESGD95D

Consumer price index, not seasonally adjusted, EAESHARMF

(Author's calculations for seasonal adjustment)

Source european Commission

Industry survey, EAEUSI××Q   with ×× = PR, PA, OB, EB, FP

Consumer survey, EAEUSC××Q   with ×× = FN, FY, EC, EY, PR, PY, UN, MP, PC, SA, SY

Source european Central Bank

Government bond yield – 10 year (monthly average), EMECB10Y

(Author's calculations before 1994)

3-month money market (monthly average), EMIBOR3.

Exchange rate euro/Dollar (monthly average), CMA#(USECBSP)

(Author's calculations before 1999)

Source IMF

World market crude petroleum price, WDI76AAZA

Germany

Source Deutsche Bundesbank

GDP constant prices, BDGDP…D

Consumer price index, seasonally adjusted, BDCONPRCE

3-month money market (monthly average), BDINTER3

Manufacturing new orders, BDUSC002G

Source Bank of England

Exchange rate Dollar/euro (monthly average), BDXRUSE.

Source Commerz Bank

DAX share price index, BDSHRPRCF

Source IFO

Business climate index, seasonally adjusted, BDCNFBUSQ

Source european Commission

Construction survey: limits to activity, labour, BDEUSCLBQ

France

Source INSEE

Quarterly Services Survey, FRSUR××TQ with ×× =AC, FA, AF, FF, FD

Monthly Industry Survey, FRSUR×××Q with ××× = GPD, FMP, SMP, GMP, TMP, PMP

Consumer price index, seasonally adjusted, FRCP….E

GDP, constant price, FRGDP…

Source european Commission

Construction survey, FREUSB××Q with ×× = AC, OB, EM

Source The Conference Board

US leading indicator, USCYLEAD

Source Datastream

Benchmark Bond 10 YR, FRBRYLD

3-month interbank rate, CMA#(PIBOR3M)

UK

	Source	ONS Code	Datastream Code
GDP, chained volume, SA	ONS	ABMI	UKABMI..
Index of Production, chained volume, SA	ONS	CKYW	UKCKYW..
Retail Sales Index, volume, SA	ONS	EAPS	UKEAPS..
% of firms working below capacity, manufacturing sector	CBI	—	UKCBICAB
Activity indicator in financial services	CBI/PWC a)	—	UKCBIFXX where XX = LB, DO, DM, LO, OP, ST, VF, VB
Activity indicator in wholesale trade	CBI	—	UKCBWXXB where XX = SE, DE, TE, KE
Activity indicator in retail trade	CBI	—	UKCBRXXB where XX = SE, DE, TE, KE
Industrial activity indicator	european Commission	—	UKEUSIXXQ where XX = PR, OB, EB, FP, PA
Three-month interbank rate	BoE/ONS	AMIJ	UKAMIJ..
Gross redemption yield on ten-year gilt edged stocks	Datastream	—	UKMEDYLD
Oil prices	IMF	—	WDI76AAZA
Producer price index (manufactured products)	ONS	PLLU	UKPLLU..
Manufacturing purchasing managers' index (PMI-ISM), US	Institute for supply management	—	USCNFBUSQ
Three-month US Treasury bill	Federal reserve	—	USTRB3AV
Ten-year US Treasury bill	Federal reserve	—	USTRCN10

Appendix 3: Forecasts at the beginning of March 2005

Country	*2005Q1*	*2005Q2*
USA	0.8 %	1.0 %
UK	0.7 %	0.8 %
Euro zone	0.2 %	0.1 %
Germany	0 %	− 0.3 %
France	0.4 %	0.7 %