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OFCE**Analysis and Forecast Department**

A Leading Indicator for EMU

Why a leading indicator?

Forecasting methods may be divided in two fields. On the one hand traditional business cycle analyses based on the compilation of as large a number of series as possible aim at characterising current fluctuations thus inferring from it the present state of tensions in a given economic system. A systematic comparison with similar past situations gives then clues about the likely development of these tensions and of the associated fluctuations of global activity. On the other hand, structural econometric models, whose equations dynamically reflect recognised behaviours of economic agents and accounting constraints, provide a future growth path, under a specified context of exogenous assumptions.

Both fields give useful elements of judgement but are not free of shortcomings. The business cycle analysis may give wrong signals when fluctuations are due to unusual external shocks ; it delivers qualitative messages that are not easily translated into quantitative forecasts ; it lacks the permanent consistency check that models based on national accounts warrant. As for econometric models they may err when structural changes make obsolete relations based on past average behaviours ; they tend to smooth fluctuations and are usually late to recognise and negotiate turning points ; they have continuously to be adjusted to actual economic developments to deliver reasonable forecasts.

Therein lies the usefulness of leading indicators. A large variety of methodologies have been used to build leading indicators:

- the traditional approach, mixing a bunch of individual series usually in advance of the business cycle elaborates a retrended composite indicator, with turning points that lead the cycle by several months;

- a more recent qualitative approach computes the probability of the occurrence of turning points;

- an econometric approach forecasts the growth of real GDP over the next quarters, using a set of leading variables. This last approach is here utilised as being the one deemed most useful to remedy the above mentioned shortcomings. As a matter of fact, it fits the gap between the business cycle analysis and the model forecasting : while it allows for a needed quantification of the cyclical development, it also eases the adjustment of the model to the current and near-term economic situation, giving it a more reliable starting point for any forecasting exercise.

A set of indicators

Actually, different indicators are to be produced if we want to meet these expectations :

- First of all we build a quarterly coincident indicator denoted QCI : such an indicator is worthwhile in that it can be used to check the last values of GDP delivered by Eurostat, which sometimes may be subject to further revisions, especially at the beginning of a recovery. More specifically, we estimate the growth of real GDP on a 4-quarter change basis. The QCI is delivered when a new quarterly GDP figure becomes available.

- Secondly we elaborate a pair of monthly revised leading indicators (MLI) designed to estimate the 4-quarter change of real GDP corresponding to each of the following two quarters. The MLI are delivered at the beginning of each month when new monthly data are published. This allows us to confirm or improve estimates or forecasts of previous months, as the information content on the current period is updated and enlarged.

Nature and availability of components

Business surveys provide the bulk of the coincident (industry and trade) or slightly leading (construction) components. Their information content is extracted by means of a principal components analysis, which provides a weighted average of the most highly correlated questions within each survey. Yearly changes of car registrations and of the US industrial production complete the set of coincident data.

Monetary conditions have a consistent and well documented lagged influence on the real economy. Here they are captured, on the domestic side, through the spread between the euro-zone short-term real interest rate and the trend growth rate (actual yearly rate for the last five years), on the external side, through the euro per dollar exchange rate. Their yearly changes are used — 2 years for the rate of interest, 1 year for the exchange rate — and lead GDP by two quarters.

The information extracted from surveys and other coincident variables loses progressively its relevance when it comes to estimating the current quarter, and forecasting the next one. Car registrations and the US production are dropped, the momentum, rather than the level, of the industrial survey factor is taken into account, and price fluctuations of raw materials expressed in dollars are included. As expected, contributions of monetary conditions are found increasing.

Choosing a year-on-year basis to estimate and forecast GDP growth is justified by the high correlation found with the surveys factors.

Nearly all data requested to compute the indicator at month (M) are available around the end of the first week of month (M+1). The US production and car registrations are the only exception, being delivered between the tenth and the fifteenth of each month. Where the US production is needed though not yet available, it is estimated using the NAPM qualitative survey. When missing, car registrations are maintained at their recent level and updated next month.

The first issue of the GDP of quarter T takes place around the tenth of month 3 of quarter (T+1). Consequently, the date of publication of the monthly revised EMU leading indicators is also fixed around the tenth of each month.

Notations

As we work with two data frequencies (quarterly and monthly), we introduce two sets of indexes ; one set using a single number - denoted t - for quarterly data, another set using two numbers - denoted (t,m) - for monthly data, where m is the month of the quarter t ($m=1,2,3$). As the econometric estimates are performed using quarterly data, we have to quarterise monthly data. We proceed differently according to the type of data and its role in equations. We denote by :

$X_{t,m}$ the quarterly value of variable X , obtained by selecting the month m of quarter t ,

$\bar{X}_{t,3} = \frac{1}{3}(X_{t,3} + X_{t,2} + X_{t,1})$ the quarterly value corresponding to the average for the three months of quarter t,

$\bar{X}_{t,2} = \frac{1}{3}(X_{t,2} + X_{t,1} + X_{t-1,3})$ the quarterly value, average of the three consecutive months starting from the second month of quarter t,

$\bar{X}_{t,1} = \frac{1}{3}(X_{t,1} + X_{t-1,3} + X_{t-1,2})$ the quarterly value, average of the three consecutive months starting from the first month of quarter t.

Let dX be the growth rate on a year-on-year basis defined as followed:

$$dX_t = 100 \times \left(\frac{X_t - X_{t-4}}{X_{t-4}} \right) \quad dX_{t,m} = 100 \times \left(\frac{X_{t,m} - X_{t-4,m}}{X_{t-4,m}} \right)$$

and let Δ be the first difference operator $\Delta X_t = X_t - X_{t-1}$

The mnemonics of variables used in the tables are :

GDP	quarterly gross domestic product at 1995 prices
FI	industry survey factor
FR	retail survey factor
FB	construction survey factor
CAR	passenger car registrations
DOLL	real dollar/euro exchange rate
CSTIR	euro-zone real short-term interest rate (three month) minus trend growth (a proxy of a cyclical component)
RMPI	raw material price index in dollar, computed by REXECODE
USIPI	US industrial production index

The survey factors are the first factors of a principal components analysis. All variables, except the survey data, the interest rate and the raw material price index, are computed as growth rates on a year-on-year basis. The interest rate variable is computed as follow : we take the 8-quarter difference of the spread between the real short-term interest rate and the GDP growth smoothed on the last five years.

The equations are estimated on period (1989q3-1999q3). On the estimation period, most variables are trended (thus are non stationary). The T-student of trend coefficients are

reported in annex 1 for each variable. To avoid spurious regressions we introduce a trend in all equations. Thus, all variables are detrended.

The GDP reference data

As the Eurostat EMU GDP figures start from the first quarter of 1991, the growth rate of real GDP on a 4-quarter change basis is only available since the first quarter of 1992. Estimating the indicators on such a short period (1992q1-1999q3) is problematic, as it gives too much importance to the 1992-1993 recession. On the other hand, a long estimation period may also not be appropriate because of two structural changes : the rather recent EMU project and the reunification of Germany.

To extend the number of estimation points, we use older series constructed according to ESA79 from 1988 to 1992 and the Eurostat series from 1992 onwards. But, it is a shaky solution as the combined series includes different price bases. This solution aims at giving less importance to the recession period included in the estimation period.

The quarterly coincident indicator

The coincident indicator is built using the equation reported in table 1. The variables have the expected sign and are strongly significant.

Taking into account the industrial survey of month (T+1,1), made at the beginning of the month, instead of the month (T,3) one gives less good results : some questions refer to the past (activity) but some others refer to the very short future (like expected production, or order books). Thus the survey of month (T,3) fits better GDP growth.

The survey factors for retail trade and construction sectors are very volatile. So they are averaged over the quarter. Note that the retail trade factor is coincident and that the construction factor is lagged by one quarter.

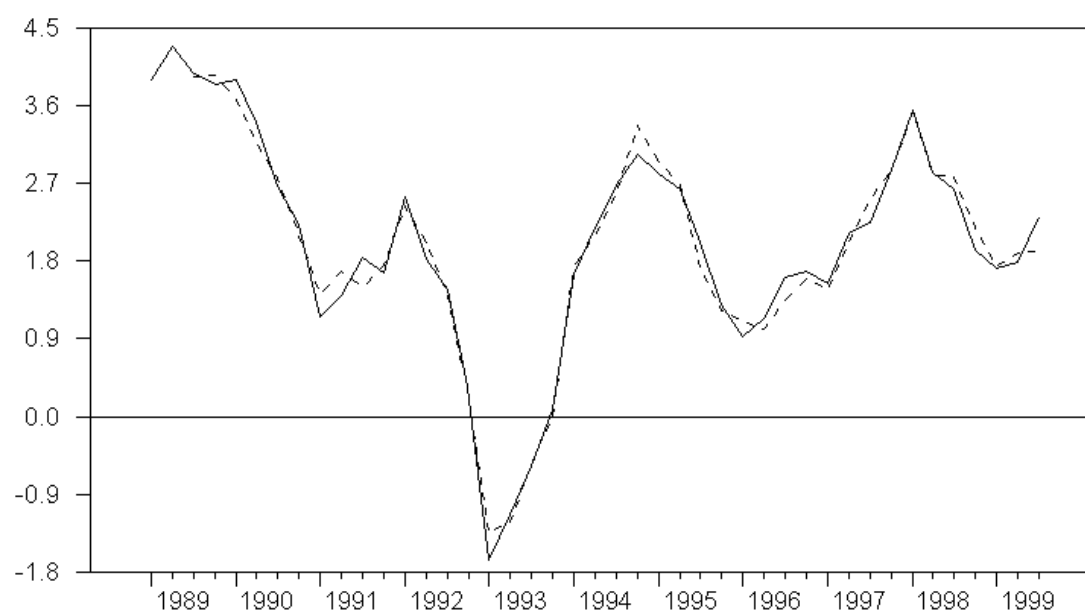
In months 1 and 2 of quarter (T+2), the same equation will be used to estimate the first quarter not yet delivered by Eurostat, as all the necessary information is then available.

Table 1 : OLS estimates of the coincident equation

	Coefficient	T-student	
$FI_{t,3}$	1.6	3.2	Estimation period 89q3 – 99q3 Usable observations 41 SEE = 0.2 Rbar ² = 0.973 DW = 2.14
$\overline{FR}_{t,3}$	3.4	4.3	
$\overline{FB}_{t-1,3}$	2.0	2.9	
$d\overline{CAR}_{t,3}$	0.025	4.7	
$CSTIR_{t-2}$	-0.309	-4.7	
$d\overline{DOLL}_{t-2,3}$	0.029	6.4	
$d\overline{USIPI}_{t,3}$	0.13	4.0	
trend	-0.029	-6.6	
constant	3.1	14.7	

Equation of table 1 appears to fit the data quite well (figure 1). The standard error of equation is rather low, equal to 1/5 point. Contributions are shown in annex two.

Figure 1 : Actual (full line) and fitted (dotted line) values of equation given in table 1



The monthly revised leading indicator

The one-quarter-ahead forecast equations

The equations are estimated over period (1,T) and give $dGDP_{T+1}$ in the first two months of the following quarter (T+2,1) and (T+2,2). For the third month (T+2,3), we have now to forecast $dGDP_{T+2}$, as GDP relating to the quarter T+1 is about to be published when we compute the indicator. In table 2, we specify which monthly variables are available when the GDP of quarter T is known. For instance, at the beginning of January (second line of table 2), we know the GDP of the third quarter of the last year and all explanatory variables until December, except car registrations and the US industrial production index which are published too late (around mid-month). In January, we may still use the coincident equation by estimating the missing values (for instance, forecasting the US IPI with NAPM surveys). All the information for the fourth quarter is available from mid January (third line of table 2). Thus, for February, the coincident equation can be used to give an early estimate of the GDP of the fourth quarter.

Table 2 : Available information when the last known GDP refers to quarter T

Computing date of the indicator	last known GDP	last known surveys and financial data	last known real data (CAR, USIPI)
early month 3, quarter (T+2)	T	(T+2,2)	(T+2,1)
early month 1, quarter (T+2)	T	(T+1,3)	(T+1,2)
early month 2, quarter (T+2)	T	(T+2,1)	(T+1,3)

The estimation results and the figure comparing actual and fitted values do not differ from table 1 and figure 1.

So, we have only to find an equation forecasting quarter (T+2) in early month (T+2,3). For instance, at the beginning of March 2000, when the last known GDP is about to shift from the third to the fourth quarter of 1999, we need to estimate GDP growth for the first quarter of 2000. Survey and financial data are known until February. Survey variables are not fully

known for the quarter, but can be replaced with their $(T+2,2)$ values. For real data, available only until January, we again estimate separately the two remaining months.

The one-quarter-ahead forecast equation to be used at the middle of month $(T+2,3)$ is given on table 3. This equation is valid in March, June, September and December.

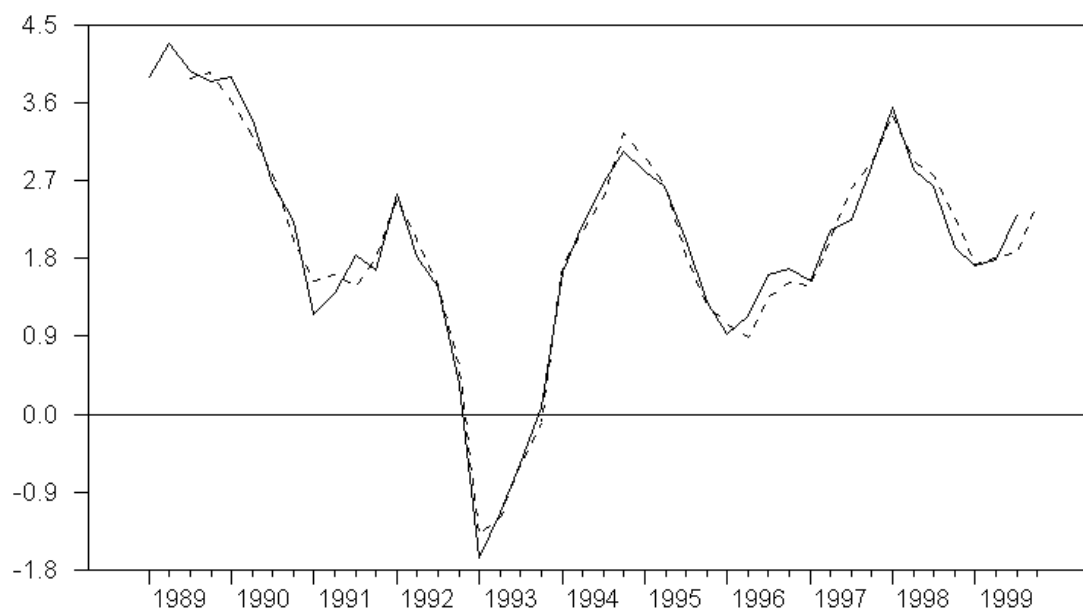
Table 3 : OLS estimates of the one-quarter-ahead forecast equation to be used at the middle of March, June, September and December.

	Coefficient	T-student	
$FI_{t,2}$	2.1	3.9	Estimation period 89q3 – 99q3 Usable observations 41 SEE = 0.22 Rbar ² = 0.967 DW = 1.9
$\overline{FR}_{t,2}$	2.6	3.1	
$\overline{FB}_{t-1,3}$	2.0	2.5	
$d\overline{CAR}_{t,3}^*$	0.025	4.2	
$CSTIR_{t,2}$	-0.27	-3.8	
$d\overline{DOLL}_{t-2,3}$	0.034	6.9	
$d\overline{USIPI}_{t,3}^*$	0.1	3.0	
trend	-0.027	-5.7	
constant	3.1	13.3	

* : includes a separate estimate of last points

The equation appears to fit the data quite well (figure 2). The standard error of the equation is about 1/5 point.

Figure 2 : Actual (full line) and fitted (dotted line) values of equation given in table 3



The two-quarter-ahead forecast equations

The equations are estimated over period (1,T) and give $dGDP_{T+2}$ in months (T+2,1) or (T+2,2). For month (T+2,3), the forecast is $dGDP_{T+3}$. We look at the one-quarter-ahead forecast equations and try to replace at best the unknown variables. It sums up to using the most recent information. This leads to three equations (according to the month) presented in tables 4 to 6.

The results are rather good, the standard errors of equation are less than 1/3 point.

Table 4: OLS estimates of the two-quarter-ahead forecast equation for months March, June, September and December.

	Coefficient	T-student	
$\Delta FI_{t-1,2}$	3.5	3.4	Estimation period 89q3 – 99q3
$\overline{FR}_{t-1,2}$	2.9	2.9	Usable observations 41
$\overline{FB}_{t-1,2}$	4.1	3.2	SEE = 0.3
$CSTIR_{t-2}$	-0.39	-4.9	
$\overline{dDOLL}_{t-2,3}$	0.05	6.6	$Rbar^2 = 0.943$
$RMPI_{t-1,2}$	0.026	4.6	DW = 2.1
trend	-0.0005	-0.8	
constant	-0.65	-1.4	

Table 5 : OLS estimates of the two-quarters-ahead forecast equation for months January, April, July and October.

	Coefficient	T-student	
$\Delta FI_{t-1,3}$	2.1	2.3	Estimation period 89q3 – 99q3
$\overline{FR}_{t-1,3}$	2.6	2.6	Usable observations 41
$\overline{FB}_{t-1,3}$	4.5	3.5	SEE = 0.3
$CSTIR_{t-2}$	-0.38	-4.9	
$\overline{dDOLL}_{t-2,3}$	0.05	6.7	$Rbar^2 = 0.942$
$RMPI_{t-1,3}$	0.028	4.5	DW = 2.3
trend	-0.002	-0.2	
constant	-0.8	-1.0	

Table 6 : OLS estimates of the two quarters ahead forecast equation for months February, May, August and November.

	Coefficient	T-student	
$\Delta FI_{t,1}$	2.1	2.5	Estimation period 89q3 – 99q3
$\overline{FR}_{t,1}$	3.2	3.4	Usable observations 41
$\overline{FB}_{t-1,3}$	3.7	3.1	SEE = 0.28
$CSTIR_{t-2}$	-0.43	-6.0	
$\overline{dDOLL}_{t-2,3}$	0.045	5.9	$Rbar^2 = 0.948$
$RMPI_{t-1,3}$	0.025	4.1	DW = 2.14
trend	-0.004	-0.68	
constant	-0.37	-0.45	

Figures 3 to 5 reproduce the adjustments obtained with the equations of tables 4 to 6. The equation for March, June, September and December (with the lowest content of information) not surprisingly gives the poorest results.

Figure 3 : Actual (full line) and fitted (dotted line) values of equation given in table 4 March, June, September and December.

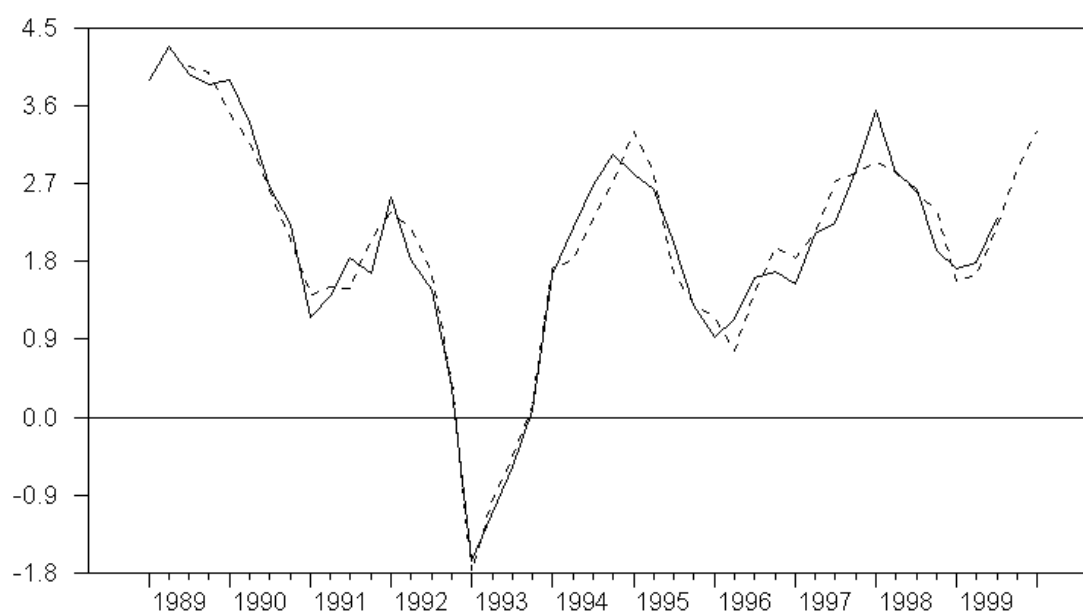


Figure 4 : Actual (full line) and fitted (dotted line) values of equation given in table 5.
January, April, July and October.

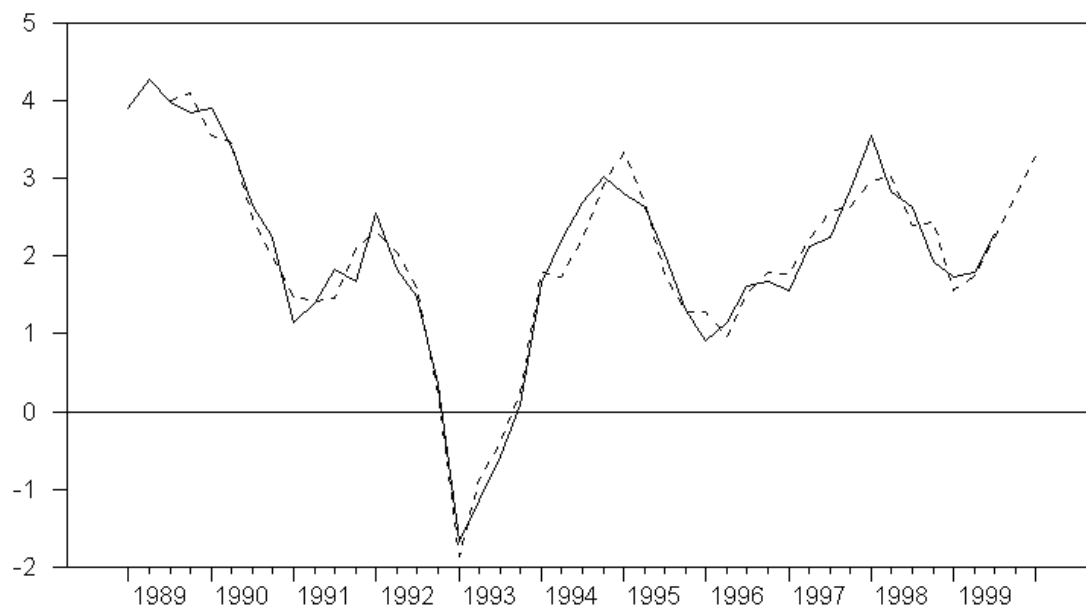
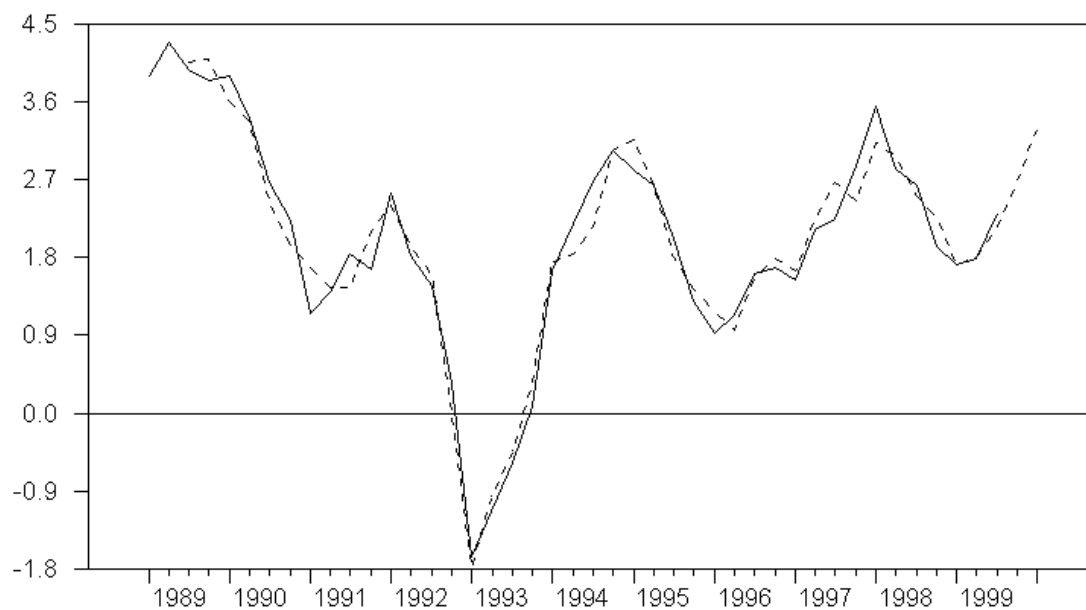
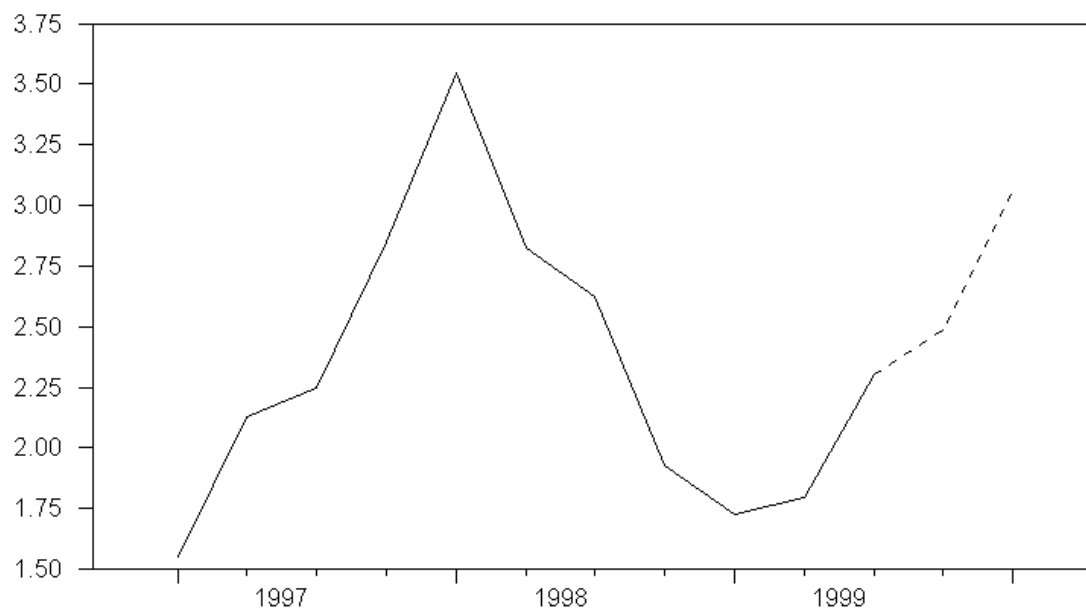


Figure 5 : Actual (full line) and fitted (dotted line) values of equation given in table 6
February, May, August and November.



To conclude, we present on figure 10 the forecasts for 1999q4 and 2000q1 which would have been given at the middle of February.

Figure 6 : Growth forecasts for 1999q4 and 2000q1 (dotted line)



The forecast gives a yearly growth rate for the whole year 1999 equal to 2.1 %. The estimate for the fourth quarter of 1999 is equal to 2.5 % year over year. The forecast for the first quarter of 2000 is equal to 3.1%.

Annex 1

Table 1 : The T-student of trend coefficient on period 1989q1-1999q3

Variables	T-student
dGDP	-0.2
FI	0.7
FR	-2.7
FB	-1.8
dCAR	1.7
CSTIR	-5.0
dDOLL	2.2
dUSIPI	5.8
RMPI	-0.4

Annex 2

Figure 2.1 : GDP growth (full line) and contributions (dotted line) of surveys (middle), financial data (upper) and real data (lower) of equation given in table 3

