Are annual revisions to the national accounts cyclical?

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GDP growth in 2000 is currently put at 4.2%, representing a major revision compared with the initial estimate of 3.2%. This raises two questions. Is growth systematically underestimated? Are the revisions linked to the position in the cycle? The following analysis relates to manufacturing production, which was the subject of substantial revisions to the 2000 figure. It shows that the revisions to growth in manufacturing output that can be evaluated using statistical models of the quarterly accounts contain no bias and are not cyclical. Nor are these revisions capable of being reduced by using more complex dynamic models than the models for the quarterly accounts. Finally, there is no means of anticipating future revisions to the accounts. In particular, there is no reason to think that the slowdown in 2002 is likely to be more marked.

At the time of its preliminary evaluation, in other words at the time of the publication of the quarterly accounts for Q4 2000, the growth rate for real GDP in 2000 was estimated to be 3.2%. As the next year went on, the incorporation of revisions to the short-term indicators made it possible to revise this estimate upwards to 3.6%. However, the infra-annual information on which the quarterly accounts are based is still often only partial. The exhaustive information making it possible to calculate the annual accounts is subsequently incorporated into the quarterly accounts and leads to revisions compared with the initial evaluations. To take the example of the year 2000, the semi-definitive[(1)] annual accounts resulted in an upward revision in estimated growth to 4.2%

A revision on this scale is fortunately rare, but it had been foreshadowed by certain economists basing themselves on the sharp rises in employment and tax revenue in 2000, data which do not enter into the calculation of the quarterly GDP. In addition, it revived memories of the substantial revisions that had affected the various accounts published by the end of the 1980s, when growth had been severely underestimated in the initial evaluations.

This could mean that national accounts are subject to revisions of a cyclical nature to the preliminary evaluations, the result being to smooth the scale of both high growth and major slowdowns. In order to establish a clear diagnosis, one would need to take a substantial number of past revisions. Unfortunately, the base change and the adoption of the new system of national accounts that took place in Q1 1999 led to numerous methodological changes that made accounts on the old and new bases hard to compare. Moreover, the accounts on the new base have not been calculated for a sufficiently long time to permit the analysis of possible cyclical elements in the revisions.

Nevertheless, analysis of the differences between the spontaneous estimates of the quarterly accounts models and the annual evaluations are capable of providing a picture of the «error» committed by using short-term indicators instead of the annual accounts. Too large a cyclical element in this error would be the sign of inadequate short-term information or inadequate incorporation of this information. Moreover, the methodology underlying quarterly accounts is based on relatively simple models and an analysis of these models can show whether more elaborate statistical methods would have resulted in better utilisation of the available information — and less revision.

A reminder of the methodology

The French annual national accounts are based on information that comes close to being exhaustive but cannot be used for the quarterly accounts, for reasons either of timing requirements or periodicity. On the other hand, numerous short-term indicators are rapidly available but often differ from the national accounts, notably for reasons of definition and coverage. These indicators often in fact in-

(1) The provisional accounts are the second evaluation of the accounts for a given year, published at the same time as the «detailed results» for the fourth set of quarterly accounts; the semi-definitive accounts are the third evaluation, published a year later; the definitive accounts are the final evaluation, published a further year later.

volve a trade-off between rapidity of publication and statistical quality. They are often based on samples, meaning that they fail to cover firms that have recently been set up. This may be at the origin of notable differences between the exhaustive annual information and these indicators, since the demography of firms is closely linked to the economic cycle.

The quarterly accounts associate with each item in the national accounts a short-term indicator that can be observed infra-annually and corresponds as closely as possible to the definition used in the accounts. This association is carried out at an intermediate level of aggregation: for example, automobile production, exports of agricultural products, etc. The basic idea underlying the quarterly accounts is then to «adjust» the indicators to the annual accounts, by estimating the statistical relationship that has in the past linked the annualised indicator to the corresponding account and then to postulate that this observed relationship for annual data still holds good for the quarterly data *(see box 1)*.

For example, in order to estimate manufacturing output, the indicators used are the industrial production index (IPI) for some branches and turnover indices for the rest[(2)]. The latter do not correspond pre-

(2) The IPI and the turnover indices are published monthly in INSEE's «Informations Rapides».

BOX 1: THE CALIBRATION METHOD USED IN THE QUARTERLY ACCOUNTS

The calibration relation is a simple linear equation linking the annual accounts and the annualised indicator, written as follows:

$$C_a = \alpha + \beta * I_a + u_a$$

where C_a is the annual accounts figure for year a, I_a is the annualised indicator, in other words the annual summation of the quarterly indicator: $I_a = \sum_{q=1}^{4} I_{a,q}$, and u_a the annual differential, which represents the evolutions in the accounts that are not adequately conveyed by those of the indicator.

Coefficients α and β are estimated over several years that are common to both the account and the indicator, this period having to be sufficiently long for the estimate to be stable. In order to optimise the estimation, three models are used, involving different statistical forms for the differential. It is then possible to define the residual ε_a for these models, which is itself systematically white noise.

- A model taking levels. The differential is then stationary and non-auto-correlated; the residual is equal to the differential.
- A model taking into account a non-null auto-correlation for the differential:
$$u_a = \rho * u_{a-1} + \varepsilon_a$$
- A difference model in which the differential is not stationary: $\Delta C_a = \gamma + \beta * \Delta I_a + \varepsilon_a$

  In this case, if the coefficient γ differs significantly from zero, the calibration relationship linking the indicator to the account is in fact:
$$C_a = \beta * I_a + \gamma * T_a + u_a$$

  where T_a is a linear trend and where the differential u_a does not necessarily have a zero mean.

This relation between the account and the annualised indicator is assumed to be stable in order that estimations for the recent past remain valid for the present and also in order to permit the best possible forecasts for years for which the annual account is not known. Moreover, this relation is assumed to be identical infra-annually and this makes it possible to compile the quarterly accounts. The idea is then to apply the estimated coefficients to the quarterly indicator and to put the differential on a quarterly basis. The quarterly account is then constructed as:

$$C_{a,q} = \frac{\alpha}{4} + \beta * I_{a,q} + u_{a,q}$$

where $C_{a,q}$ is the account for quarter q of year a [(1)] and $u_{a,q}$ is the quarterly differential, smoothed so that:

$$\sum_{q=1}^{4} u_{a,q} = u_a$$

In fact, merely reproducing the observed relation between the indicator and the annual account does not make it possible to retain at quarterly level all the information contained in the annual account. There remains the differential , which contains information which the indicator, even after adjustment, cannot provide. It is then necessary to replicate this information by fitting the quarterly accounts on the annual accounts throughout all the past available period. For this purpose, the annual differential has to be broken down over each of the quarters as evenly as possible. The «smoothing» method used makes it possible to minimise variations from one quarter to another. This procedure is often preferable to simply dividing the annual differential by four — theoretically more correct when the differential is stationary — since it avoids a sharp break in the accounts at the time of the changeover from one year to another.

The sum of the quarterly accounts figures is then equal to the annual account for all the fitted years, in other words up to the semi-definitive annual accounts. For the two non-fitted years, the year of the provisional account and

(1) If the calibration relationship contains a linear trend, this is obviously retained on a quarterly basis, in other words the equation becomes:

$$C_{a,q} = \beta * I_{a,q} + \gamma * T_{a,q} + u_{a,q}$$

where $T_{a,q}$ *is a linear trend such that* $\sum_{q=1}^{4} T_{a,q} = T_a$

BOX 1: THE CALIBRATION METHOD USED IN THE QUARTERLY ACCOUNTS

the following year, the annual differential is extrapolated. The extrapolation function is linked to the method of estimating the coefficients in the calibration relationship, since it sets the residual ε_a at zero for the unknown years.

If the differential is not auto-correlated,

$$u_p = u_{p+1} = 0$$

where p is the year of the provisional annual account.

If the differential is auto-correlated, but stationary,

$$u_p = \hat{\rho} u_{p-1} \text{ and } u_{p+1} = \hat{\rho} u_p$$

If the differential is non-stationary,

$$u_p = u_{p+1} = u_{p-1}.$$

The smoothing procedure is carried out after this extrapolation of the annual calibration adjustments, and this makes it possible to avoid introducing a break between the calibrated quarters and the quarters corresponding to the provisional accounts.

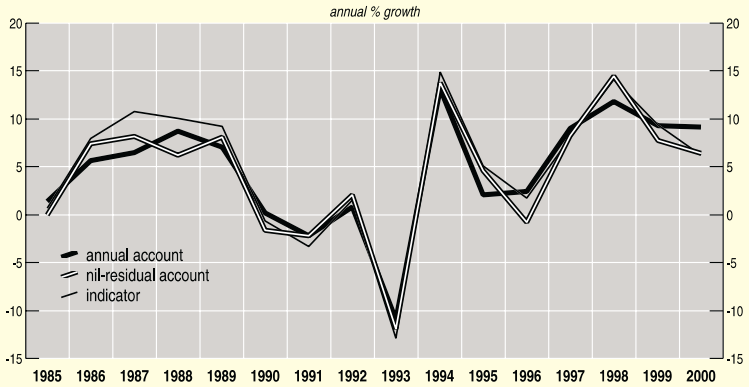
Two examples: the output of the automobile industry expressed in volume and the output of the electrical and electronic components industry expressed in value

To illustrate the transition from the short-term indicators to the quarterly accounts, two examples are set out here in detail. The graphs compare the growth rate in the annual account (C_a), in the indicator (I_a) and in the account with the nil residuals. The latter corresponds to the results of the calibration that would have been obtained if the annual account were not known, in other words extrapolating the adjustment in such a way as to set the residual to zero.

- The indicator of output in volume of the automobile branch used in the quarterly accounts is the IPI for the branch. However, on average, the IPI evolves slightly more rapidly than the annual account. The calibration therefore provides a downward correction in the growth in the indicator *(see graph 1)*. The residuals are relatively small and the IPI is in this case a good indicator.

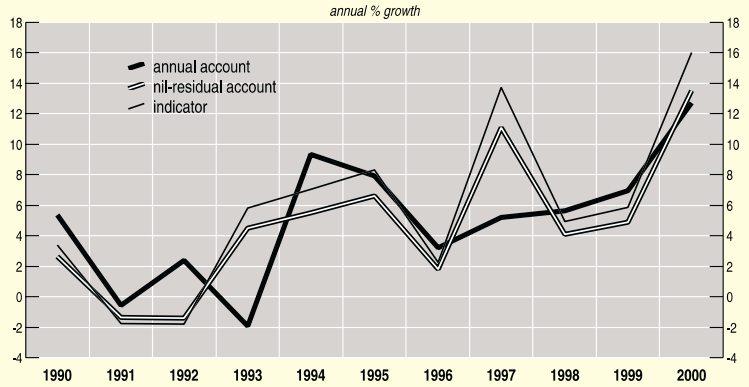
- The indicator of output expressed in value of the electrical and electronic components industry is the turnover index. In this case the annual growth rates in the indicator are often higher than for the annual account *(see graph 2)* and the calibration does indeed make it possible to correct these evolutions since the non-calibrated account is systematically less dynamic than the indicator. However, the annual differential remain very substantial as a proportion of output. In this branch, the turnover index is not a very good indicator. ■

1



ANNUAL GROWTH RATES FOR OUTPUT IN VOLUME IN THE AUTOMOBILE INDUSTRY, FOR THE IPI IN THE SAME BRANCH AND THE NIL-RESIDUAL ACCOUNT (DIFFERENCE MODEL)

2



ANNUAL GROWTH RATES FOR OUTPUT IN VALUE IN THE ELECTRICAL AND ELECTRONIC COMPONENTS INDUSTRY, FOR THE INDICATOR (TURNOVER INDEX) AND FOR THE NIL-RESIDUAL ACCOUNT (LEVEL MODEL)

cisely to the definition of output for national accounts purposes. This is because they show the evolution of turnover without making it possible to distinguish between stock changes and output. Moreover, they are published by sector of activity and not by branch. As for the industrial production index, this attempts to represent the evolution in a particular type of output, but in certain branches it is probably closer to output calculated in physical quantities than in volume. Moreover it is sometimes based, for want of anything better, on indirect information (quantities delivered, invoices ex tax, etc.). And it only covers firms with more than 10 employees.

The statistical method used in the quarterly accounts therefore attempts to adjust for differences between the average information contained in the short-term indicators and in the annual accounts. The adjustment equation which translates short-term indicators into annual accounts is called **"calibration model"**. If, for example, in a given branch the output of firms with fewer than 10 employees evolves more rapidly than that of the others, the tendency shown by the IPI will be smaller than that of the annual output in the same branch. A statistical model can then make it possible to correct this bias by adjusting the evolution of the IPI.

Revisions to the quarterly accounts

There are many causes for revisions to the quarterly accounts. It is necessary to make a distinction between those that occur at the time of the publication of the "detailed results" for the fourth quarter and take into account the evaluations of the national accounts for the three latest years from those that take place at the time of each publication.

The revisions carried out at the time of each publication have multiple origins. First of all, the short-term indicators are themselves liable to be revised or to have been incorporated when information for the latest months was still missing. Second, each indicator is adjusted for seasonal variations and this adjustment is carried out afresh each quarter, possibly leading to revisions for the relatively recent quarters. Finally, when a source disappears or is no longer suitable, the change in indicator can lead to the revision of the whole series.

As regards the past, these revisions affect only the pattern over time within the year, since the quarterly accounts are fitted on the annual accounts. They can also modify the estimate of annual growth for the last complete year, the year of the provisional account, for which only certain aggregates are fitted.

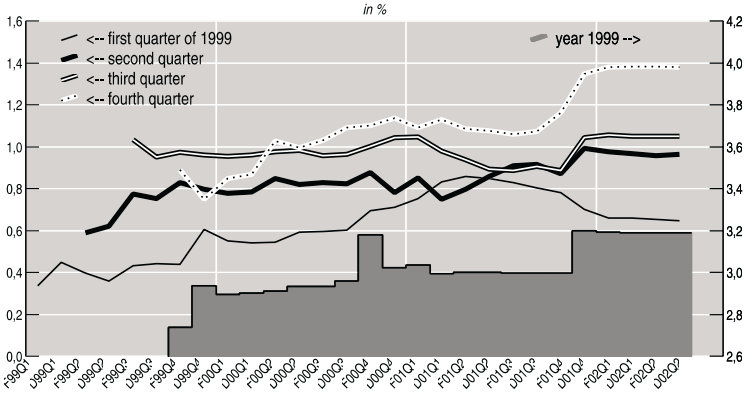
The revisions linked to the publication of the «detailed results» for the fourth quarter are of two types. First, the fitting on the definitive and semi-definitive annual accounts makes it possible to take into account the latest estimates; the incorporation of annual information in the case of the provisional account makes it possible to refine the evaluation for the latest year but this does not mean that all the accounts for that year are fitted. Moreover, the calibration relationships and the models making it possible to adjust for the impact of the number of working days are re-estimated and this can modify the patterns over time within the year for the whole of the period.

Among all these sources of revision, it is the fitting on the definitive and semi-definitive accounts that has the greatest impact. *Graph 1* shows that the largest revisions take place at the time of the publication of the «detailed results» for the fourth quarter. The following analysis therefore deals with the revisions resulting from the difference in information between the short-term indicators and the semi-definitive and definitive annual accounts. The revisions of the indicators themselves will not be analysed.

1

SUCCESSIVE REVISIONS TO THE GDP GROWTH RATES FOR 1999

in %



How to read the graph:

The curves show the growth rates for individual quarters in 1999 taking successive publications, from the «first results» for the first quarter of 1999 (F99Q1) up to the «detailed results» for the second quarter of 2002 (D02Q2). For example, at the time of the first publication for Q1 1999, the GDP growth rate for this quarter was put at 0.3%. In the following publication, it was revised to 0.4%. The shaded histograms show the evaluations for the year 1999. In this case, the «first results» for Q4 1999 show an initial growth rate for 1999 of 2.7%. The provisional accounts then show 2.9%, the semi-definitive accounts 3.0% (*), and finally the definitive accounts 3.2%.

(*) The evaluation of 3.2% already contained in the «first results» for the fourth quarter of 2000 is an exceptional case: the annual accounts adopted a new methodology for consumer prices in the telecommunications sector and this led to higher growth rates for the corresponding volume. The quarterly accounts began to use this methodology even before the publication of the semi-definitive accounts, whereas the latter subsequently produced sharp downward revisions in other items and especially industrial output.

Analysis of the residuals of the calibration models for manufacturing shows that these are not cyclical

The residuals of the calibration models give an idea of the revisions, since they correspond to the error committed in a preliminary evaluation for the year using short-term indicators and calibration models, compared with the evaluations of the definitive account (semi-definitive in the case of the year 2000). However, the information was not identical at the time of the publication of the provisional accounts: apart from the revisions to the indicators, the calibration models were estimated for different periods and the value of the coefficients is probably sensitive to the estimation period used; the calibration models may, furthermore, have changed in the meantime. The following analysis cannot therefore be as conclusive as a study of past revisions, for which the series using the new base is unfortunately of too short duration.

The study of the residuals made here is restricted to manufacturing. Value added in manufacturing in fact accounts for two thirds of the revision to the 2000 growth rate between the provisional account and the semi-definitive account. Furthermore, the analysis can be carried out directly on output, in contrast to services for which the output figure is obtained indirectly from the net change in demand items.

As indicated earlier, two types of indicator are used for manufacturing output: the industrial production index for certain branches, covering 73% of manufacturing production, and turnover indices for 22% of the total[3]. The IPI is a volume indicator, whereas the turnover indices are value indicators. As a result, in the calibration models are to be found, on the one side, annual output in volume and the IPI and, on the other, annual output in value and sales indices. In this latter case, a second calibration then makes it possible to arrive at the accounts on a volume basis, by deflating the figures in value using a price indicator. In general, this latter step does not lead to much revision, as information on prices is often the same for the definitive account and for the quarterly accounts. In the case of industrial output, the indices used are those for industrial producers prices.

This lack of homogeneity makes it necessary to deal separately with the part of manufacturing output that is estimated using the IPI in the quarterly accounts from that evaluated using the turnover indices. The sum of the residuals for each of the two parts, expressed as a percentage of output in the past year, corresponds to the error that would have been committed in the calculation of the growth rate of output for the evaluation concerning a given year, for identical information.

As can be seen from *graph 2*, the calibration models are generally satisfactory as regards that portion of manufacturing output covered by the IPI, the standard deviation of the error being 0.8% of the level of output. The mean of this error is not significant, which is consistent with the estimation methods. Nor is the correlation between this error and output significant; seen in this light, there is no cyclical element in this error. The error committed in

BOX 2: THE TECHNICAL COEFFICIENTS

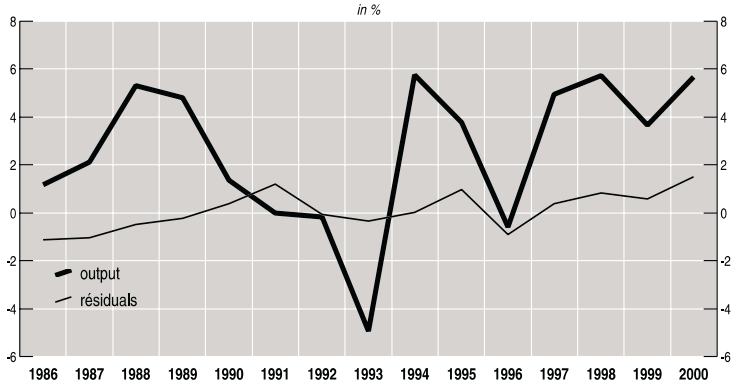
In the manufacturing branch, examination of the calibrations for output is insufficient to capture the possible revisions to value added, since these emanate also from revisions on the input side, in other words to the technical coefficients[1]. These coefficients in manufacturing and also in the economy as a whole are slightly pro-cyclical around an upward trend. However, the quarterly accounts model does not allow for this cyclical tendency, mainly for needs of rapidity of implementation[2]: there is merely an extrapolation of the past trend. However, this cyclical element is small in comparison to that for output. Moreover, merely extrapolating the trend leads to overestimating the cycles: in times of strong growth, inputs are initially underestimated and this leads to overestimating the growth rate of value added and hence of GDP, and vice versa for times of slowdown. This led to a tendency to overestimate growth in 2000. ■

(1) The technical coefficients are the ratios of intermediate consumption to output, by branch and by product. They represent the manner in which inputs contribute to the production process.
(2) The accounts are drawn up for 40 products, implying 1600 technical coefficients.

2

EVOLUTIONS IN OUTPUT AND RESIDUALS FOR BRANCHES ESTIMATED USING THE IPI

in %



(3) For production in the shipbuilding, aeronautical and railway equipment branch (5% of manufacturing output and 2% of value added in manufacturing), no indicator was judged to be satisfactory. The figure was therefore extrapolated from past trends or from the sectoral information that can sometimes be collected.

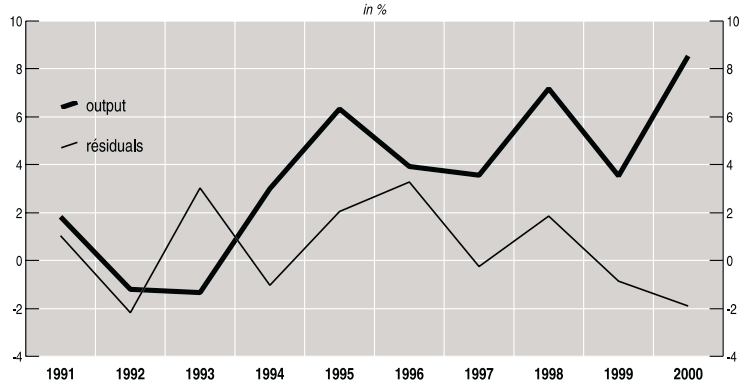
2000 is indeed substantially positive, precisely at a time when output was growing strongly, but this situation is not systematically observed in the past, 1988, 1989 and 1994 being years of major evolutions in output with negative errors. In addition, the underestimation of the year 2000 seems to be exceptional in the light of past errors and more than a third of it stems from the automobile production branch, for which the information supplied by the IPI for the year 2000 is — a rare event — really different from that emanating from the annual accounts.

Given that the turnover indices have been back-calculated only to 1990, the calibration models have therefore been estimated for the period 1990-2000. For this part of manufacturing output, the residuals are relatively substantial *(see graph 3)*. This is due principally to the existence of very large residuals in the electrical and electronics equipment industry. Even so, the residuals are not cyclical and their correlation with output is not significant. In particular, they are negative in 2000, the year in which production rose most strongly.

3

EVOLUTIONS IN OUTPUT AND RESIDUALS FOR BRANCHES ESTIMATED USING SALES INDICES

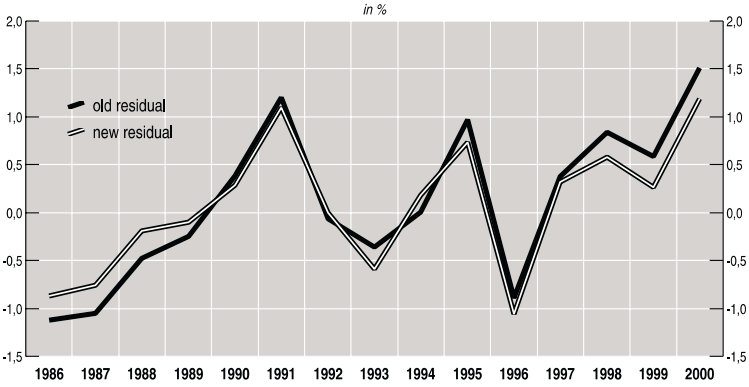
in %



4

AGGREGATED RESIDUALS OF BRANCHES ESTIMATED USING THE IPI

in %



There is need for a more complex dynamic adjustment for the calibration models in the case of manufacturing production

The calibration models used for the quarterly accounts are relatively simple. Other models were tested to see whether a more complex dynamic adjustment could improve the estimates. In addition to the contemporary indicator, these other models introduce the past history of the account and the indicator[4]. However, as these models require a sufficiently long estimation period, only one lag was tested in the case of the turnover figures.

From statistical examination of these models for all branches of manufacturing, it emerges that only in the chemical industry does the use of past levels produce a substantial gain in quality, especially towards the end of the period considered. The benefit observed is substantial, especially as it has appreciable repercussions at a more aggregated level *(see graph 4)*. This model[5] was incorporated at the time of the publication of the "first results" for Q3 2002.

Taking branches individually, it would therefore appear that the calibration models used bring the short-term information into line as far as possible with annual data, making use of the regularities observed in the past. Analysis of relations between residuals at branch level also shows significant correlations and taking these into account does not improve the calibration. Moreover, calibration at aggregate level gives much the same residuals.

Finally, the preceding analysis indicates that the residuals for manufacturing production are not cyclical. In particular, those for the year 2000 are on an exceptional scale. Moreover, examination of the models does not seem to indicate that more complex dynamic adjustment would improve the estimate of production, apart from one branch for which a new model has now been adopted. Based on this analysis — albeit partial since it covers only manufacturing production and is not based on series of revisions — there is nothing to suggest that the quarterly accounts are going to understate the slowdown in 2002. ■

(4) These models are written in the following general fashion:
$C_a = \alpha + \beta I_a + \gamma C_{a-1} + \delta I_{a-1}$ *and*

$\Delta C_a = \alpha + \beta \Delta I_a + \gamma \Delta C_{a-1} + \delta \Delta I_{a-1}$

(5) After elimination of non-significant coefficients, what we have is an estimation model introducing only the contemporary level of the indicator: $\Delta C_a = \alpha + \beta \Delta I_a + \gamma I_a$.