EUROPEAN COMMISSION
Directorate General
Economic and financial affairs

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BUSINESS CLIMATE INDICATOR FOR THE EURO AREA (PRESENTATION PAPER)

Introduction

Assessment of the euro-area business climate is still overly reliant on the analysis of signals from the individual, constituent parts as opposed to aggregate signals representing developments across the whole entity. To improve the understanding of the business cycle in the area as a whole, DG ECFIN has formulated an indicator based on business surveys designed to deliver a clear and early assessment of the cyclical situation within the area.

This note presents this new business climate indicator, also called the "common factor", and outlines the appropriate method for its informative utilisation. A technical annex completes the document and explains the methodology used.

The indicator has been designed to analyse the information contained in the monthly business surveys of industry published by DG ECFIN and is updated on a monthly basis (the indicator will be published one business day following the publication of the business and consumer survey results – see release calendar in annex 1). Its movements are clearly linked to the industrial production of the euro area.

The publication of this indicator is part of a larger project launched by Pedro Solbes, EU Commissioner for Economic and Monetary Affairs, to improve and complete the quality of euro-zone and EU statistics. In addition to the recently agreed Action Plan on EMU Statistics for EURUSTAT, three new indicators are expected to be made available by DG ECFIN in the near future:

- A turning point indicator. This indicator will reveal when the euro-zone cyclical situation is changing. It will be based on the business climate indicator and will be published simultaneously with it.

- A monthly publication of euro-zone quarterly GDP forecasts. They will most probably cover the last quarter (for the period before publication of official data), the current and the next quarter from the month of reference.

- A new "service sector confidence indicator" based on new member state surveys.

What is the 'common factor' ?

This indicator uses, as input series, five balance of opinion from the industrial surveys, namely production trends in recent months, order books, export order books, stocks and production expectations. The principle of the indicator is that each of the series for the industrial surveys examined is the sum of a '**common**' component that in a way summarises the cyclical situation at a particular moment in time and a **specific** component for each of the survey questions. The objective is to separate out the information, that is common to each of the series. Such information is, as such, not normally identifiable.

The interest of such an indicator is twofold. On the one hand, it makes it possible to isolate the key information contained in the surveys. It thus allows for an 'essential' analysis of the surveys by stripping out the information which seems contradictory. For instance, in a given month, the results stemming from foreign order books may point to a slowdown while the production prospects appear more favourable. Common-factor analysis enables one to make a general diagnosis by differentiating between that information which is derived from the overall current

trend and that which is specific to a particular question. On the other hand, by comparing the evolution of the common factor and the specific component for each variable, additional insights may be gained with respect to the relative influence of each variable on the business cycle.

How to interpret the "common factor" ?

The indicator obtained, which summarises the common information contained in the surveys, may be read as a survey result: its level can be interpreted in relation to an average over a long period but its movements and trend may also be analysed.

A high level will indicate that, overall, the surveys point to a healthy cyclical situation. This may occur regardless of the fact that, for any one question in the survey, the particular situation may be slightly different. Conversely, a low level points to an adverse business climate.

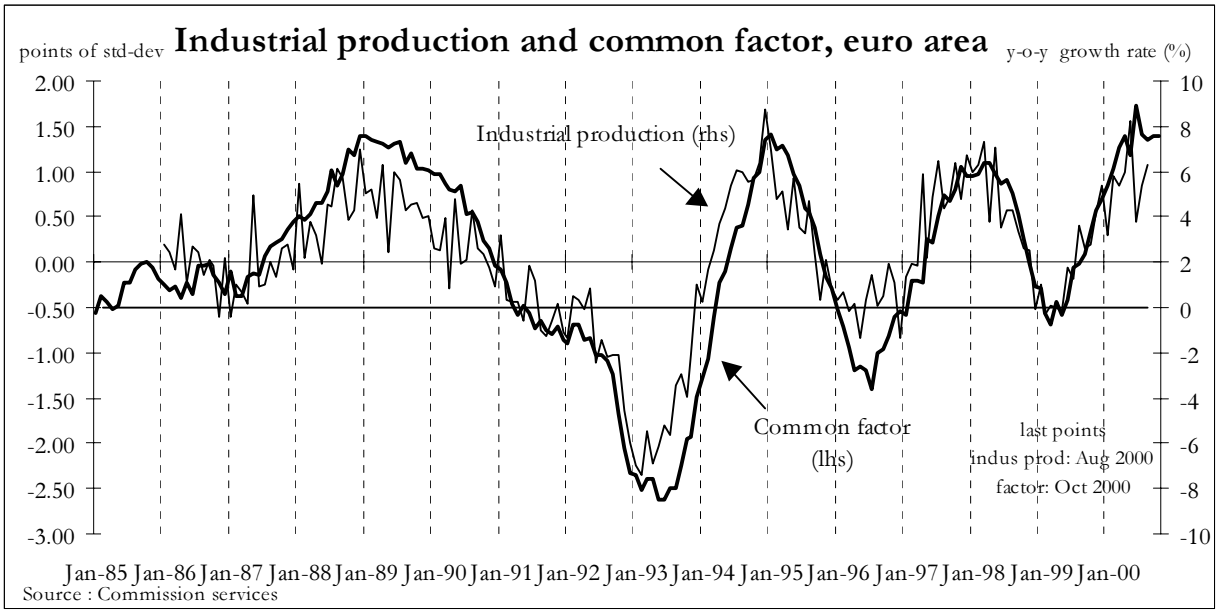
A rise (a fall) in the indicator will point to an upswing in activity and an improvement (deterioration) in the business climate.

The indicator follows a fairly smooth path, but any change in direction must be confirmed for at least two months in order to establish the existence of a significant change.

Illustration of interpretation

'Common' factor properly speaking

In order to analyse the message provided by the indicator, two opposite cyclical situations for the euro area will be commented in order to see the kind of information that the common factor delivered at that time. First, the peak following the recession of 1993 is considered. From February 1994 to January 1995, the value of the common factor rose steadily, reaching a historical high. Both the steep curvature of the slope and the level reached indicate a major reversal in the situation from that of 1993. The overall assessment of the cyclical situation in the euro area thus pointed to a clear and vigorous upswing. It was then confirmed by developments in industrial production growth rates, which recovered from a low –6 % average yearly growth rate to around +6 %.



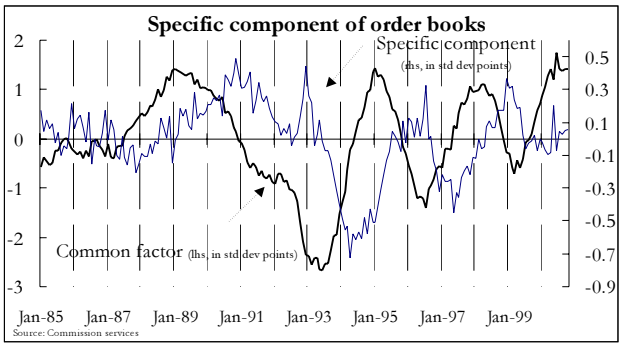
Conversely, the Asian financial crisis induced an abrupt deterioration in the common factor, beginning in early summer 1998 and lasting until March 1999. The fall of the common factor was sudden and rapid but the trough was not as severe as on previous occasions. These features are consistent with the temporary slow down experienced in the euro area at that time. Industrial production decelerated abruptly but, unlike in 1993 or mid-1996, the annual growth rate of the industrial production remained positive.

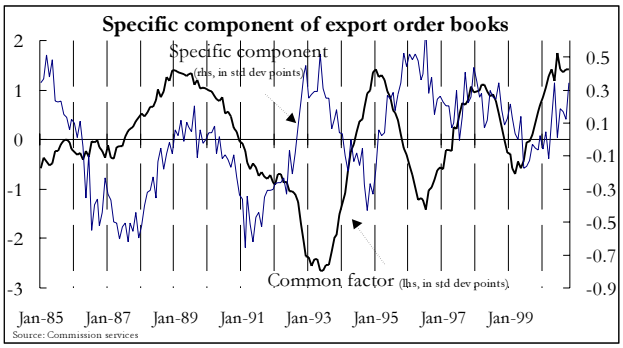
Specific components

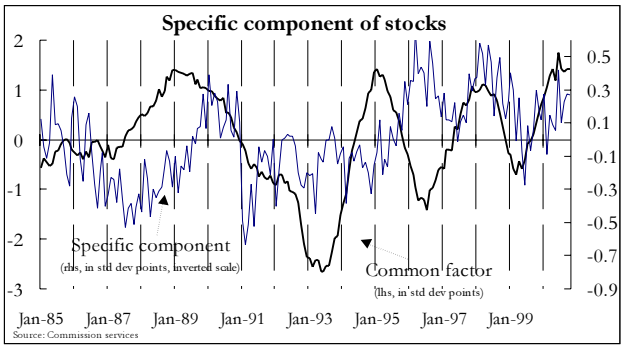
The common factor summarises the overall information that comes out from the business surveys. In addition to the common information, each particular balance of opinion includes particular information, which is sometimes called the 'idiosyncratic component'. These specific components, the analysis of which may be more intricate, can afford some useful hints as to what drives the cycle. This may be illustrated by looking at the specific component concerning the survey related to the orders.

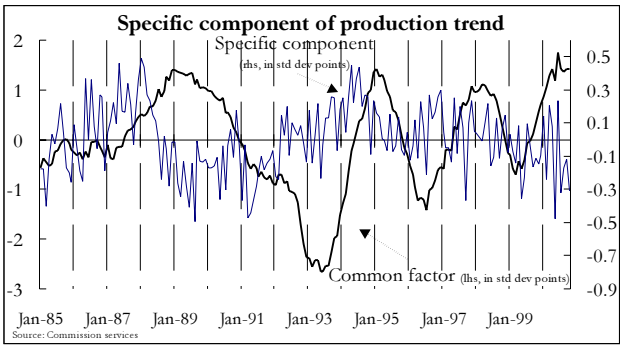
Looking back at the recovery following the 1993 recession, one can see that while the common factor was quickly recovering, the specific component with regard to orders remained at very low levels. The latter started to improve slowly only when the common factor turned positive. These developments indicate that, even if the overall climate of the business activity improved from the beginning of 1994, the order books were rather lagging in the recovery process. This implies that order books were not the most influential factor among all the relevant information that made the entrepreneurs recognise the end of the recession and the beginning of a recovery.

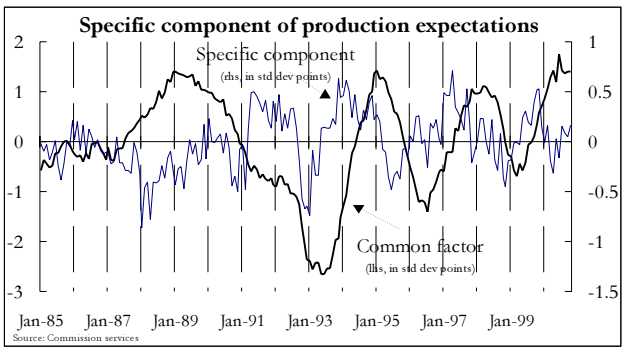
Another illustration of how to interpret the idiosyncratic component may be found from the period relating to the slow-down in the Asian crisis. As already seen, the common factor rapidly declined in early summer 1998. Contrary to the common decline, however, the specific component on order books reached a high when the common factor reached a trough, and then progressively decreased toward a more neutral area. This means that during the slow down period, the signal given by the order books was relatively more favourable (or less unfavourable) than that given by the other factors, perhaps pointing to an overly pessimistic sentiment amongst entrepreneurs re the business climate.











- A rise (fall) in the specific component means that the related balance of opinion delivers a relatively positive information compared to the other balances.
- Last points, October 2000

Methodological Annex

After first describing the data used, this Annex explains in detail the statistical method employed for the indicator.

I. Data used

(a) Use of industry survey results

The composite indicator described in this note uses the results of the monthly business surveys of industry published by DG ECFIN. These results are based on the surveys conducted at national level by the national bodies concerned (IFO in Germany, INSEE in France, etc.), with the data being reworked so as to make them more homogeneous as between Union countries. DG ECFIN publishes the series for each of the Union countries, along with two aggregates corresponding to the Union as a whole and to the euro area.

The use of survey results lends itself very well to the descriptive approach adopted here. Surveys not only enable the data to be collected direct from economic operators, but are also available rapidly (one month after the period to which they relate) and at close, regular intervals. Monthly surveys are revised very little: only the penultimate observation is marginally corrected.

The indicator is for the time being confined to industry: available surveys of the construction industry and the retail trade have not so far been used. Such a choice may appear too restrictive for analysing the business cycle in view of the fact that industry accounts for less than 25% of GDP in the euro area.

This limitation in scope can, however, be justified on two counts. First, industry is the most volatile sector of the economy: more than half of the variations in quarterly GDP is accounted for by fluctuations in industrial activity. It is therefore reasonable to study this sector more specifically with a view to detecting business cycle turning-points in the euro area. Second, for simple reasons of data availability, it is extremely difficult at the present time to cover services. The sectoral scope and time frame covered by the data are as yet too narrow for them to be the subject of an analysis comparable to that conducted on industry. Extension of the method to the construction sector and the retail trade is nevertheless under consideration.

(b) Specificity of the data published by DG ECFIN

It was decided to use the series published by DG ECFIN unchanged in order to be able to provide a direct analytical key to the data already published.

Use of these series offers the advantage of involving very little revision and benefits from consistency of the data. Unlike the practice adopted in certain published surveys (the INSEE surveys, for example), the method used for seasonally adjusting the survey balances, the "Dainties" method developed by Eurostat, does not give rise to any retrospective revisions. Observations of the past are therefore not revised, and revisions consequently do not interfere with reading of the indicator. This applies to each of the series for the euro-area countries and the euro-area aggregates used.

The new business climate indicator uses only the series relating to the euro area as a whole. These series are the result of the aggregation of the country surveys, with account being taken of the weight of the value added by each of these countries' manufacturing industry in the euro area. Use of these data allows the information from all the euro-area countries to be taken into account by assigning them a weighting commensurate with their economic importance.

(c) The euro area aggregated or each country individualised?

It was decided to use the data on all the euro-area countries for calculating the indicator. That choice reflects the desire to have a tool that takes into account all the information available in the euro area rather than an indicator "approximating" that area. The drawback of the approach is, however, that the series are available only from 1985 onwards. This reduces the number of points available for the estimations. In this context, the different estimations and asymptotic tests are not performed under the best possible conditions.

That approach having been adopted, the question arises of whether or not the data should be aggregated for the euro area. The choice regarding aggregation in fact hinges on the different viewpoints that can be taken on the business cycle in the euro area. Using the series of each of the countries is tantamount to regarding the euro area as a mere juxtaposition of the member countries' economies and giving precedence to the national dimension: a shock will affect the overall cyclical situation in the area only if its consequences are felt in each of the countries. Advocates of prior aggregation, on the other hand, take the view that any event in a euro-area country concerns the area as a whole in due proportion to the weight of that country in the area.

The choice of prior aggregation taken by DG ECFIN amounts to considering the euro area as an economic entity in its own right and not attaching particular importance to a national shock. This choice is justified in the same way as a national indicator does not give special treatment to a shock affecting a particular region of the country concerned.

On the other hand, a multinational view of the euro area involves decomposing the sum of activity in the area into a "euro area" component, a component exclusive to each country and a specific component. However, such an approach sends out a message that is inconsistent with the Community standpoint which has been given precedence here. A decomposition of this nature would mean that a shock in a single country or a shock in two regions in the same country would not be reflected in the euro-area indicator, whereas a shock affecting two regions in two different countries would be deemed to affect the indicator. Such an approach can, on the other hand, have its advantages for studying the synchronisation of cycles within the euro area, something which lies outside the scope of the indicator developed here.

There is, in any event, no consensus on the question and it is not our intention here to settle this outstanding issue. The fact remains that the differences between an indicator based on aggregate data and an indicator using juxtaposed data on each country do not result, when working on historical data, in fundamental changes in the business trend forecasts that can be made in the euro area (see the additional results set out at the end of this Annex).

(d) Details of the data

Let us briefly outline what are the series drawn from surveys (for further details, see European Commission, 1997). Generally, survey data correspond to the answers which industrial managers give to a question concerning the business climate. They can give a qualitative assessment by choosing between three types of statement, namely that the situation has improved, deteriorated or not changed in comparison with the preceding period. The answers are then aggregated having due regard to the size of the company in question and the sector in which it operates. The information on each question is presented in the form of the difference (hence the term "balance of opinion") between the percentage of firms which have noted an improvement and those which have reported a deterioration. Each series therefore varies by construction between –100 (indicating that all firms have reported a deterioration) and +100 (all firms have noted an improvement).

The one-month series are available at the beginning of the following month, except in August, the observations for which are released in October together with that for September.

Of the seven monthly series available for the euro area and published by DG ECFIN, the one relating to price movements is discarded. A strictly graphical analysis of the series suggests that the price variable appears to be less directly linked to possible expectations concerning the business climate in the euro area. Furthermore, from a statistical standpoint, studies such as those carried out by M. Forni, M. Hallin et al (2000) prove that price variables have low degrees of communality with the real economy.

Another series (the confidence indicator) is not an opinion balance proper but an average of the other series; it therefore provides only redundant information. Consequently, five series have been used: production trends in recent past (1), order books (2), export order books (3), stocks (4), and, lastly, production expectations (5). The series have been treated equally with no emphasis being placed *a priori* on the information produced by any particular question.

(e) Stationarity of the series

Construction of the "common factor" uses the technique of factor analysis, which requires stationarity of the series being analysed. As the opinion balances representing the business cycle all occur within the fixed interval [-100;+100] they are usually regarded as stationary series. This is confirmed by direct observation of the series. However, the cycles appear to be relatively slow, as confirmed by the empirical autocorrelograms for each of the series. The autocorrelations even appear to be significant up to the eighth order (see the additional results set out at the end of this Annex).

Augmented Dickey-Fuller (ADF) stationarity tests were therefore performed. As the initial series are not centred, the test's null hypothesis presupposes the existence of a constant. For each series, the test was performed taking the maximum number of lags allowing the significance level to be maintained at 95% of all the lag coefficients. The maximum lags, test statistics and associated probabilities are set out below.

Unit root test on opinion balances

	Question 1	*Question 2*	*Question 3*	*Question 4*	*Question 5*
Number of lags	8	7	8	8	8
ADF test	-3.12	-3.04	-3.31	-3.42	-3.22
Probability	2.7%	3.3%	1.6%	1.2%	2.1%

Source: Commission services.

The augmented Dickey-Fuller test therefore systematically leads us to reject the existence of a unit root at the 5% threshold: the series are consequently taken to be stationary.

Stationarity is not, however, absolutely evident: Phillips Perron tests do not allow the existence of a unit root to be rejected equally clearly at the 5% threshold. This result reflects the fact that the series used concern the euro area and are not available for a long enough time period. Unit root tests are asymptotic tests, and so it is not surprising that a limited number of observations can lead to the non-rejection of the process integration.

In constructing the indicator, the processes are therefore considered to be stationary.

II. The elaboration of the "common factor" business climate indicator

(a) Statistical method used

The method used is standard factor analysis, this being an appropriate technique where a small number of factors can represent much of the information contained in the set of initial variables.

More specifically, if y_{it} is the opinion balance for question i at date t, I the number of questions (here $I = 5$), J the number of common factors, i.e. the number of latent variables summarising the initial information, F_{jt} the value taken by the j^{th} common factor at date t and u_{it} the specific factor for question j at date t, the model can be written as

$$\forall i \in [1; I], \quad y_{it} = \lambda_{i1} F_{1t} + ... + \lambda_{iJ} F_{Jt} + u_{it}$$

$$\text{where } E(u_{it}) = 0, \quad E(F_{jt} u_{it}) = 0, \quad V(F_{1t},...,F_{Jt}) = \text{Id}, \quad V(u_{1t},...,u_{It}) = diag(\sigma_1^2,...,\sigma_I^2) = \Sigma$$

The variables are assumed here to be centred. The λ_{ij} are the regression coefficients of the jth factor for estimating the i^{th} question. The basic assumption is therefore that the specific factors are not correlated with each other and not correlated with the common factors.

To simplify the expressions, it is also assumed that the common factors are not correlated with each other and display unit variance. In that case the variance-covariance matrix of the opinion balances can be written as

$$V(y_t) = \Lambda\Lambda' + \Sigma \text{ where } \Lambda = (\lambda_{ij})_{\substack{1 \le i \le I \\ 1 \le j \le J}}$$

$$\text{or} \qquad \forall i \in [1;n], \ V(y_{it}) = \sum_{j=1}^{J} \lambda_{ij}^{\ 2} + \sigma_i^2$$

Each of the λ_{ij}^2 represents the share of the variance of y_i explained by the jth factor. The sum $\sum_{j=1}^{J} \lambda_{ij}^{\ 2}$ represents the share of the variance of y_i explained by all the factors, also called communality.

Estimation of the model was initially performed using principal factor analysis. This method does not require the number of factors to be taken to be known in advance; on the contrary, it offers a means of determining the number of relevant factors: the magnitude of the eigenvalues of the reduced correlation matrix (i.e. the correlation matrix in which the diagonal elements have been replaced by an estimate of the communalities). The results of applying this method to the opinion balances for the euro are set out in the following table.

Eigenvalues of the principal factor analysis

	1	*2*	*3*	*4*	*5*
Eigenvalue	4.58	0.046	0.008	-0.017	-0.044

Source: Commission services.

It is clear that the first eigenvalue is much more important than the others. On this criterion, it would therefore appear that a single factor is sufficient to explain the bulk of the common information in the opinion balances. This result provides a statistical justification for our choice of trying to summarise a priori the information contained in the surveys by means of a single indicator.

The model was subsequently estimated using maximum likelihood estimation with a single common factor. This method offers (in particular asymptotic) advantages over principal factor

analysis. The common factor alone explains 92% of the total variance of the opinion balances; the following table shows the communalities for each question.

Communalities of factor analysis using maximum likelihood estimation

	Question 1	*Question 2*	*Question 3*	*Question 4*	*Question 5*
Communalities	94.3%	93.0%	89.7%	91.6%	89.6%

Source: Commission services.

It will be noted that the factor analysis performed does not give rise to any Heywood cases, cases where at least one of the communalities estimated is equal to or exceeds unity. Such cases occur where the basic data do not lend themselves well to estimation and a numerical calculation problem arises. The small number of initial series (five here) together with the fact that only one factor is taken no doubt explains why a Heywood case does not occur.

(b) Static or dynamic analysis?

The use of maximum likelihood estimation for evaluating the common factor forms part of a static framework: the temporal and autocorrelated nature of the basic series is not taken into account. Everything happens, in the estimation, as if each date corresponded to the observation of an individual item of data. Strictly speaking, a dynamic method should be adopted, along the lines of that used in the macroeconomic research by Stock and Watson (1992) after Geweke (1977) but some arguments led to a static method being preferred.

The argument in favour of using the method in a static framework resides in the asymptotic properties of the maximum likelihood estimation method. Doz and Lenglart (1999) have shown that this method was consistent even in the presence of autocorrelation. The results which those authors have obtained on French data furthermore make it possible to compare the factors produced by factor analysis using maximum likelihood estimation with those produced using Kalman filters. The two factors obtained are extremely similar, something which militates in favour of using the static framework since the dynamic framework cannot be used satisfactorily.

The fact is that the dynamic test of the number of factors to be taken as developed by Doz and Lenglart (1999) yields satisfactory results. As the eigenvalues method of determining the number of factors to be taken unquestionably shows that a single factor is sufficient, in a dynamic context the Doz-Lenglart test accepts the hypothesis of sufficiency of a single factor.

Strictly speaking, a dynamic estimation of this single common factor should be perform. To make such an estimation, we would start from the initial model:

$$\begin{cases} y_{it} = \lambda_i F_t + u_{it} \text{ where i = 1 to 5 for each value of t,} \\ F_t = \varphi_1 F_{t-1} + \varphi_2 F_{t-2} + \varepsilon_t - \theta \varepsilon_{t-1} \text{ for any value of t,} \\ u_{it} = \rho_i + u_{i,t-1} + \varepsilon_{it} \text{ where i = 1 to 5 for any value of t,} \end{cases}$$

where ε_t and ε_{it} are the innovations of the common factor F_t and of the specific factors u_{it}. The dynamics of the common and specific factors is similar to that adopted by Doz and Lenglart (1999). The model can then be rewritten in the form of a state-space representation:

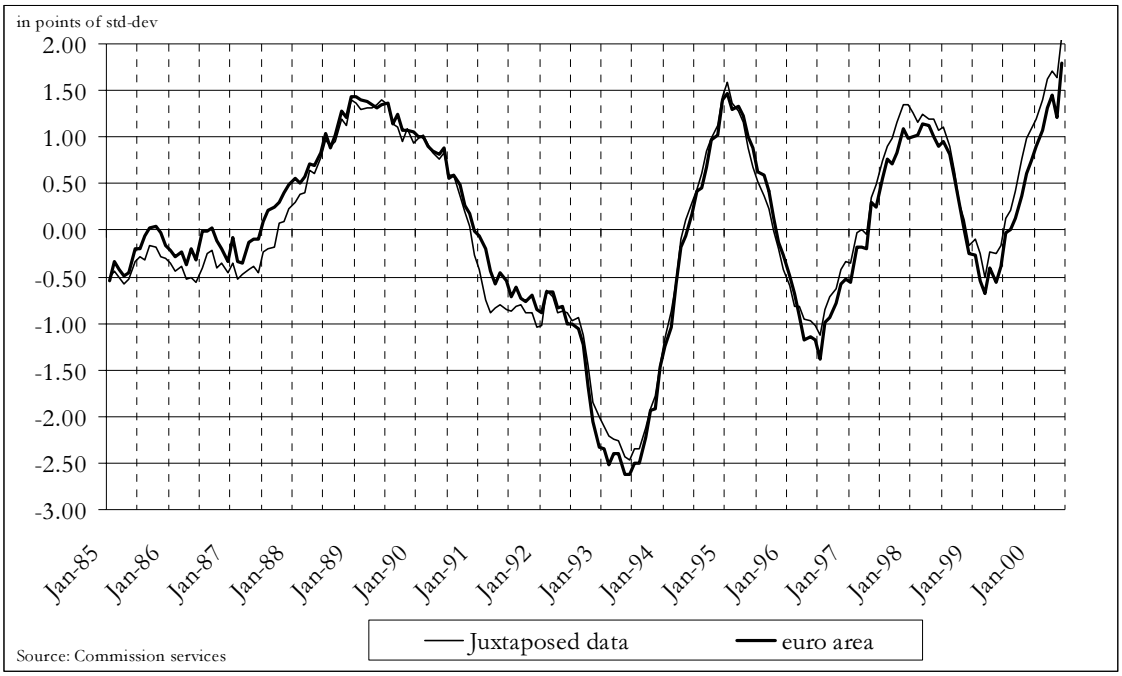
$$y_t = \begin{pmatrix} \lambda_1 & 0 & 0 & \\ \vdots & \vdots & \vdots & I_5 \\ \lambda_n & 0 & 0 & \end{pmatrix} \begin{pmatrix} F_t \\ F_{t-1} \\ \varepsilon_t \\ u_{1t} \\ \vdots \\ u_{nt} \end{pmatrix}$$

$$\begin{pmatrix} F_t \\ F_{t-1} \\ \varepsilon_t \\ u_{1t} \\ \vdots \\ u_{nt} \end{pmatrix} = \left(\begin{array}{ccc|c} \varphi_1 & \varphi_2 & -\theta & \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & \\ \hline & & & \rho_1 \\ & 0 & & \ddots \\ & & & \rho_n \end{array}\right) \begin{pmatrix} F_{t-1} \\ F_{t-2} \\ \varepsilon_{t-1} \\ u_{1t-1} \\ \vdots \\ u_{nt-1} \end{pmatrix} + \left(\begin{array}{c|c} 1 & \\ 0 & 0 \\ 1 & \\ \hline 0 & \\ \vdots & I_n \\ 0 & \end{array}\right) \begin{pmatrix} \varepsilon_t \\ \varepsilon_{1t} \\ \vdots \\ \varepsilon_{nt} \end{pmatrix}$$

Nevertheless, knowing both the results of the asymptotic test on the number of common factor and the asymptotic properties of the maximum estimation method, it has been decided to retain the static framework.

Additional results

Comparison between the common factor resulting from an analysis in which the series for each of the countries are juxtaposed and one in which aggregate data for the euro area are used



Autocorrelograms of the opinion balances

Question 1

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1	Std
0	104.965	1.00000	|********************|	0
1	98.125867	0.93484	|******************* |	0.073127
2	94.934139	0.90444	|****************** |	0.121221
3	91.478462	0.87151	|***************** |	0.153112
4	82.662352	0.78752	|**************** |	0.177670
5	75.851161	0.72263	|************** |	0.195447
6	68.979545	0.65717	|************* |	0.209248
7	58.484290	0.55718	|*********** |	0.220008
8	51.077486	0.48661	|********** |	0.227429
9	43.064373	0.41027	|********. |	0.232930
10	32.597572	0.31056	|****** . |	0.236763
11	25.810774	0.24590	|***** . |	0.238931
12	18.029752	0.17177	|*** . |	0.240281
13	8.910974	0.08489	|** . |	0.240937
14	4.417121	0.04208	|* . |	0.241097
15	-1.257693	-0.01198	| . |	0.241136
16	-6.740851	-0.06422	| *. |	0.241139
17	-8.104331	-0.07721	| **. |	0.241230
18	-11.314762	-0.10780	| **. |	0.241363
19	-12.883167	-0.12274	| **. |	0.241620
20	-11.734136	-0.11179	| **. |	0.241953
21	-13.131418	-0.12510	| ***. |	0.242229
22	-13.283569	-0.12655	| ***. |	0.242574
23	-10.965131	-0.10446	| **. |	0.242927
24	-12.478030	-0.11888	| **. |	0.243167

"." marks two standard errors

Question 2

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1	Std
0	206.261	1.00000	|********************|	0
1	202.531	0.98192	|******************* |	0.073127
2	196.371	0.95205	|****************** |	0.125138
3	188.663	0.91468	|***************** |	0.159228
4	178.007	0.86302	|**************** |	0.185207
5	165.906	0.80435	|*************** |	0.205591
6	152.679	0.74022	|************** |	0.221782
7	137.990	0.66901	|************* |	0.234622
8	122.816	0.59544	|************ |	0.244611
9	107.613	0.52173	|********** |	0.252243
10	92.154027	0.44678	|*********. |	0.257949
11	77.382021	0.37517	|******** . |	0.262054
12	63.495599	0.30784	|****** . |	0.264911
13	50.333333	0.24403	|***** . |	0.266817
14	38.563672	0.18697	|**** . |	0.268008
15	27.876340	0.13515	|*** . |	0.268705
16	18.331278	0.08887	|** . |	0.269068
17	10.899631	0.05284	|* . |	0.269225
18	4.631528	0.02245	| . |	0.269280
19	-0.751105	-0.00364	| . |	0.269290
20	-4.763753	-0.02310	| . |	0.269291
21	-7.704766	-0.03735	| *. |	0.269301
22	-9.839407	-0.04770	| *. |	0.269329
23	-11.585905	-0.05617	| *. |	0.269374
24	-13.039401	-0.06322	| *. |	0.269437

"." marks two standard errors

Question 3

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1	Std
0	180.943	1.00000	|********************|	0
1	176.380	0.97478	|******************* |	0.073127
2	170.151	0.94036	|****************** |	0.124539
3	162.365	0.89733	|***************** |	0.158011
4	151.493	0.83724	|**************** |	0.183246
5	139.808	0.77266	|*************** |	0.202673
6	127.028	0.70203	|************** |	0.217856
7	113.084	0.62497	|************* |	0.229635
8	98.292690	0.54322	|*********** |	0.238558
9	83.571091	0.46186	|*********. |	0.245083
10	69.186103	0.38236	|******** . |	0.249694
11	54.798857	0.30285	|****** . |	0.252806
12	41.910338	0.23162	|***** . |	0.254739
13	29.848723	0.16496	|*** . |	0.255863
14	18.900523	0.10446	|** . |	0.256431
15	9.512419	0.05257	|* . |	0.256658
16	1.323577	0.00731	| . |	0.256716
17	-4.904957	-0.02711	| *. |	0.256717
18	-9.783639	-0.05407	| *. |	0.256732
19	-13.747596	-0.07598	| **. |	0.256793
20	-16.226609	-0.08968	| **. |	0.256913
21	-18.188307	-0.10052	| **. |	0.257081
22	-19.290730	-0.10661	| **. |	0.257291
23	-20.606484	-0.11388	| **. |	0.257527
24	-21.708049	-0.11997	| **. |	0.257796

"." marks two standard errors

Question 4

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1	Std
0	29.522720	1.00000	|********************|	0
1	28.465262	0.96418	|******************* |	0.073127
2	27.290357	0.92438	|****************** |	0.123654
3	25.972783	0.87976	|***************** |	0.156299
4	24.259487	0.82172	|**************** |	0.180851
5	22.080750	0.74792	|*************** |	0.199822
6	19.768523	0.66960	|************* |	0.214270
7	17.391925	0.58910	|************ |	0.225182
8	15.056392	0.50999	|********** |	0.233278
9	12.555084	0.42527	|*********. |	0.239166
10	9.980625	0.33807	|******* . |	0.243176
11	7.587985	0.25702	|***** . |	0.245676
12	5.216534	0.17670	|**** . |	0.247110
13	2.966162	0.10047	|** . |	0.247785
14	0.849480	0.02877	|* . |	0.248003
15	-0.919608	-0.03115	| *. |	0.248020
16	-2.275216	-0.07707	| **. |	0.248041
17	-3.286862	-0.11133	| **. |	0.248169
18	-4.070477	-0.13788	| ***. |	0.248436
19	-4.486625	-0.15197	| ***. |	0.248845
20	-4.692300	-0.15894	| ***. |	0.249341
21	-4.731999	-0.16028	| ***. |	0.249882
22	-4.598860	-0.15577	| ***. |	0.250431
23	-4.250101	-0.14396	| ***. |	0.250949
24	-3.879752	-0.13142	| ***. |	0.251390

"." marks two standard errors

Question 5

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1	Std
0	67.486688	1.00000	|********************|	0
1	64.740285	0.95930	|******************* |	0.073127
2	61.564415	0.91225	|****************** |	0.123248
3	57.799938	0.85646	|***************** |	0.155211
4	53.136694	0.78737	|**************** |	0.178706
5	48.011898	0.71143	|*************** |	0.196383
6	42.169237	0.62485	|************** |	0.209712
7	36.425779	0.53975	|*********** |	0.219443
8	30.265209	0.44846	|********* |	0.226431
9	24.007095	0.35573	|******* . |	0.231132
10	18.069836	0.26775	|***** . |	0.234041
11	12.476111	0.18487	|**** . |	0.235674
12	7.078216	0.10488	|** . |	0.236448
13	2.004494	0.02970	|* . |	0.236697
14	-2.762757	-0.04094	| *. |	0.236716
15	-6.892357	-0.10213	| **. |	0.236754
16	-10.166342	-0.15064	| ***. |	0.236990
17	-12.675994	-0.18783	| ****. |	0.237501
18	-14.392170	-0.21326	| ****. |	0.238294
19	-15.300489	-0.22672	| *****. |	0.239313
20	-15.453138	-0.22898	| *****. |	0.240459
21	-15.013863	-0.22247	| ****. |	0.241622
22	-13.913145	-0.20616	| ****. |	0.242715
23	-13.184356	-0.19536	| ****. |	0.243649
24	-11.922839	-0.17667	| ****. |	0.244486

"." marks two standard errors

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