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Address	**Kaiserstrasse 29**
	D-60311 Frankfurt am Main
	Germany
Postal address	**Postfach 16 03 19**
	D-60066 Frankfurt am Main
	Germany
Telephone	**+49 69 1344 0**
Internet	**http://www.ecb.int**
Fax	**+49 69 1344 6000**
Telex	**411 144 ecb d**

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Abstract

We investigate the usefulness of the European Commission confidence indicators in forecasting real GDP growth rates in the short-run in selected euro area countries (Belgium, Spain, Germany, France, Italy and the Netherlands) which account for almost 90% of the euro area. We estimate a linear relationship between real GDP and confidence indicators and we compare the forecasting performance of the estimated models with a benchmark ARIMA model. We generally find that confidence indicators can be useful in forecasting real GDP growth rates in the short run in a number of countries (Belgium, Germany, France, Italy and the Netherlands). Notwithstanding some signs of instability in the relation between confidence indicators and real GDP, improvements with the use of time-varying parameter models appear to be fairly limited but confirm the findings obtained with constant parameter techniques. The results obtained are robust to a wide range of variant tests implemented.

Key words: Forecasting real GDP, Confidence Indicators, Kalman Filter

JEL Classification: C22, E27

Non-technical summary

Given their timeliness, confidence indicators are widely used by analysts and applied economists to assess short-term conjunctural economic developments. However, clear evidence of their usefulness to forecast real GDP growth is lacking in the literature. In this paper empirical work has been carried on to assess the usefulness of confidence indicators in forecasting real GDP growth in the short-run. The analysis has been implemented for the six largest euro area countries (Belgium, Spain, Germany, France, Italy and the Netherlands) using the European Commission Economic Sentiment Indicator (ESI) and Industrial Confidence Indicator (ICI).

The clearest results are that confidence indicators, and the ESI in particular, can be useful in forecasting real GDP growth rates in the short run in most of the examined countries (Belgium, Germany, France, Italy and the Netherlands). In the case of Spain, results appear to be less satisfactory pointing to a doubtful usefulness of confidence indicators to forecast real GDP growth rates in the short-run. These findings were robust to a wide variety of model specifications, encompassing both the use of a different specification form for the estimated equations and the inclusion of additional indicators as explanatory variable for real GDP. Interestingly, the specification form used appeared to be appropriate and most of the results obtained with the basic models were confirmed. The most important caveat to attach to these results is that they are based on a limited number of observations for the assessment of the out-of-sample properties. Given the presence of some sign of instability in the relation, tests were also implemented using time-varying estimation techniques. The estimation of models with the Kalman filter broadly confirmed the findings of the constant-parameter models and the improvements observed appear to be fairly limited.

1. Introduction

There has been a growing literature on confidence indicators and their use in monitoring or forecasting short-term economic developments. These indicators are now regularly followed both by public and private institutions (see Box for a definition of the types of indicators used and some indications on their construction) to get both an indication of the current economic situation and – in some cases – to help predicting short-term developments[2].

Although confidence and survey indicators are broadly used to assess current economic developments and/or undertake short-term forecasts, their use is still controversial. A set of different models (linear or not, with constant or time-varying coefficients) are proposed by practitioners, academics and applied economists to evaluate performances of forecasting models based on confidence indicators, with a view to take into account data properties. To assess the quality of the various models, both in-sample and out-of-sample properties are generally examined.

Hamilton and Perez-Quiros (1996) compare a different set of models (univariate and bivariate linear models, with and without cyclical factors) to forecast real GNP and conclude that composite leading indicators are in general useful in predicting real GNP both in in-sample and out-of-sample exercises. Camba-Kapetanios-Smith-Weale (2000) compare the GNP forecasting performance of an Automatic Leading Indicator (ALI) model based on a dynamic factor model, a VAR model and a simple autoregressive model. The results obtained crucially depend on the out-of-sample period chosen and differ among countries. For the United Kingdom, the ALI model seems to outperform both the VAR and autoregressive models whilst for the United States this evidence is much weaker.

Some authors are more skeptical about the usefulness of confidence and/or leading indicators in forecasting. Emerson and Hendry (1994) use a VAR approach to state that, in general, leading indicators do not add additional information in forecasting. Some further limitations are that leading indicators are frequently revised and open to a certain degree of subjectivity in the selection process of the component variables. Furthermore, they do not lead for long. These findings are in line with those of Weale (1996), in which the initial treatment of data (such as the smoothing of time series and the removal of trends) is considered as a further source of uncertainty when dealing with leading indicators. Stock and Watson (1992) consider the choice of the indicators included in the model as the key source of uncertainty in model specification and forecasting.

[2] See for instance "The information content of composite indicators of the euro area business cycle", ECB Monthly Bulletin (2001)

Against this background, the objective of this paper is to see to what extent confidence indicators can be useful to predict real GDP growth rate in the short run, restricting the analysis to two European Commission confidence indicators: the Economic Sentiment Indicator and the Industrial Confidence Indicator. The tests were carried out for the six largest euro area countries, which represent almost 90% of the euro area. For each country, we estimate a relationship between real GDP growth and confidence indicators. An aggregation of the results could be informative to assess the euro area short-term outlook of real GDP. Moreover, the use of a bottom-up or country specific approach is deemed appropriate given that country specific shocks have occurred in the sample period under investigation (the German Reunification, the ERM crises probably affecting different countries asymmetrically) and that data at a country level are in general available on a deeper historical basis.

The paper is structured as follows. In section 2 we present the general model we estimate and the data used are described in section 3. The estimation results obtained using the constant parameter equations are reported in section 4 together with results of a Granger causality analysis. In section 5 we investigate the robustness of the results obtained implementing several variants. In section 6 we present some stability analysis of the relationship between real GDP growth rates and confidence indicators. In this vein, results of more general time-varying parameters models estimated with a Kalman filter methodology are presented and compared with the basic results. Finally, section 7 concludes. Detailed tables and charts are provided in the Annexes.

Box. Some definitions of leading, coincident, lagging and composite indicators

A **leading indicator** is meant to anticipate an "underlying index of economic activity" (the latter being defined usually in terms of real GDP growth, industrial production or a composite indicator, see below). In general terms, if the indicator leads for one period, a drop of the leading indicator at time t-1 should be followed by a decrease in the underlying index at time t. An example of leading indicators is the OECD composite leading indicators leading by approximately 6 months industrial production. The usefulness of leading indicators for economic policy is clear-cut, leading indicators should be able to predict turning points and to track developments in economic activity. Conversely, a **coincident indicator** has no lead with respect to the underlying index, but it is coincident with its movements. However, a coincident indicator can still be useful in predicting current economic activity if the indicator is available before the underlying index (e.g. survey data on business confidence are usually released before real GDP or industrial production). A **lagging indicator** follows the movement of the reference variable instead of anticipating it. This type of indicator can be used ex-post to confirm evidence that a turning point has occurred. A **composite indicator** is obtained combining together a number of either leading or coincident indicators. The rationale behind the construction of a composite indicator is that of summarising all the information considered relevant in predicting current or future economic activity. Dealing with composite indicators, the key issues are how to choose the relevant variables to include in the composite indicator (selection process) and how to combine the different indicators that have been selected (aggregation process).

One way of constructing composite indicators is to use a scoring system that attributes points to different properties of each indicator such as: cyclical timing, economic significance, availability, statistical adequacy, conformity to the business cycle, smoothness and whether it is subject to revision. As an example, the National Bureau of Economic Research uses a scoring system to select 11 variables (out of 72) and aggregate them to construct a US composite leading indicator[3]. This methodology does not completely eliminate the subjectivity of both the selection and the aggregation process. To overcome this problem, different alternative methodologies have been proposed in the literature. Camba-Kapetanios-Smith-Weale (2000) presented an Automatic Leading Indicator (ALI) model using a dynamic factor model to automatically select the variables to be aggregated in the leading indicator. In Stock and Watson (1989) the leading variables were chosen from an initial list of 280 variables. The number of variables was then reduced after checking the statistical properties of each variable with respect to the coincident economic index produced by the US Department of Commerce. A stepwise regression was subsequently used to further reduce the number of indicators. Stock and Watson (1992) use also a Schwartz information criterion to choose the variables to be introduced in the composite indicator. Altissimo, Marchetti and Oneto (2000) combined the use of traditional NBER methods with more recent techniques of cyclical analysis (spectral analysis) in order to select, via iterative steps, the variables used to build the composite leading indicator for the Italian economy. Interestingly, the results obtained appear to be confirmed also by a methodology based on dynamic principal components (Altissimo, Marchetti and Oneto 1999).

[3] Among the 11 selected variables we have: the index of consumer expectations, manufacturers' new orders, contracts and orders for plant and equipment, changes in materials prices, broad money measured by M2, initial claims for unemployment insurance. In general, this process cannot be considered fully a-theoretical.

2. Model

In this section, we present the general model we estimate in the following sections. It is introduced in the most general way it is used in the paper, namely with time-varying parameters. A much simpler version is obtained when the stability of the parameters over time is assumed.

Let $\Delta \ln GDP_t = \begin{pmatrix} \Delta \ln GDP_1 \\ \vdots \\ \Delta \ln GDP_t \end{pmatrix}$ be a (t,1) vector that we aim to estimate.

$\mathrm{A}_t = \begin{pmatrix} \alpha_1 \\ \vdots \\ \alpha_t \end{pmatrix}$ and $\Gamma_t = \begin{pmatrix} \gamma_1 \\ \vdots \\ \gamma_t \end{pmatrix}$ two (t,1) vectors of coefficients, $I = \begin{pmatrix} 1 & 0 & \cdots & 0 \\ 0 & \ddots & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & 1 \end{pmatrix}$ the identity matrix of t dimension, $\Delta INDIC = \begin{pmatrix} \Delta INDIC_1 & 0 & \cdots & 0 \\ 0 & \ddots & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & \Delta INDIC_t \end{pmatrix}$ a (t,t) matrix , $w_t = \begin{pmatrix} w_1 \\ \vdots \\ w_t \end{pmatrix}$ of dimension (t,1) and $s_t = \begin{pmatrix} s_1 \\ \vdots \\ s_t \end{pmatrix}$ of dimension (2t,1) two vectors of residuals.

The notation is as follows: ΔlnGDP is the quarter-on-quarter real GDP growth, ΔINDIC is the first difference of the Industrial confidence indicator (ICI) or the Economic Sentiment Indicator (ESI). We have chosen to focus on the quarter-on-quarter rate of real GDP, rather than the year-on-year growth rate as can often been seen in the literature, for practical reasons. Indeed short-term forecasts for activity are usually done in many institutions on a quarter-on-quarter basis as quarterly rates are usually closer to cyclical changes than year-on-year changes which by definition depend on what happened the year before.

Both real GDP growth and the first difference of the confidence indicator refer to the same quarter. The fact that confidence indicators are released well in advance of real GDP renders this model useful for practical forecasting purposes, whether confidence indicators are leading indicators of real GDP or not[4].

[4] As an example, official National Accounts data for 2001Q2 were released for the majority of the countries examined in September 2001 whilst the EC business and consumer surveys indicators for 2001Q2 were available from mid June. This implies that an estimate of real GDP can be implemented at least 2 months before the actual data are released. Forecasting the EC indicators one quarter ahead allows to forecast real GDP in 2001 Q3 approximately 5 months before the actual data are released.

The model we have estimated for each of the six euro area countries has the following form.

$$\begin{cases} (1) \quad \Delta \ln GDP_t = \begin{bmatrix} I & \Delta INDIC \end{bmatrix} * \begin{bmatrix} \mathrm{A}_t \\ \Gamma_t \end{bmatrix} + w_t = \begin{bmatrix} I & \Delta INDIC \end{bmatrix} * \beta_t + w_t \\ (2) \quad \beta_t = \beta_{t-1} + s_t \end{cases}$$

The core of the model is a measurement equation (see equation (1)) where the growth of real GDP is a function of the variation in the confidence indicator (alternatively the ICI or the ESI). The vector of coefficients of the system (β_t) is determined by a transition equation (see equation (2)) which is assumed to follow a random walk process[5]. In the case when the parameters are assumed to be constant over time, equation (2) disappears and equation (1) becomes a basic linear relationship between real GDP growth and the variation of confidence indicators. We expect gamma to be positive, meaning that an increase in confidence will translate into higher GDP growth.

The error terms w_t and s_t are white noise orthogonal vectors such as:

$$\left\{ E(w_t w_\tau ') = \begin{cases} R & for\ t = \tau \\ 0 & otherwise \end{cases} \right.$$

$$\left\{ E(s_t s_\tau ') = \begin{cases} M & for\ t = \tau \\ 0 & otherwise \end{cases} \right.$$

$$E(w_t s_\tau ') = 0$$

The disturbances are assumed to be uncorrelated at all lags and $INDIC_t$ is uncorrelated with all the realisations of w_t.

3. Data

Confidence data were taken from the European Commission Business and Consumer surveys, namely the Industrial Confidence Indicator (ICI) and the Economic Sentiment Indicator (ESI). The choice of these indicators is to a large extent motivated by their timeliness and their comparability across countries[6]. The ICI reflects the short-term trend of industrial activity and thus the major movements in overall economic activity, while the ESI is a broad composite indicator summarising surveys among a large number of economic actors. The ICI

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[5] We do not have a strong view on the "dynamics" of the parameter β and we keep the transition equation as simple as possible.

[6] "National" indicators such as the IFO index for Germany, the INSEE for France index or the BNB indicators for Belgium could also have been utilised to forecast real GDP. However, previous studies focusing on industrial production show that, although the EC indicators are somewhat simpler, national

is the result of a monthly survey among manufacturing companies that are requested to answer questions on production trends in the recent past, total and export order books, stocks of finished products, production expectations for the months ahead and selling price expectations. The indicator is generally used to interpret short-term developments of industrial activity. Regarding the ESI, the European Commission has recently revised its calculation method excluding the share price index from the index, which was a very volatile component. It is this new ESI index that we use in this study. It consists of the ICI (with a weight of 40%), the consumer and construction confidence indicator and confidence in the retail trade sector (each component weighting 20%).[7]

The ESI is likely to be a broader measure of economic activity, therefore more closely linked to the business cycle and the dynamics of real GDP. On the other hand, a possible drawback of the ESI compared with the ICI lies in the aggregation method, which is basically a simple average of the four components indicators. The relevance of the ICI is likely to be higher in a case of an economic slowdown driven by a lack of investment following a drop in firms' confidence. As shown in the graphs, the ICI is more volatile than the ESI for all the countries examined (see Annex 2). For illustration purpose, the use of other indicators also published by the European Commission was also investigated (see part 5.7).

4. Empirical results

We first check the stationarity of the variables that enter in the relationship. As expected, real GDP is integrated of order 1, warranting its use in growth rate in the estimation. The ESI is also integrated of order one (see Annex 3 Table A1) in all the countries except Germany where the outcome of the tests is not clear-cut. Concerning the ICI, the interpretation of the tests is not straightforward, as the level of the indicator is stationary according to an ADF test but not according to a Phillips Perron test. In this case, the regression between real GDP growth and the level of the indicator has been also tested (see section 5.1).

For illustration purpose, Granger causality tests between the growth rates of real GDP and the first difference of the confidence indicators (ESI and ICI) have been implemented[8] (see Table A2 in Annex 3). The ICI Granger causes real GDP in all countries except Spain. On the contrary, the reverse causation does not hold in all countries. These results suggest the usefulness of ICI and its lagged values in explaining real GDP growth. Regarding the ESI, one-way causation, namely the ESI Granger causing real GDP, is found for all countries

indicators tend not to bring additional information to obtain an estimate of industrial production which amount for a large part of real GDP (see Annenkov, Dieppe, Mourougane (1999)).

[7] See European Economy (1997) and (2001) and Annex 1 for more details.

except Spain. In the case of Spain, no causation is found. These results are encouraging as a preliminary hint of the usefulness of confidence indicators in forecasting real GDP growth rates in the short-run.

The second stage of our investigation consists of regressing real GDP on each of the confidence indicator, using ordinary least squared techniques. Both the ICI and the ESI are significant determinants of real GDP growth, except for the ICI in Spain and in the Netherlands (see Table A1 in Annex 4)[9]. In these two countries, however, the indicator lagged one period proves to be significant (see below). As expected, the relationship between real GDP and confidence indicator is positive. The amplitude of the coefficient is comparable across countries. The fit of the equations is generally good, though the adjusted R squared is low. This low level stems from large residuals during specific episodes, for instance the German Reunification which translate into large negative residuals in most countries. Dummying-out this episode would allow a marked increase in the adjusted R-squared. This suggests that the proposed linear model is not fully appropriate for period of very large shocks. Most of the time, there are no problems of autocorrelation or heteroskedascity. In most regressions, the reset test indicates that the models are well specified and the Chow tests testing the prediction ability of the equation at a one or two quarter horizon give good results.
To assess the performances of confidence indicators in predicting real GDP growth, we focus now on the forecasting properties of the estimated models in the out-of-sample period 1995Q1 2000Q4 and compare them with the performances of a naive model used as a benchmark[10]. Given that real GDP is integrated of order one, we use a simple ARIMA model in the log of real GDP as a benchmark[11]. As we are interested only in short-term forecasts, we run one step forecasts[12], using a rolling sample of estimation starting in 1995Q1. To compare the two alternative forecasts we then calculate a Relative Mean Squared Forecasting Error (RMSFE) as the ratio between the mean squared forecasting error of the confidence model (ICI or ESI model) and the mean squared forecasting error of the ARIMA. A RMSFE higher than one implies that the out-of-sample performance of the confidence model is worse than

[8] The numbers of lags for the Granger test have been selected using the Schwarz information criterion. In most of the countries only one lag was used. In most of the cases the choice of the optimal number of lags has been also confirmed by the use of the Akaike information criterion.
[9] Tests were also carried out using the forward looking components of the ICI surveys, namely expectations for the months ahead regarding total orders and production, export and employment. Taken all together, most of these indicators do not appear to be significant determinants of real GDP. Used separately, only employment and production expectations are significant. Employment looses significance when production expectations are included in the equation.
[10] For an exhaustive treatment regarding the evaluation of forecast accuracy and comparison of alternative forecasts see Clements and Hendry (1998).
[11] For each country, the selection of the benchmark ARIMA models has been made using the Akaike and Schwartz information criteria (see Annex 3 Table A3 for more details).
[12] Both the ARIMA and the forecast using confidence indicators are dynamic h steps ahead forecasts.

the performance of the ARIMA model. We then use the Diebold-Mariano test[13] to see whether the RMSFE is significantly different from 1.[14.]

The out-of-sample results of the basic model suggest better forecasting performances of the confidence model, compared to the ARIMA, for most countries (see Table 1 below). The exception is Spain, where the out-of-sample errors of the ESI model are higher than the ones obtained using an ARIMA model. Moreover, the outcomes of the Diebold Mariano test indicate that in most of the cases the RMSFE is significantly different from one, the exception being the ICI model for France and Germany and the ESI for the Netherlands.[15] In conclusion, confidence indicators and, in particular the ESI, prove to be useful to predict real GDP growth rates in the short-run in Belgium, France, Germany and Italy. In the latter country, the performance of a model based on the ICI indicator appears to be better than those of a model using the ESI indicator.

Table 1: Relative Mean Squared Forecasting Error (RMSFE) of the basic model with constant parameters against the ARIMA model.

	ICI MODEL	ESI MODEL
BE	0.51 (2.20)	0.53 (2.23)
ES	-	1.38 (-2.26)
DE	0.63 (1.34)**	0.52 (2.01)
FR	0.94 (0.23)**	0.68 (1.43)**
IT	0.68 (2.15)	0.73 (1.58)**
NL	-	0.85 (0.88) **

Note: Diebold-Mariano statistics are provided in brackets. A star indicates that the ratio is non significantly different from 1 at 5%. Two stars indicate that the ratio is non significantly different from 1 at 10%.

[13] We are grateful to Franck Sédillot who provided us with the codes to implement the Diebold-Mariano test.

[14] The aim of this test is to see whether or not it is possible to discriminate between two forecasting models. Let e_{1t} and e_{2t} denote alternative forecast errors and $d_t = (e_{1t})^2 - (e_{2t})^2$. The Diebold- Mariano test for equal MSEs is simply formed as a t-statistic on a constant a in the regression $d_t = a + \varepsilon_t$. Though it is true that in general the closer the RMSFE is to 1, the more likely the Diebold-Mariano test will conclude to an acceptance of the hypothesis of same forecast performance, this link is in fact not so direct (see for instance the results for France and Germany). This is due to a correction of the variance which is implemented in the Diebold Mariano test. For a reference of the Diebold-Mariano test see T.E. Clark (1999).

[15] In France and Italy (ESI models), the test was accepted at a threshold slightly above 10%.

5. Robustness Tests

In this section we check the robustness of the results by implementing several variants. Results obtained are encouraging and show that most of our findings still hold once the basic model is supplemented by additional variables or when an alternative functional form is used.

5.1 An alternative specification of the model: the indicator in level

When the statistical tests were not able to give a clear answer on the stationarity of the indicators (see Table A1 in Annex 3), an alternative specification of the models making use of the level of the confidence indicators rather than the first difference has been tested. In particular, this was done for the ICI model in all the countries except Spain and for the ESI model in Germany. The idea implicit here is that activity could be sensitive to the level of confidence, and not to whether it has recently experienced a decline or an increase. This could be especially warranted in cases when the indicator is at a relatively high (or low) level compared to its long-term average. In that case, even if economic agents loose confidence, confidence could be high enough to continue to affect positively real GDP. As indicated by the estimations, the level of the indicator was most of the time significant (see Table A2 in Annex 4). The in-sample properties were slightly better than for the model using the first difference of the indicator. Regarding the out-of-sample ability of the equation to predict GDP, the results generally deteriorate compared to the basic specification using the first difference of the indicator (see Table A1 in Annex 5). Given the latter result, we have maintained the specification in first difference to perform the other variants.

5.2 Use of the lagged indicator

There is no consensus on the leading properties of the ICI and the ESI on real GDP growth in the literature [16] and it is beyond the scope of this paper to investigate this question. Still, as a test of robustness of our findings, we have tried a specification using the confidence indicators lagged one quarter[17]. It appears that the lag by one quarter is significant for both indicators in most of the countries with the exception of Belgium (ICI model) and Spain (ESI

[16] To a large extent, the lack of consensus come from the diversity of the methods employed to assess the leading properties of the indicators. See for instance, Hamilton and Perez-Quiros (1996), Vaccara-Zarnowitz (1978), Garner (1995), Stock-Watson (1998) for simple judgement-based tests, Weale (1996), Banerji (1999) for example of non-parametric tests and Artis-Bladen-Zhang (1995) or Entdorf (1993) for the use of econometric techniques

[17] Looking at higher lags, good results are obtained for the models including the indicator lagged by three quarters. However the in-sample properties are worse than those obtained for the basic models, with in particular a deterioration of the adjusted R-squared compared to the basic model or the model with the indicator lagged by one period.

model) (see Table A3 in Annex 4). Compared to the basic model, the use of the lag indicator deteriorates slightly the fit of the models as measured by the adjusted R-squared, particularly in France. However, equations that were failing the reset and the heteroskedascity tests with the basic specification appear to pass it when the lagged variation of the indicator is introduced. The out-of-sample properties of the equations are generally worse than those of the basic models (see Table A2 in Annex 5). However, in the case of Italy and the Netherlands (ESI) the confidence models predict significantly better real GDP compared to the basic model specification.

5.3 Supplementing the basic models with a large set of variables

The next set of variants consists of supplementing the basic models with variables which are potentially relevant to explain real GDP developments namely real GDP growth lagged by one quarter, industrial production growth (lagged by one period) and lags of the confidence indicators[18]. To start with, we have tested a multivariate specification where all these variables were included. In most of the regressions the explanatory variables were not statistically significant. Following a general to specific method of sequentially removing insignificant terms leads to very simple specifications with in most cases a significant role played by the coincident confident indicator (see Table A4 in Annex 4). An important exception is the Netherlands where in both the ESI and ICI models the lagged dependent variable and the lagged confidence indicator are statistically significant. However, the out-of-sample results indicates that the ICI model does not perform better then the benchmark and the results for the ESI model broadly confirm those of the basic model. For Italy (ICI model), the general-to-specific approach leads to a specification with the lagged indicator and industrial production with out-of-sample properties very close to the basic model.

To further assess the impact of each additional variable added to the basic specification, we present in the following sections the results of variants where each variable is introduced separately.

5.4 Allowing a richer dynamic for the confidence indicators

Two variants were implemented to test whether there was a need for allowing a richer dynamic for the confidence indicators: firstly, the inclusion of both the contemporary and 1 quarter lagged confidence indicator and secondly, the inclusion of a higher lag (up to two

[18] Including both the ESI and the ICI indicators is not really warranted given that ICI is one of the ESI components of ESI. Such a regression would lower the significance of the indicators and lead to unsatisfactory results.

quarters) of the confidence indicator. The fit of the equations as measured by the adjusted R-squared slightly deteriorates compared to the basic models. In most of the countries, the contemporaneous confidence indicator looses significance when lags are introduced. The main exception is the Netherlands for which both coincident and lag indicators are significant when included at the same time. Interestingly, the out of sample results of these specifications (see Table A3 and A4 in Annex 5) confirm the findings obtained using the confidence indicator lagged by one quarter only (see Table A2 in Annex 5), namely that an improvement compared to the basic model is observed in the case of Italy and the Netherlands for the ESI model. The ESI model for France including both coincident and one period lag indicator, performs marginally better out of sample than the basic model. In all other cases the results obtained are broadly similar to the basic model.

5.5 Supplementing the model with industrial production

As industrial production is very often considered as a useful source of information for short-term forecasters of real GDP, we have investigated if the inclusion of industrial production (excluding construction) in the models could improve the quality of the estimates. As a general approach we have tried to add the quarter-on-quarter growth rate of industrial production lagged by one period to the basic models. The use of the lagged rather than coincident industrial production is warranted by the fact that industrial production is always released after confidence indicator. As shown in Table A5 in Annex 4, in most cases, confidence remains a significant determinant of real GDP whilst industrial production is not. A notable exception is Spain, for which industrial production proves to be significant in the presence of either the ESI or the ICI indicator. It is also worth noting that in Italy (ICI model) and in the Netherlands, the presence of industrial production markedly lowers the significance of the confidence indicator. The out-of-sample properties of the equations supplemented with industrial production are in most of the cases broadly similar to those of the basic models (See Table A5 in Annex 5).

5.6 Supplementing the model with a lagged dependent variable

An additional test of the predictive power of confidence indicators is to ask whether these carry information about current GDP over lagged GDP. To test this, the models have been supplemented by real GDP growth lagged by one quarter[19]. In most cases, the confidence indicators remain significant. It appears that the lag of GDP is not significant in any countries,

[19] Newest-West standard errors have been used in this section to correct from moving average errors.

except Belgium (ESI). However, the RMSFE is in this case is broadly similar than for the basic model (see Table A6 in Annex 5).

5.7 Use of alternative indicators

Given the huge number of existing confidence indicators, it could also be interesting to assess whether other indicators could be useful to forecast real GDP growth in the short-run. Obviously it was not possible to run an exhaustive check and we have restricted the analysis to some indicators published by the European Commission in its business and consumer surveys. These are the assessment of the present business situation, an assessment of stocks, the orders placed with suppliers, expectations on business situation, an assessment of the situation on the labour market, a retail confidence indicators and the consumer confidence indicator. The results were most of the time unsatisfactory, as most of these indicators were not significant determinants of real GDP growth. More precisely, the consumer confidence indicator was significant only in Italy and the assessment and the expectations on the labour market situation were only significant in the Netherlands. At last, orders appear to determine real GDP only in Italy and in the Netherlands. Lags of one quarter of these indicators were also tested and were in most of the cases not significant determinant of activity, the major exception being the consumer confidence indicator in the majority of countries. However, the use of this indicator however did not improve markedly the adjusted R-squared compared to the models using the ESI or ICI indicators and the out-of-sample properties of this equation were not better, with RMSFE significantly below 1 only in Italy, Germany and the Netherlands (see Table A7 in Annex 5). To conclude, amongst the additional EC indicators that have been tested, no one proved to be as useful as the ESI or the ICI in forecasting short-term real GDP growth rates for all the countries examined.

6. Is the relation between confidence indicators and real GDP stable overtime?

As indicated above, confidence indicators seem to be useful to forecast real GDP growth in the short-run in the majority of the countries examined. One explanation for the somewhat unsatisfactory performance of the models in some countries or over certain periods could be that the relation between real GDP and confidence indicators, which was supposed unchanged over time, is in fact time-varying. Indeed, the sample period under examination covers a number of shocks like the German Reunification and the ERM crisis of 1992 and there might have been some break or at least some instability in the relationship. Moreover, the low R-squared obtained for some equations is, as mentioned above, stemming from specific episodes when the performance of the equation is not fully satisfactory. To investigate further this point, stability tests were implemented by computing recursive residuals of the basic equations[20]. Graphs of these recursive residuals, as well as the one-step forecast test probabilities are reported in Annex 6. Residuals outside the standard error bands suggest instability in the parameters of the equation. As shown in these graphs for the ESI model, the relation appears pretty stable in the Netherlands. By contrast, there are some signs of instability for the relations in Germany, France, Italy and Spain throughout the period. This also holds, though to a lesser extent, for Belgium and warrants the use of time-varying parameters methods. Signs of instability emerge also in the ICI model for the four countries for which the model has been estimated.

Time-varying parameters models have been estimated using a Kalman filter procedure (TVKF). This technique is generally used to estimate non-observable component models. It allows for smooth continuous adjustment of the estimate in real time as new data becomes available. It uses two sets of recursive equations to make an optimal prediction using the information available at a point in time and to update the predictors using new information based on the past prediction errors (see Hamilton (1994) page 372-408 for more details on the technique and section 2 for the specification of the estimated model).

After having checked the existence of a positive and statistically significant relationship between the variation of the indicator and real GDP growth using OLS estimates we have applied the Kalman filter on equation (1) and (2) presented in section 2[21].

Taking into account the variability over time of the estimates of β_t we generally find non-negligible movements in the coefficients over the sample but a fairly smooth profile of the estimated coefficients towards the end of the sample period (see the graphs in Annex 7 of the coefficients $\boldsymbol{\alpha}_t$ and γ_t associated to the confidence indicators) for the majority of the countries. This property warrants the use of an estimate of β_t constant over time to forecast real GDP growth in the out-of-sample period. The Lagrangian Multiplier tests indicate the absence of autocorrelation of order one and, in general, the absence of autocorrelation of order four (see Table A1 in Annex 7).

[20] In recursive least squares, the equation is estimated repeatedly, using ever larger sample of data.

[21] In order to initialise the system, we used the unconditional mean of βt obtained by estimating equation (1) with OLS. To set R, we used the unconditional variance of the residuals of (1). To initialise M, we used a proportionality rule setting $M=\lambda R$, where $\lambda=0.0001$ is the same for every estimation. λ can be interpreted as a smoothing parameter and is referred to in the literature as the signal-to-noise ratio (see Harvey (1989)). The choice of an initial value for the variance of equation (1) could be partially seen as a limit of the TVKF estimation technique. However, to reduce the arbitrariness of this step, we have used the same methodology for all countries and we have set a proportionality rule between the variance of the measurement and the transition equation.

Regarding the out-of-sample forecasting properties of the TVKF models (see Table 2 below), it appears than the RMSFE is lower than 1 in all countries but Spain and in general slightly lower than the one obtained with the OLS estimations. Examining both the RMSFE and the results of the Diebold-Mariano test, we can conclude that the results broadly confirm those of the OLS models. In particular, an improvement is obtained in the case of Germany (both ESI and ICI) and Spain. However, in the case of Spain, the improvement obtained is not sufficient to conclude on the usefulness of confidence indicators in forecasting real GDP growth. In the remaining countries results are broadly similar to those obtained in section 4.[22]

To conclude, the use of a TVKF methodology broadly confirms the results obtained with the basic constant-parameter models in terms of ability of confidence indicators to forecast real GDP growth rates. Moreover, a slight improvement of the results is obtained in some of those countries, namely Spain and Germany, where signs of instability in the relationship between GDP and confidence indicators are visible.

Table 2: Relative Mean Squared Forecasting Error of the basic model with time-varying parameters against the ARIMA model.

	ICI MODEL	ESI MODEL
BE	0.52 (2.18)	0.53 (2.22)
ES	-	1.12 (-0.83) **
DE	0.53 (1.69) *	0.48 (1.98)
FR	0.92 (0.40) **	0.78 (1.43) **
IT	0.70 (1.94)	0.74 (1.44) **
NL	-	0.80 (1.12) **

Note: Diebold-Mariano statistics are provided in brackets. A star indicates that the ratio is non significantly different from 1 at 5%. Two stars indicate that the ratio is non significantly different from 1 at 10%.

[22] In the case of France, in spite of a slight worsening in the RMSFE, the Diebold-Mariano test is the

7. Conclusions

This paper assesses the usefulness of confidence indicators in forecasting real GDP growth in the short-run. The analysis has been implemented for the six largest euro area countries (Belgium, Spain, Germany, France, Italy and the Netherlands) using the European Commission Economic Sentiment Indicator (ESI) and Industrial Confidence Indicator (ICI).

The clearest results are that confidence indicators, and the ESI in particular, could be useful in forecasting real GDP growth rates in the short run in a number of countries (Belgium, Germany, France, Italy and the Netherlands). In the case of Spain, results appear to be less satisfactory pointing to a doubtful usefulness of confidence indicators to forecast real GDP growth rates in the short-run. These findings were robust to a wide range of model specifications, encompassing both the using of a different specification form for the estimated equations and the inclusions of additional indicators as explanatory variable for real GDP. Given the presence of some sign of instability in the relation, tests were also implemented using time-varying estimation techniques and confirmed the findings of the constant-parameter models. Some limited improvements were observed in the case of Germany and Spain.

The most important caveat of the analysis presented is related to the structural break due to the creation of EMU, which has not been taken into account, as the estimations stopped in 1994Q4. Such a break may have modified the nature of the relationship between real GDP and confidence indicators.

A possible extension could be the estimation of GDP components, a natural candidate being the estimation of private consumption using the EC Consumer Confidence Indicator. The use of alternative aggregation weights for the ESI indicators could also be a possible future development of this study as a mean to increase its forecasting performances of real GDP.

same as in the constant parameter model.

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ANNEX:

Annex 1: The data set

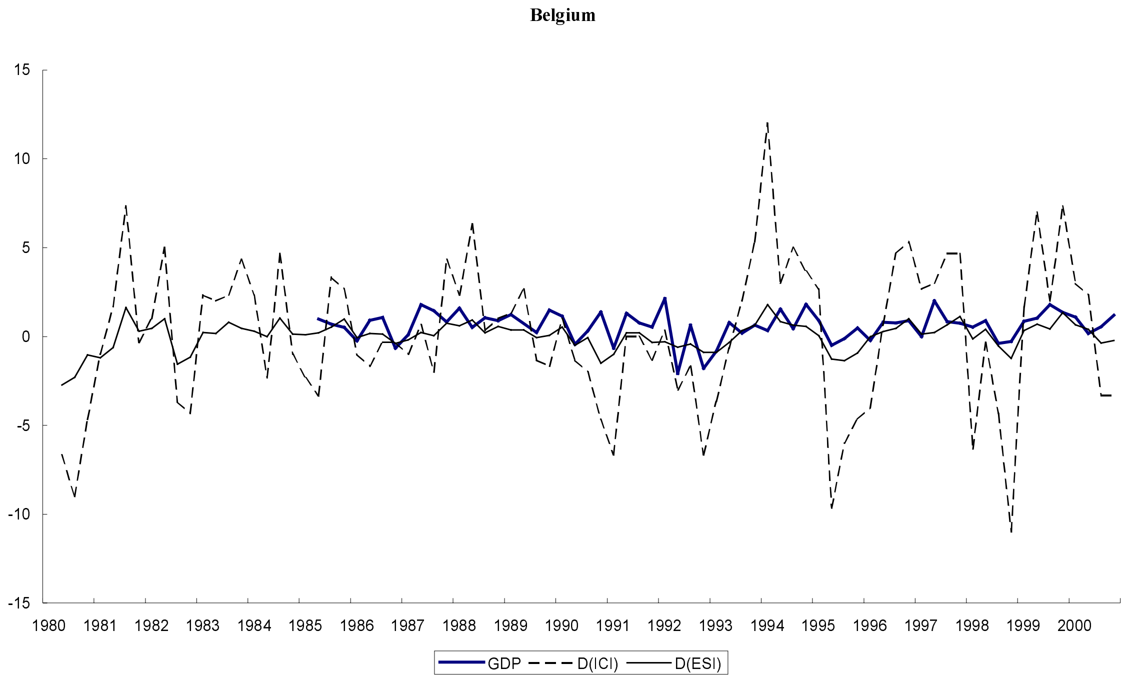
For Belgium we used ESA95 seasonally adjusted quarterly real GDP data from 1985 Q1. For Spain and Italy we used ESA95 seasonally adjusted quarterly real GDP data from 1980 Q1.
For Germany, France and the Netherlands we used ESA95 seasonally and working day adjusted quarterly real GDP data from 1980Q1.
In the case of Germany we joined real GDP series using BIS seasonally and working day adjusted data from 1980 Q1 and ESA95 seasonally and working day adjusted quarterly data from 1991 Q1.

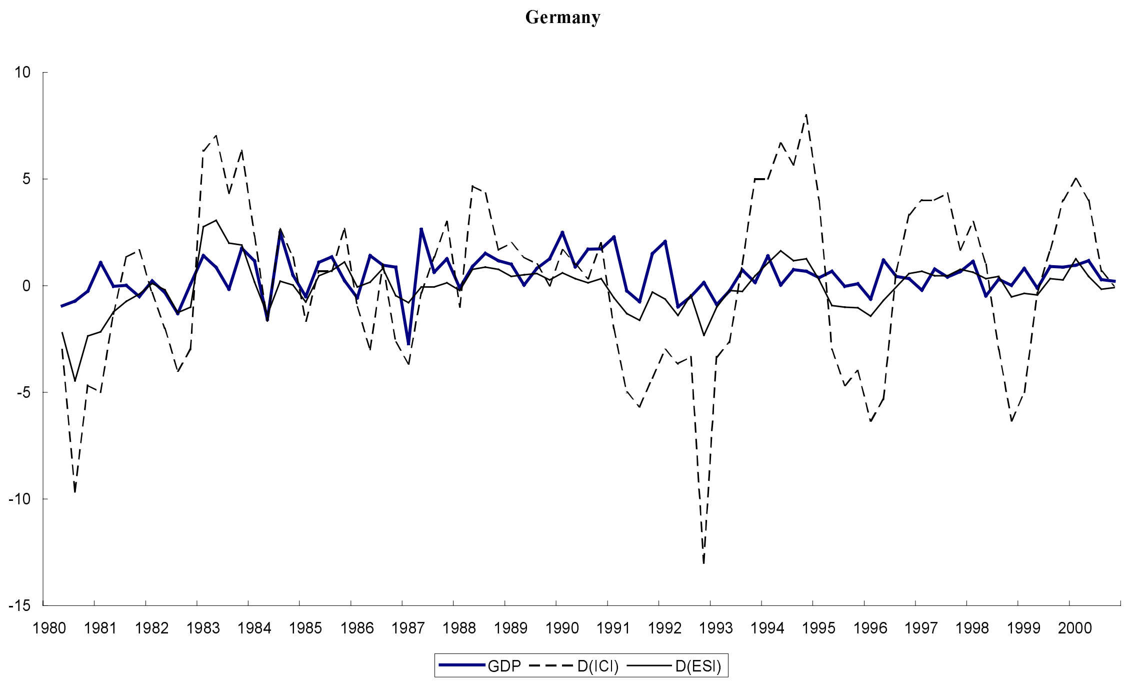
Monthly European Commission Industrial confidence indicators (ICI) and Economic sentiment indicators (ESI) were used for the six countries examined. Data used are seasonally adjusted. Monthly data were converted into quarterly series using a simple average.

Industrial Production is a production index, total excluding construction, published by Eurostat for all the countries, except for the Netherlands and Belgium for which the National definition has been used.

Annex 2:

Graphs of ESI, ICI (first difference), GDP (quarter-on-quarter % change)





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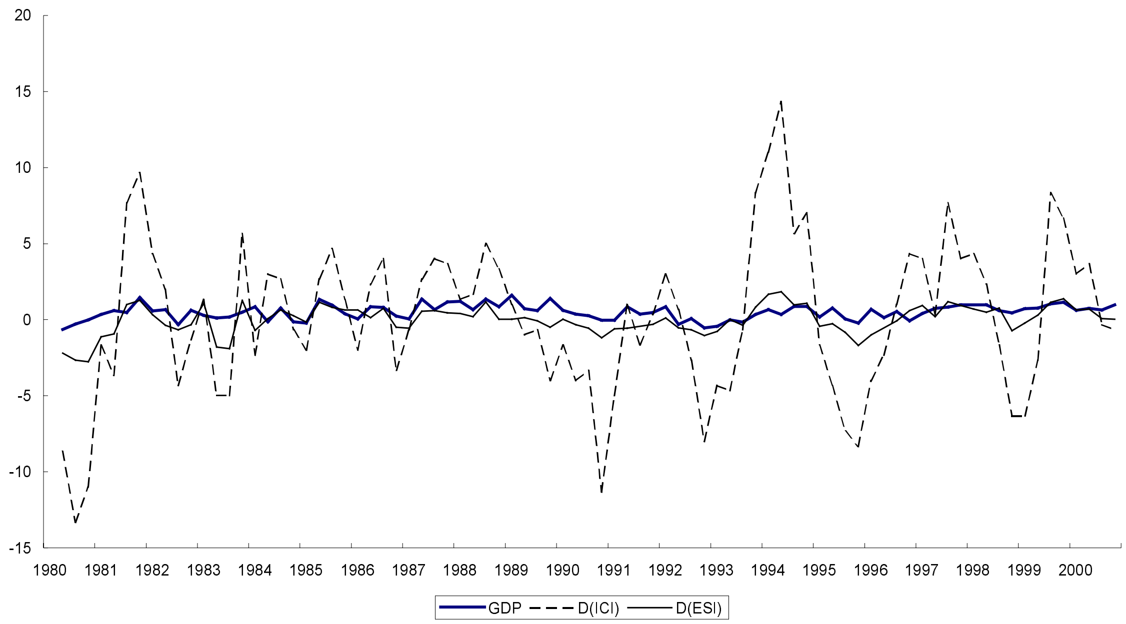
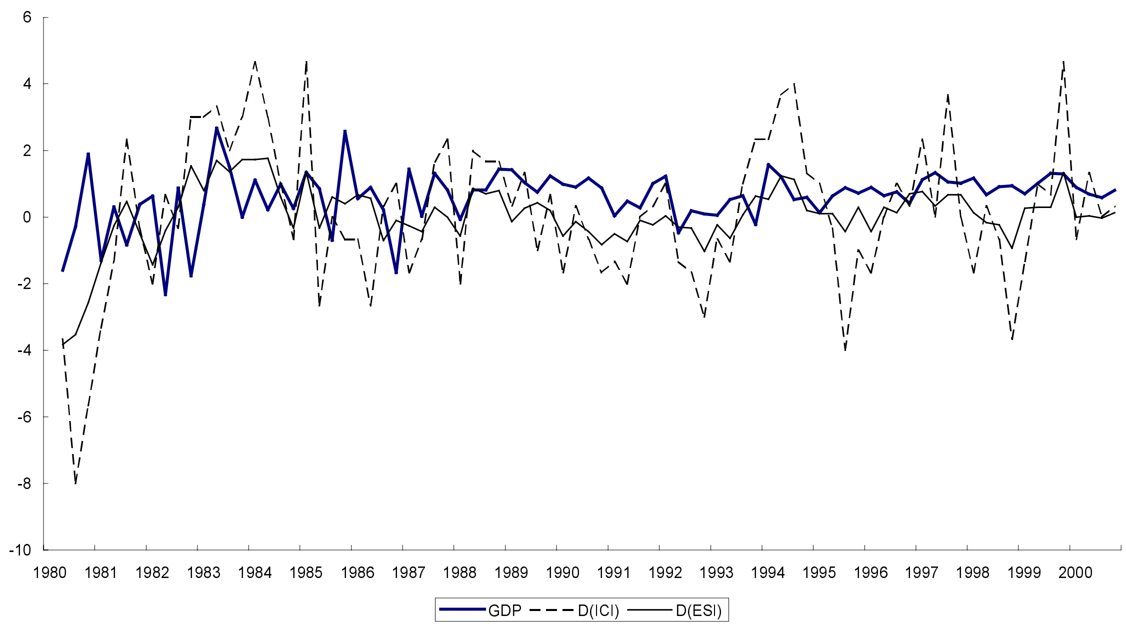


the Netherlands



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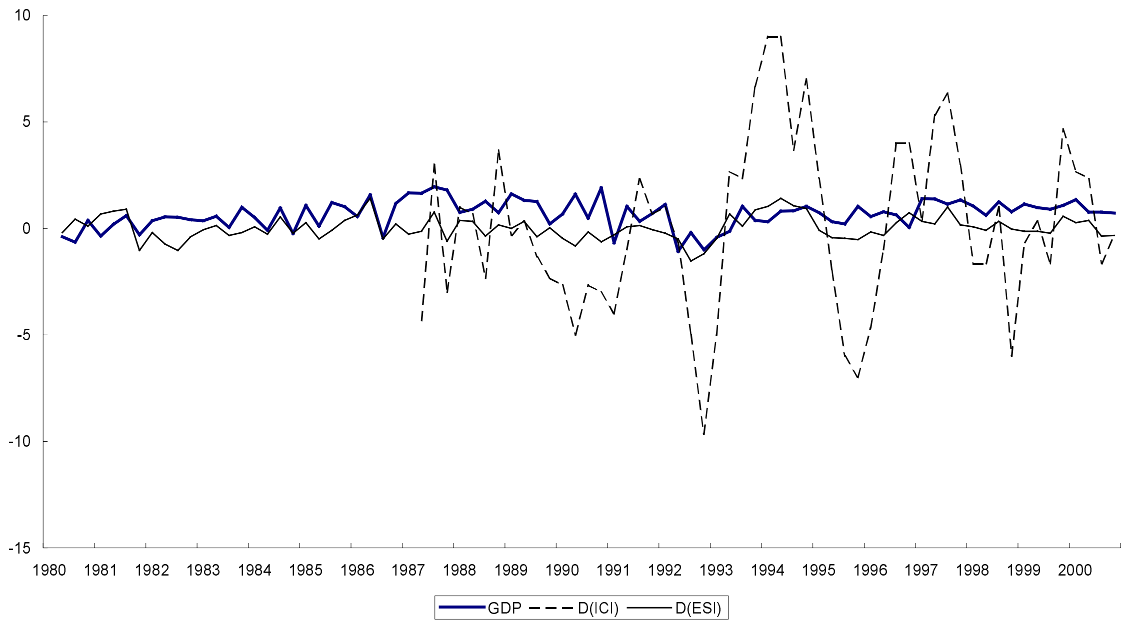
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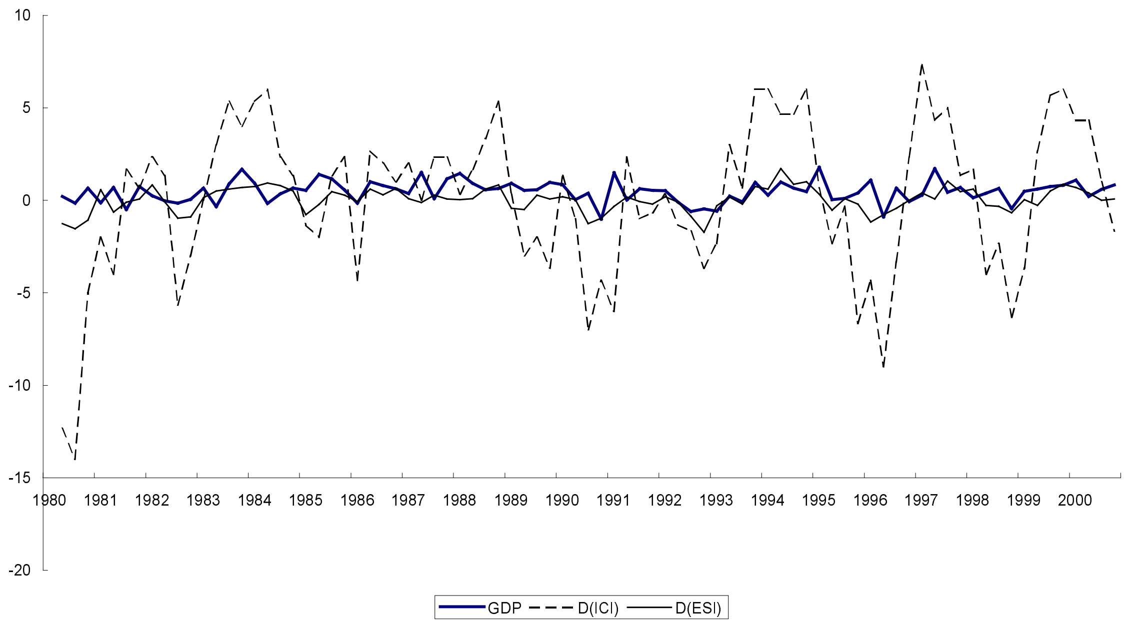
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Annex 3: Preliminary results

Table A1: Stationarity table

	BE			DE			ES			FR			IT			NL		
	ICI		D(ICI)	ICI		D(ICI)	ICI		D(ICI)	ICI		D(ICI)	ICI		D(ICI)	ICI		D(ICI)
ADF(1)	-3.4		-5.2	-3.7		-4.5	-2.7		-3.4	-3.6		-5.1	-3.0		-5.2	-1.9	**	-4.7
ADF(2)	-3.6		-4.8	-3.5		-4.4	-2.4	**	-3.5	-3.2		-5.4	-2.9		-4.9	-2.7		-4.8
ADF(3)	-3.8		-5.6	-3.1		-5.1	-2.2	**	-4.5	-2.7		-5.9	-2.4		-4.9	-2.9		-4.6
PP(1)	-2.8	**	-5.7	-2.0	**	-4.1	-1.5	**	-3.6	-1.9	**	-4.6	-1.7	**	-4.8	-1.3	**	-5.3
PP(2)	-2.5	**	-5.7	-2.3	**	-4.2	-1.7	**	-3.7	-2.3	**	-4.6	-2.0	**	-4.9	-1.5	**	-5.4
PP(3)	-2.6		-5.7	-2.4	**	-4.2	-1.8	**	-3.8	-2.4	**	-4.6	-2.1	**	-4.9	-1.6	**	-5.4
	ESI		D(ESI)	ESI		D(ESI)	ESI		D(ESI)	ESI		D(ESI)	ESI		D(ESI)	ESI		D(ESI)
ADF(1)	-2.2	**	-5.5	-3.6		-5.3	-2.4	**	-4.0	-2.5	**	-4.9	-2.3	**	-5.4	-2.0	**	-5.2
ADF(2)	-2.1	**	-4.8	-2.9	*	-4.3	-3.1	*	-4.3	-2.2	**	-4.9	-2.2	**	-5.1	-2.6	**	-5.1
ADF(3)	-2.1	**	-6.3	-3.1	*	-5.0	-2.6	**	-4.9	-2.1	**	-5.1	-2.1	**	-3.9	-2.5	**	-4.4
PP(1)	-1.4	**	-5.7	-2.5	**	-4.1	-1.7	**	-5.6	-2.1	**	-5.0	-1.4	**	-5.2	-0.9	**	-5.1
PP(2)	-1.6	**	-5.7	-2.7	**	-4.1	-1.9	**	-5.8	-2.3	**	-4.9	-1.6	**	-5.2	-1.1	**	-5.1
PP(3)	-1.7	**	-5.7	-2.8	**	-4.1	-2.0	**	-5.8	-2.5	**	-4.9	-1.7	**	-5.1	-1.2	**	-5.2

No star means that the variable is stationary at a 1% level, * stationary at a 5% level, ** no stationary
ADF(X): Augmented ADF test including a constant and X lagged difference terms
PP(X): Phillips Perron test including a constant and X lagged difference terms

TABLE A2: Granger Tests

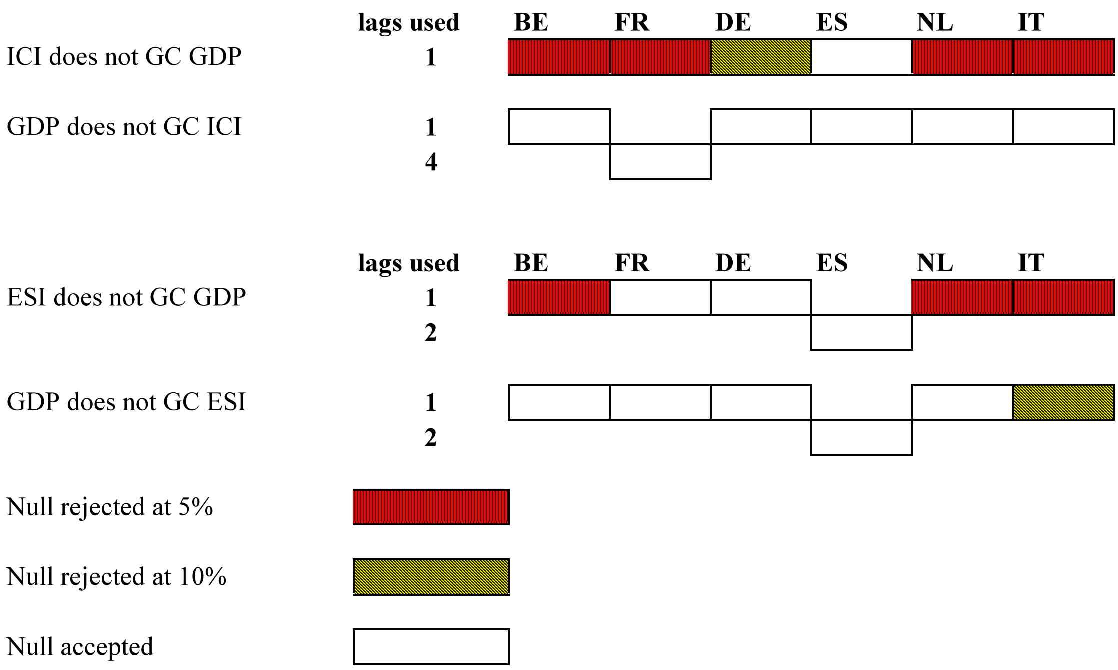


Table A3: Benchmark ARIMA Model for GDP

GDPG	BE		DE			ES		FR		IT			NL	
	1987Q1-1994Q4		1981Q1-1994Q4			1980Q3-1994Q4		1980Q4-1994Q4		1980Q2-1994Q4			1980Q4-1994Q4	
	COEF	T-STAT	COEF	T-STAT		COEF	T-STAT	COEF	T-STAT	COEF	T-STAT		COEF	T-STAT
CST	0.01	3.10	0.01	2.72		0.01	3.43	0.00	4.55	0.00	3.22		0.01	5.14
AR(1)			1.23	7.06		0.85	7.59	1.23	4.86	-0.94	-4.38		-0.80	-2.86
AR(2)			-1.15	-7.87				-0.58	-3.12	0.62	1.80		-0.17	-1.36
AR(3)			0.70	5.01						0.75	4.26			
MA(1)	-0.20	-1.31	-1.44	-7.24		-0.68	-3.84	-1.08	-4.87	1.13	4.38		0.73	2.75
MA(2)	0.52	3.35	1.51	9.23				0.67	6.17	-0.33	-0.68			
MA(3)			-0.75	-3.47						-0.71	-2.70			
S.E.	0.01		0.01			0.01		0.00		0.01			0.01	
R2 ADJUSTED	0.14		0.13			0.16		0.12		0.11			0.04	
Akaike info criterion	-6.49		-6.25			-7.13		-7.74		-7.43			-6.47	
Schwarz criterion	-6.36		-6.00			-7.03		-7.56		-7.18			-6.33	
Inverted AR Roots			0.85	.19+.89i	.19 -.89i	0.85		.61+.45	.61 -.45i	0.84	-.89+.30i	-.89 -.30i	-0.50	-.40+.11i
Inverted MA Roots	.10 -.7	.10+.72i	0.75	.34 -.94	.34+.94i	0.68		.54+.62	.54 -.62i	0.72	-.92-.38i	-.92+.38i	-0.73	

Annex 4: OLS results

Table A1: Basic models

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q2-1994Q4		1980Q2-1994Q4		1987Q3-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.01	4.03	0.01	3.84	0.01	4.62	0.00	7.67	0.00	6.16	0.00	3.98
D(ICI)	0.001	2.17	0.001	3.16	0.0004	1.14	0.001	4.93	0.0003	1.93	0.001	1.19
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.09		0.13		0.01		0.29		0.05		0.01	
RESET	0.02		0.10		0.09		0.02		0.94		0.92	
HETEROSKED.	0.02		0.17		0.05		0.55		0.21		0.92	
SERIAL CORR. 1	0.23		0.39		0.34		0.31		0.99		0.27	
SERIAL CORR. 4	0.77		0.01		0.26		0.00		0.50		0.48	
NORMALITY	0.35		0.98		0.75		0.73		0.92		0.01	
CHOW MID-SMPL	0.03		0.21		0.11		0.54		0.17		1.00	
CHOW 1Q FCST	0.48		0.74		1.00		0.97		0.94		0.97	
CHOW 2Q FCST	0.40		0.38		0.98		0.10		0.83		0.99	

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.01	3.85	0.01	4.22	0.01	6.19	0.00	8.07	0.00	6.26	0.01	4.15
D(ESI)	0.006	2.66	0.004	3.79	0.003	1.70	0.003	4.78	0.003	2.79	0.002	2.15
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.14		0.19		0.03		0.27		0.10		0.06	
RESET	0.02		0.13		0.37		0.23		0.50		0.83	
HETEROSKED.	0.00		0.48		0.13		0.63		0.24		0.55	
SERIAL CORR. 1	0.12		0.45		0.11		0.29		0.64		0.17	
SERIAL CORR. 4	0.64		0.08		0.00		0.06		0.50		0.41	
NORMALITY	0.62		0.74		0.73		0.60		0.83		0.01	
CHOW MID-SMPL	0.02		0.40		0.22		0.68		0.35		1.00	
CHOW 1Q FCST	0.48		0.91		0.96		0.96		0.87		0.96	
CHOW 2Q FCST	0.77		0.44		0.95		0.31		0.92		0.99	

Table A2: Models with the level of the indicator

GDPG	BE		DE		FR		IT		NL	
	1985Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4		1980Q2-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.01	4.32	0.01	4.88	0.01	8.22	0.01	6.42	0.01	4.99
ICI	0.0004	2.22	0.0003	3.06	0.0002	4.37	0.0001	2.53	0.0004	2.74
S.E.	0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.09		0.13		0.24		0.08		0.10	
RESET	0.45		0.50		0.83		0.67		0.38	
HETEROSKED.	0.28		0.17		0.37		0.10		0.03	
SERIAL CORR. 1	0.19		0.16		0.49		0.93		0.06	
SERIAL CORR. 4	0.50		0.06		0.67		0.79		0.04	
NORMALITY	0.17		0.16		0.98		0.97		0.22	
CHOW MID-SMPL	0.03		0.73		0.90		0.10		1.00	
CHOW 1Q FCST	0.59		0.97		0.97		0.87		0.87	
CHOW 2Q FCST	0.70		0.99		0.86		0.70		0.78	

GDPG	DE	
	1980Q2-1994Q4	
	COEF	T-STAT
CST	-0.09	-2.60
ESI	0.001	2.75
S.E.	0.01	
R2 ADJUSTED	0.10	
RESET	0.57	
HETEROSKED.	0.44	
SERIAL CORR. 1	0.25	
SERIAL CORR. 4	0.14	
NORMALITY	0.09	
CHOW MID-SMPL	0.73	
CHOW 1Q FCST	0.98	
CHOW 2Q FCST	0.95	

Table A3: Models with the first difference of the confidence indicator lagged by one period

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q2-1994Q4		1980Q3-1994Q4		1987Q4-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.01	4.02	0.01	3.84	0.01	4.59	0.00	7.59	0.00	6.20	0.01	4.46
D(ICI(-1))	0.001	1.20	0.001	1.53	0.001	1.77	0.0004	3.33	0.0004	2.03	0.001	2.04
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.01		0.02		0.07		0.15		0.05		0.05	
RESET	0.79		0.73		0.40		0.57		0.49		0.02	
HETEROSKED.	0.66		0.20		0.63		0.25		0.28		0.10	
SERIAL CORR. 1	0.28		0.37		0.41		0.16		0.73		0.18	
SERIAL CORR. 4	0.63		0.02		0.20		0.19		0.60		0.31	
NORMALITY	0.02		0.72		0.71		0.71		0.67		0.02	
CHOW MID-SMPL	0.02		0.61		0.01		0.67		0.20		1.00	
CHOW 1Q FCST	0.54		0.97		0.87		0.89		0.95		0.84	
CHOW 2Q FCST	0.68		0.75		0.69		0.57		0.86		0.77	

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q2-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.006	3.85	0.005	3.93	0.006	6.34	0.005	7.67	0.005	6.18	0.005	4.59
D(ESI(-1))	0.004	1.78	0.002	1.62	0.002	1.31	0.002	2.85	0.002	2.26	0.002	2.27
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.05		0.03		0.01		0.11		0.07		0.07	
RESET	0.78		0.62		0.03		0.56		0.45		0.04	
HETEROSKED.	0.35		0.41		0.69		0.17		0.08		0.13	
SERIAL CORR. 1	0.19		0.36		0.25		0.20		0.89		0.21	
SERIAL CORR. 4	0.56		0.05		0.00		0.21		0.65		0.37	
NORMALITY	0.07		0.57		0.58		0.67		0.69		0.05	
CHOW MID-SMPL	0.02		0.60		0.19		0.68		0.27		1.00	
CHOW 1Q FCST	0.49		0.99		0.96		0.93		0.85		0.91	
CHOW 2Q FCST	0.84		0.84		0.98		0.83		0.84		0.77	

Table A4: Multivariate approach - specific models

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q2-1994Q4		1980Q2-1994Q4		1987Q3-1994Q4		1980Q2-1994Q4		1981Q3-1994Q4		1980Q3-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.01	4.03	0.01	3.84	0.01	4.62	0.00	7.67	0.004	4.81	0.006	4.75
D(ICI)	0.001	2.17	0.001	3.16	0.0004	1.14	0.001	4.93				
GDPG(-1)											-0.127	-1.59
DLOG(IP(-1))									0.083	1.52		
D(ICI(-1))									0.000	1.56	0.001	2.51
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.09		0.13		0.01		0.29		0.08		0.05	
RESET	0.02		0.10		0.09		0.02		0.89		0.22	
HETEROSKED.	0.02		0.17		0.05		0.55		0.08		0.26	
SERIAL CORR. 1	0.23		0.39		0.34		0.31		0.88		0.29	
SERIAL CORR. 4	0.77		0.01		0.26		0.00		0.91		0.43	
NORMALITY	0.35		0.98		0.75		0.73		0.74		0.03	
CHOW MID-SMPL	0.03		0.21		0.11		0.54		0.44		0.98	
CHOW 1Q FCST	0.48		0.74		1.00		0.97		0.70		0.87	
CHOW 2Q FCST	0.40		0.38		0.98		0.10		0.87		0.88	

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q3-1994Q4		1980Q2-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4		1980Q2-1994Q4		1980Q3-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.006	3.70	0.005	4.44	0.005	5.15	0.005	7.67	0.004	5.96	0.006	5.09
D(ESI2)	0.007	1.94	0.004	4.52	0.001	0.54	0.00	2.85	0.003	3.32		
GDPG(-1)	-0.214	-1.64									-0.174	-1.95
DLOG(IP(-1))					0.197	2.12						
D(ESI2(-1))											0.003	2.64
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.16		0.19		0.15		0.11		0.07		0.08	
RESET	0.06		0.13		0.41		0.56		0.45		0.26	
HETEROSKED.	0.00		0.48		0.63		0.17		0.08		0.24	
SERIAL CORR. 1	0.58		0.45		0.56		0.20		0.89		0.81	
SERIAL CORR. 4	0.86		0.08		0.01		0.21		0.65		0.82	
NORMALITY	0.98		0.74		0.65		0.67		0.69		0.08	
CHOW MID-SMPL	0.79		0.60		0.19		0.68		0.27		0.84	
CHOW 1Q FCST	0.51		0.99		0.96		0.93		0.85		0.91	
CHOW 2Q FCST	0.63		0.84		0.98		0.83		0.84		0.84	

Table A5: Models with industrial production

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q2-1994Q4		1980Q3-1994Q4		1987Q3-1994Q4		1985Q3-1994Q4		1981Q3-1994Q4		1980Q3-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.01	4.12	0.01	3.82	0.01	5.07	0.00	6.09	0.00	5.27	0.01	4.17
D(ICI)	0.00	2.28	0.00	2.62	0.00	-1.73	0.00	2.33	0.00	1.00	0.00	0.75
IPG(-1)	-0.08	-0.98	0.03	0.28	0.44	4.97	0.10	1.41	0.08	1.42	0.04	0.79
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.09		0.11		0.46		0.21		0.05		-0.01	
RESET	0.09		0.08		0.78		0.03		0.97		0.15	
HETEROSKED.	0.07		0.29		0.06		0.68		0.32		0.52	
SERIAL CORR. 1	0.38		0.22		0.34		0.33		0.56		0.09	
SERIAL CORR. 4	0.75		0.01		0.46		0.01		0.79		0.12	
NORMALITY	0.44		0.94		0.46		0.44		0.98		0.01	
CHOW MID-SMPL	0.05		0.25		0.10		0.42		0.25		1.00	
CHOW 1Q FCST	0.59		0.91		0.90		0.93		0.75		0.98	
CHOW 2Q FCST	0.56		0.53		0.74		0.29		0.91		0.97	

GDPG	BE		DE		ES		FR		IT		NL	
	1985Q2-1994Q4		1980Q3-1994Q4		1980Q3-1994Q4		1985Q3-1994Q4		1981Q3-1994Q4		1980Q3-1994Q4	
	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT	COEF	T-STAT
CST	0.01	3.96	0.01	4.07	0.01	6.05	0.00	6.14	0.00	5.50	0.01	4.19
D(ESI2)	0.01	2.80	0.004	3.15	0.001	0.71	0.003	2.52	0.003	2.23	0.001	1.17
IPG(-1)	-0.08	-1.11	0.03	0.32	0.20	2.94	0.10	1.36	0.05	0.86	0.04	0.69
S.E.	0.01		0.01		0.01		0.00		0.01		0.01	
R2 ADJUSTED	0.14		0.15		0.15		0.23		0.12		0.00	
RESET	0.06		0.11		0.41		0.02		0.66		0.34	
HETEROSKED.	0.00		0.58		0.63		0.68		0.45		0.36	
SERIAL CORR. 1	0.18		0.29		0.56		0.27		0.62		0.07	
SERIAL CORR. 4	0.64		0.07		0.01		0.04		0.87		0.14	
NORMALITY	0.58		0.71		0.65		0.38		0.84		0.01	
CHOW MID-SMPL	0.03		0.45		0.40		0.58		0.40		1.00	
CHOW 1Q FCST	0.59		0.91		0.90		0.93		0.75		0.83	
CHOW 2Q FCST	0.65		0.64		0.93		0.33		0.90		0.97	

Description of the diagnostic tests:

The p-values of the diagnostic tests are reported.

Reset: is the Ramset reset test of functional form based on the inclusion of squared and cubed fitted values.

Heterosked.: White tests for heteroskedasticity to the residuals of the equation.

Serial corr.: Breusch-Godfrey Lagrange-Multiplier test for the first and fourth order serial correlation of the residuals.

Normality: Jarque-Bera test for normality of the residuals.

Chow mid-smpl: Chow breakpoint tests at the middle of the sample.

Chow 1Q fcst (or 2 Q fcst): Chow forecast test one (or two) quarter(s) ahead.

Annex 5: Out-of-sample forecasting properties

Tests are reported only when satisfactory in-sample models were found.

Table A1: Models with the level of the indicator

	ICI MODEL	ESI MODEL
BE	0.84 (1.48)**	-
ES		-
DE	0.70 (1.66)*	0.59 (2.12)
FR	0.87 (0.60)**	-
IT	0.74 (1.60)**	-
NL	0.55 (1.55)**	-

Table A2: Models with the first difference of the confidence indicator lagged by one period

	ICI MODEL	ESI MODEL
BE	-	0.85 (1.03)**
ES	1.40 (-1.91)*	-
DE	0.63 (1.79)*	0.60 (2.05)
FR	1.06 (-0.44)**	0.95 (0.47)**
IT	0.67 (1.60)**	0.62 (2.20)
NL	0.96 (0.20)**	0.69 (1.87)*

Table A3: Models with the contemporaneous and one period lagged confidence indicator

	ICI MODEL	ESI MODEL
BE	0.53 (2.14)	0.55 (2.15)
ES	1.42 (-2.06)	1.24 (-1.47)**
DE	0.61 (1.39)**	0.51 (2.02)
FR	0.92 (0.32)**	0.69 (1.51)**
IT	0.66 (1.78)*	0.65 (1.97)
NL	1.00 (-0.04)**	0.73 (1.66)*

Table A4: Models with the contemporaneous and up to two periods lags of confidence indicator

	ICI MODEL	ESI MODEL
BE	0.52 (2.15)	0.57 (1.94)
ES	1.48 (-2.44)	1.19 (-1.29)**
DE	0.69 (1.09)**	0.54 (1.81)*
FR	1.04 (-0.17)**	0.72 (1.30)**
IT	0.67 (1.74)*	0.65 (2.01)
NL	1.05 (-0.25)**	0.75 (1.56)**

Table A5: Models with industrial production

	ICI MODEL	ESI MODEL
BE	0.50 (2.57)	0.50 (2.67)
ES	1.61 (-1.09)**	1.17 (0.65)**
DE	0.64 (1.33)**	0.54 (1.95)
FR	0.86 (0.63)**	0.74 (1.05)**
IT	-	0.71 (1.57)
NL	-	-

Table A6:Models with GDP lagged by one period

	ESI MODEL
BE	0.52 (2.41)
ES	-
DE	-
FR	-
IT	-
NL	-

Table A7: Models with Consumer confidence indicator lagged by one period

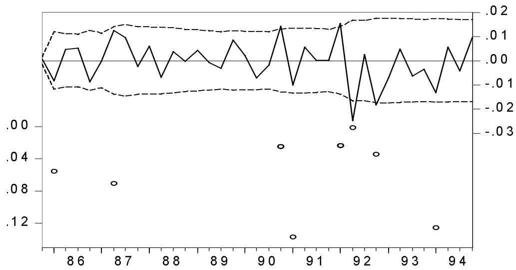
	CCI MODEL
BE	1.05 (-0.19)**
ES	0.88 (1.38)**
DE	0.70 (1.70)*
FR	1.20 (-1.09)**
IT	0.76 (1.64)*
NL	0.66 (1.22)**

Note: Diebold-Mariano statistics are provided in brackets. A star indicates that the ratio is non significantly different from 1 at 5%. Two stars indicate that the ratio is non significantly different from 1 at 10%.

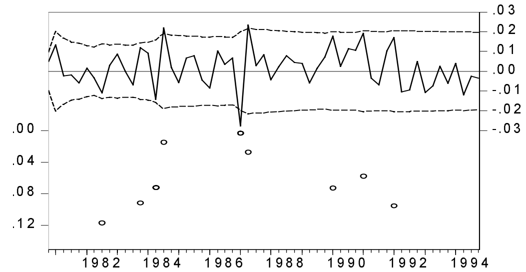
Annex 6: One-step forecast stability tests

ESI

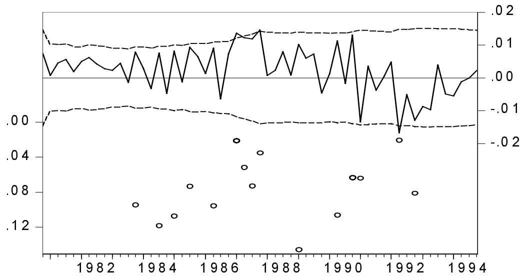
Belgium



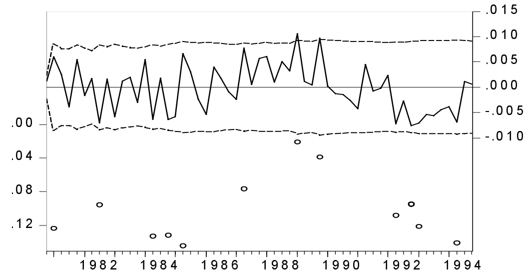
Germany



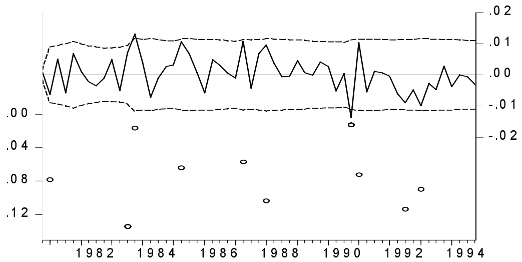
Spain



France



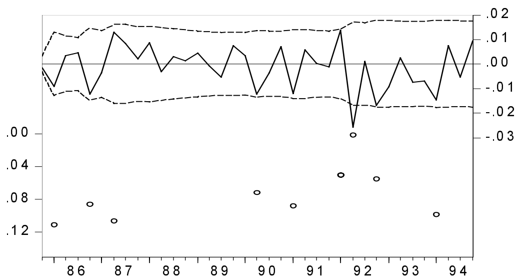
Italy



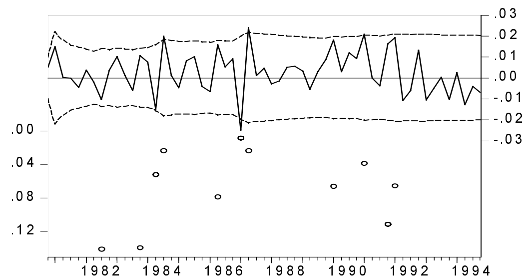
The Netherlands

ICI

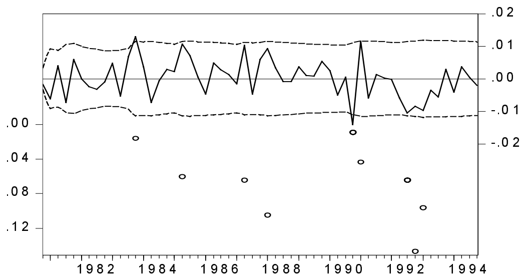
Belgium



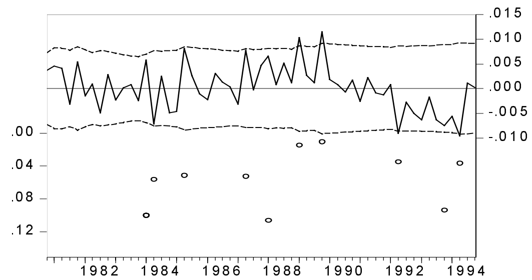
Germany



Italy



France



Annex 7: Kalman filter estimation

Table A1: Kalman Filter results in sample

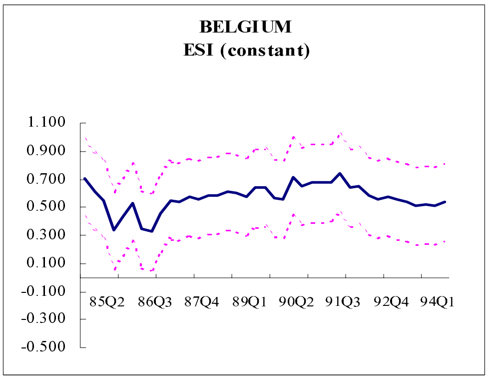
Time-varying Kalman filter model using ICI. Reported parameters refer to 1994:Q4.

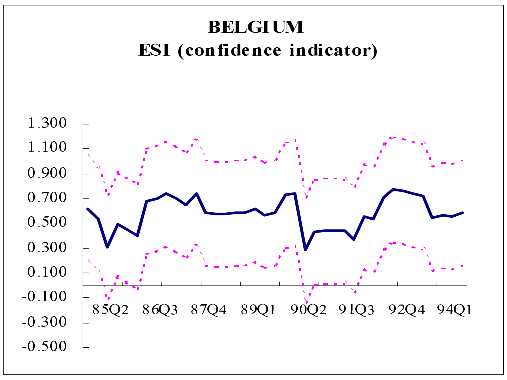
	BE	DE	FR	IT
	1985Q2-1994Q4	1980Q2-1994Q4	1980Q2-1994Q4	1980Q2-1994Q4
	COEF	COEF	COEF	COEF
CST	0.001	0.001	0.0005	0.0004
D(ICI)	0.0001	0.0001	0.00004	0.00003
S.E.	0.85	0.77	0.45	0.56
SERIAL CORR. 1	0.20	0.25	0.15	0.91
SERIAL CORR. 4	0.71	0.01	0.00	0.53
Log Likelihood	1.20	-5.01	41.92	28.42

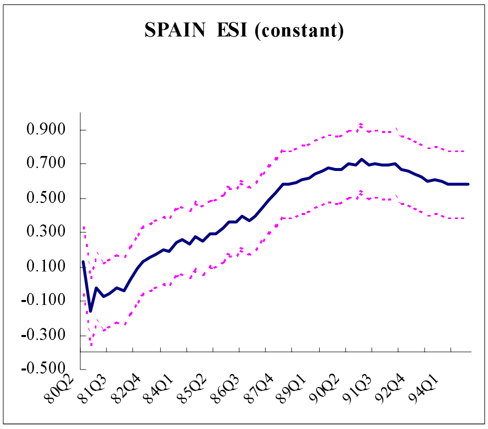
Time-varying Kalman filter model using ESI. Reported parameters refer to 1994:Q4.

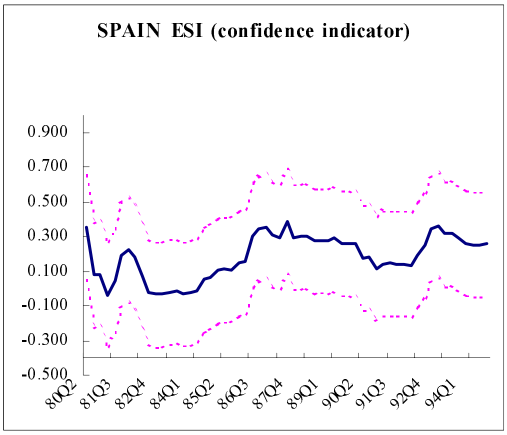
	BE	DE	ES	FR	IT	NL
	1985Q2-1994Q4	1980Q2-1994Q4	1980Q2-1994Q4	1980Q2-1994Q4	1980Q2-1994Q4	1980Q2-1994Q4
	COEF	COEF	COEF	COEF	COEF	COEF
CST	0.001	0.001	0.001	0.0005	0.0004	0.0005
D(ESI)	0.001	0.0004	0.0003	0.0003	0.0003	0.0002
S.E.	0.85	0.98	0.72	0.45	0.55	0.86
SERIAL CORR. 1	0.11	0.43	0.10	0.24	0.62	0.12
SERIAL CORR. 4	0.60	0.05	0.01	0.05	0.51	0.39
Log Likelihood	3.97	-2.15	16.34	42.86	32.45	0.51

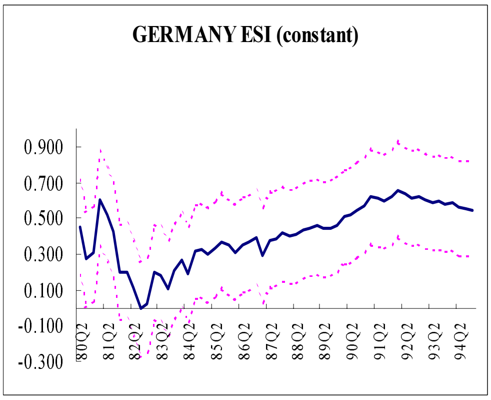
Graphs of the coefficients in the TVKF Model

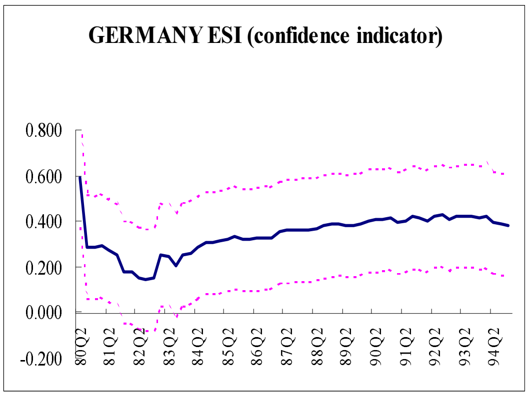


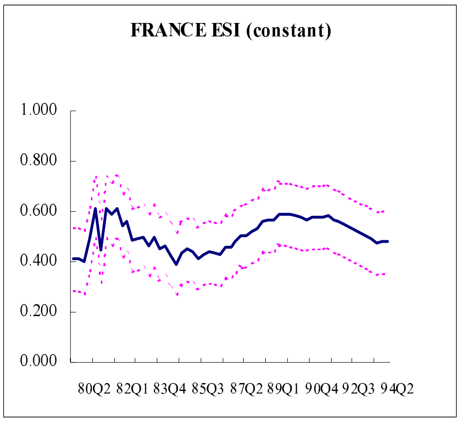


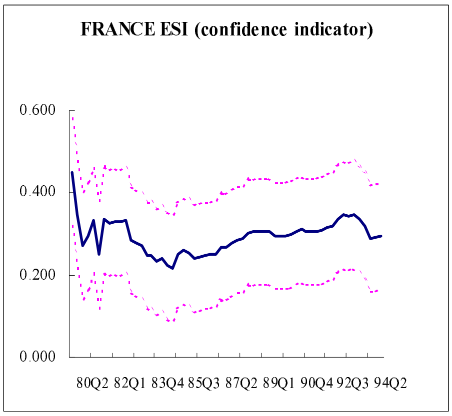


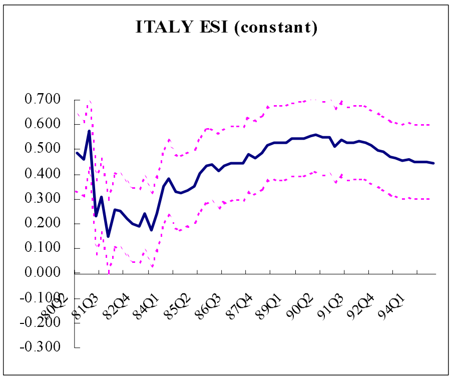


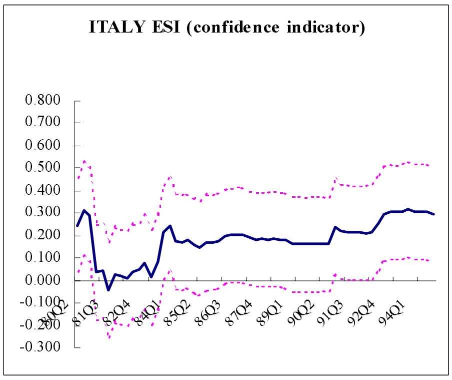


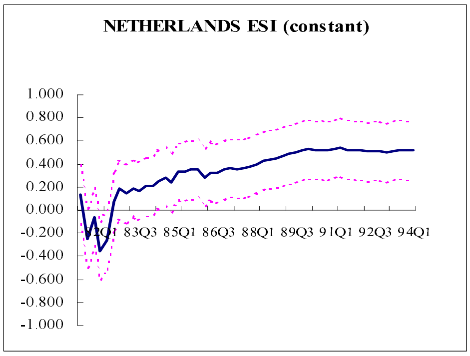


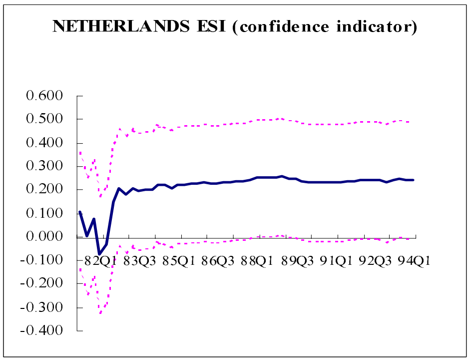

FRANCE ESI (constant)
1.000
0.800
0.600
0.400
0.200
0.000
80Q2 82Q1 83Q4 85Q3 87Q2 89Q1 90Q4 92Q3 94Q2

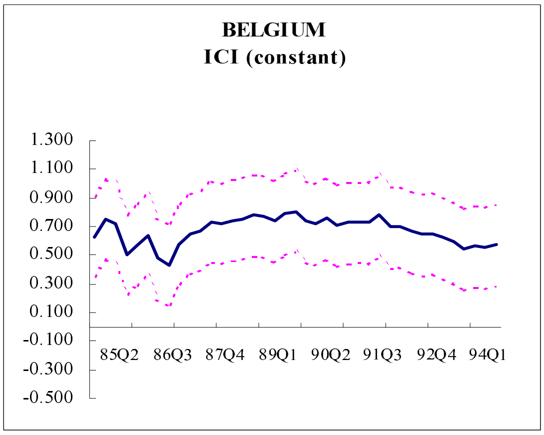

FRANCE ESI (confidence indicator)
0.600
0.400
0.200
0.000
80Q2 82Q1 83Q4 85Q3 87Q2 89Q1 90Q4 92Q3 94Q2

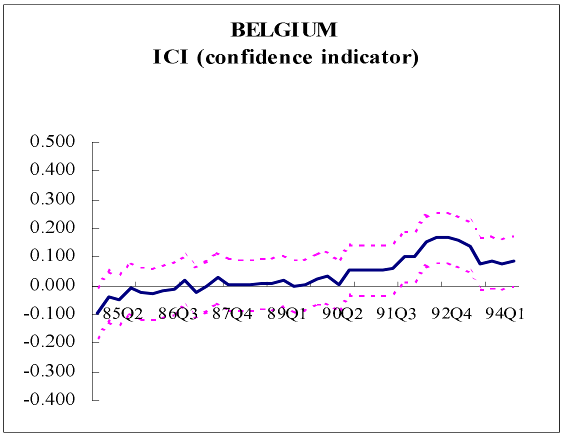

ITALY ESI (constant)
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
80Q2 81Q3 82Q4 84Q1 85Q2 86Q3 87Q4 89Q1 90Q2 91Q3 92Q4 94Q1

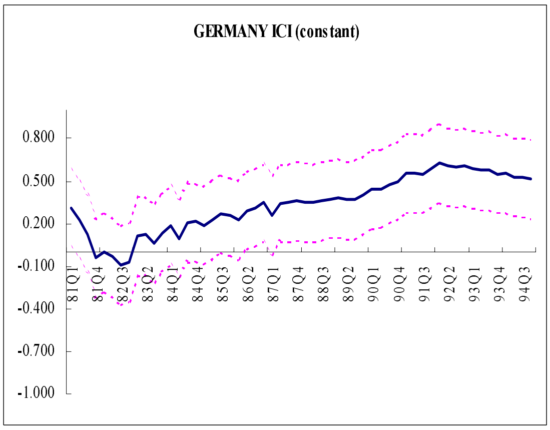

ITALY ESI (confidence indicator)
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
80Q2 81Q3 82Q4 84Q1 85Q2 86Q3 87Q4 89Q1 90Q2 91Q3 92Q4 94Q1

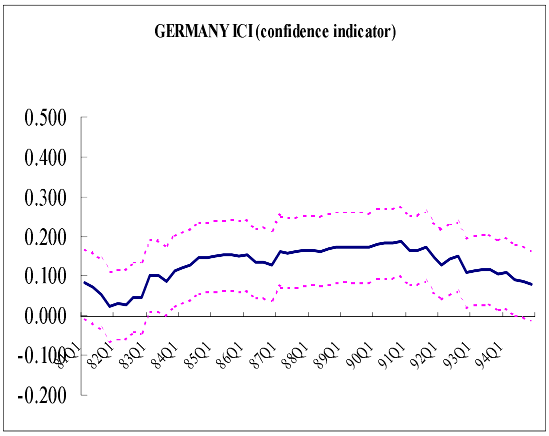

NETHERLANDS ESI (constant)
1.000
0.800
0.600
0.400
0.200
0.000
-0.200
-0.400
-0.600
-0.800
-1.000
82Q1 83Q3 85Q1 86Q3 88Q1 89Q3 91Q1 92Q3 94Q1

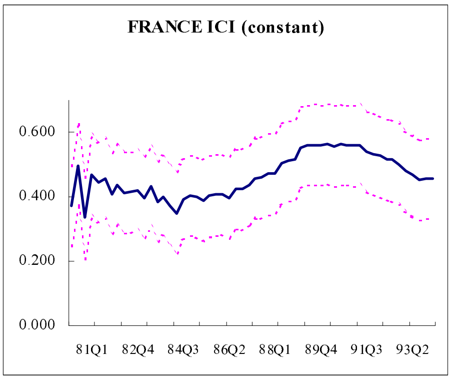

NETHERLANDS ESI (confidence indicator)
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
-0.400
82Q1 83Q3 85Q1 86Q3 88Q1 89Q3 91Q1 92Q3 94Q1

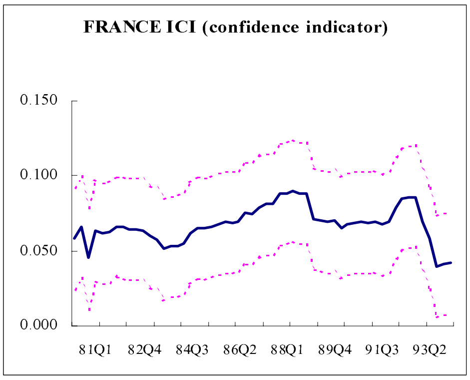

BELGIUM
ICI (constant)
1.300
1.100
0.900
0.700
0.500
0.300
0.100
-0.100
-0.300
-0.500
85Q2 86Q3 87Q4 89Q1 90Q2 91Q3 92Q4 94Q1

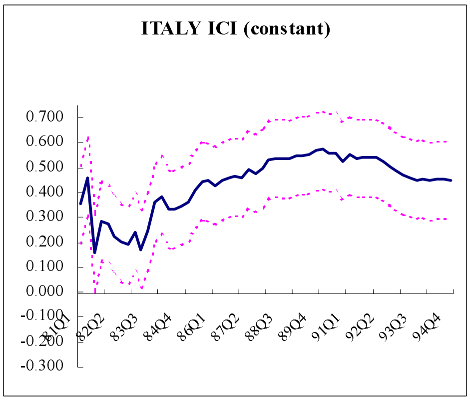

BELGIUM
ICI (confidence indicator)
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
-0.400
85Q2 86Q3 87Q4 89Q1 90Q2 91Q3 92Q4 94Q1

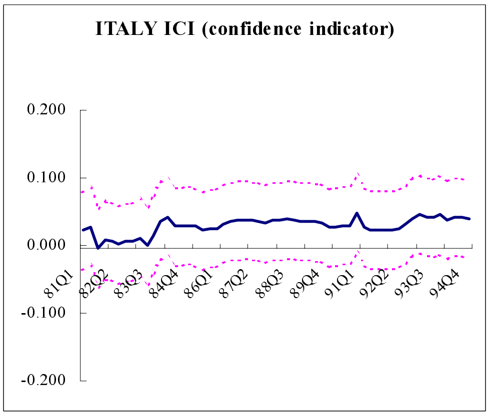

GERMANY ICI (constant)
0.800
0.500
0.200
-0.100
-0.400
-0.700
-1.000


GERMANY ICI (confidence indicator)
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200


FRANCE ICI (constant)
0.600
0.400
0.200
0.000
81Q1
82Q4
84Q3
86Q2
88Q1
89Q4
91Q3
93Q2


FRANCE ICI (confidence indicator)
0.150
0.100
0.050
0.000
81Q1
82Q4
84Q3
86Q2
88Q1
89Q4
91Q3
93Q2


ITALY ICI (constant)
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
81Q1
82Q2
83Q3
84Q4
86Q1
87Q2
88Q3
89Q4
91Q1
92Q2
93Q3
94Q4


ITALY ICI (confidence indicator)
0.200
0.100
0.000
-0.100
-0.200
81Q1
82Q2
83Q3
84Q4
86Q1
87Q2
88Q3
89Q4
91Q1
92Q2
93Q3
94Q4

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