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RESEARCH INTO METHODS TO IMPROVE THE TIMELINESS OF SHORT-TERM INDUSTRIAL PRODUCTION STATISTICS

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Prepared by: Leendert Hoven and Ronald van der Stegen
Statistics Netherlands
Division of Macro-economic Statistics and Dissemination
Development and support department

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Contact: Richard McKenzie (richard.mckenzie@oecd.org), Statistics Directorate, OECD

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RESARCH INTO METHODS TO IMPROVE THE TIMELINESS OF SHORT-TERM INDUSTRIAL PRODUCTION STATISTICS

Summary:

This paper informs about a timeliness research project that is presently carried out by Statistics Netherlands. The aim is to investigate the possibilities of substantially improving the timeliness of short-term industrial production statistics. The paper focusses on industrial turnover statistics, which is one of the primary sources of the industrial production index and quarterly GDP. Simulations demonstrate that the accuracy of the estimates is greatly reduced if these are based on early (lower) response while using the current imputation method for responding units that have not yet reported.

The timeliness research considers three possible approaches in particular. These are a) a ”traditional” approach, b) the subsampling approach and c) the Expected Value Approach. The first approach involves estimation based on lower response rates through improving current methods to respondent imputation. Simulations demonstrate that methods can be found that perform better. The idea behind the subsample approach is to use a subsample of the most important enterprises. Assuming that response chasing for these enterprises results in complete response within 21 days, a significant improvement in timeliness, as well as in accuracy, can be achieved. In the Expected Value Approach the values for all enterprises are imputed prior to data collection using a suitable imputation model, and then these imputed values are replaced by respondent data as soon as they come in. At any stage the combination of real and imputed responses can be used to create estimates. This method is still under investigation.

A final report on the complete project is expected at the end of this year.

Keywords: timeliness, short-term economic statistics, subsampling, expected value approach, nowcasting

1. Introduction

Timeliness is becoming an increasingly important dimension of the quality of statistical information. Statistics Netherlands has recognized this and has given a high priority to improving the timeliness of short-term economic statistics. It is felt that a substantial improvement of timeliness cannot be achieved without a redesign of the compilation process. Several redesigns are investigated; they can be divided into three categories:

1. A “traditional” approach. “Traditional” refers to the fact that no additional information (leading indicators, related indicators, business tendency survey outcomes) is used and that no special

action is untertaken to increase early response. The emphasis is on looking for better methods to respondent imputation, such as time series analysis.

2. Subsampling methods. Another possibility may be found in the use of smaller subsamples, for example consisting of the most important enterprises, i.e. the largest enterprises. If subsampling is applied to produce timely indicators it may be an option to contact the enterprises in an early stage of the data collection period and ask them to make a best guess or a first estimate of their variables of interest.

3. The Expected Value Approach. In this approach the starting point is not "observed values", but "expected values", either at enterprise level or at some intermediate aggregate level. These expected values or "nowcasts" could for example be obtained using information from tendency surveys or related indicators. Expected values are then replaced by observed values from enterprises once these become available. The real observations can also be used to improve the imputations for the remaining missing data. In this approach, preliminary outcomes can be obtained at any moment after the reporting period. They gradually evolve from "pure" nowcasts into truly statistical estimates, as more real observations become available.

Statistics Netherlands is presently exploring the possibilities of using these approaches for short-term industrial production statistics. This paper gives an impression of the progress being made. A final report is expected at the end of this year.

In the next section the present situation is described, followed by an overview of the methods investigated in section 0. The results so far are presented in section 0. Finally some preliminary conclusions are drawn.

2. Present situation

In this section the relation between short-term economic statistics is described. Until now, our analysis mainly focussed on improving the timeliness of industrial turnover, which is one of the most important primary sources for short term industrial production statistics and quarterly GDP.

2.1 Publication of short-term statistics

The industrial production index, published each month by Statistics Netherlands, is one of the most important short-term economic indicators. To a certain extent, this indicator is a first impression of economic growth/decline. The industrial production index is commonly presented as a value added quantity index which refers to a particular base year. The production index is one of the most important inputs for the quarterly flash estimate of the Gross Domestic Product (GDP), which is released 45 days

after the end of the reference quarter. The first release of the production index is around 40 days after the end of the reference month[1].

Industrial turnover is used as the primary source for the production index, if possible in combination with stock data. Producer price indices are used to arrive at volume measures. Statistics on industrial turnover are published monthly. The first release is around 37 days after the end of the reference month. While this is not particularly slow, compared to other European countries, it is considerably slower than in the United States, where quarterly GDP is published after 25-30 days, and the first monthly industrial output estimate around the 15th of the following month[2].

2.2 Present compilation process

As regards industrial turnover, sales data from some 6500 enterprises are collected on a monthly basis, mostly by mail. These enterprises are selected according to a cut-off mechanism: all enterprises with 20 employees or more are selected, all enterprises with less than 20 employees are left out completely. Development of industrial turnover is commonly expressed as the percentage change over a twelve month period. This is calculated as the change in total turnover of those enterprises that are in the sample of the reporting period as well as in the sample twelve months earlier. In case of missing observations (i.e enterprises that have not yet reported), imputations are made, based on the assumption that the turnover would have moved in the same proportion as the sales of enterprises in the same 3-digit NACE category which were recorded. Imputations are adjusted continuously as more information becomes available.

2.3 Performance of the compilation process

The timeliness of publication depends to a large extend on the available response. Column 2 of Table 2 in the appendix presents an overview of the present development of response through time, which is calculated over a period from April 2000 up till March 2002 (24 months). The average response is expressed as the percentage of the value of the total industrial turnover. The first release of industrial turnover (after 37 days) is based on 68 % response on average of the total turnover. These imputations introduce an error which is expressed by the deviation and the root mean square error (rmse).

The deviation ρ_{day} and the rmse σ_{day} are presented in Figure 1. The deviation represents the average difference between the current value of the industrial turnover growth and the final one.

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[1] The production index is subject to revision in each of the subsequent four or five months as a result of more complete response. Additionally, the production index is adjusted annually to the three most recent years of National Accounts available.

[2] See: Report of the taskforce on Benchmarking in Infra-Annual Economic Statistics to the SPC (CPS 2001/42/8/EN), Annex 3: EU-US COMPARISON: Observations of the taskforce at the occasion of its study visit to the main Federal Statistical Agencies in the US.

$$\rho_{day} = \frac{1}{n}\sum_{i=1}^{n}\left(x_{day} - x_{365}\right)$$

with n for the number of months and x_{day} and x_{365} for the growth of the industrial turnover on a certain "day" and 365 days after the end of the reference month. It is assumed that response missing after one year won't be received at all. The rmse represents the root of the average quadratic difference between the current value of the industrial turnover growth and the final one. σ_{day} is calculated as

$$\sigma_{day} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_{day} - x_{365}\right)^2}$$

The deviation and the rmse are negatively correlated with the number of days, see Figure 1. Both graphs converge to 0 after 365 days. The deviation ρ_{day} is positive. From this it can be concluded that better performing enterprises respond earlier. The industrial turnover growth is published after 37 days. The deviation and the rmse are then 0.24 and 1.25 %-point respectively. Figure 1 demonstrates that earlier publication (after 14 or 21 days) would result in a significant increase in the error.

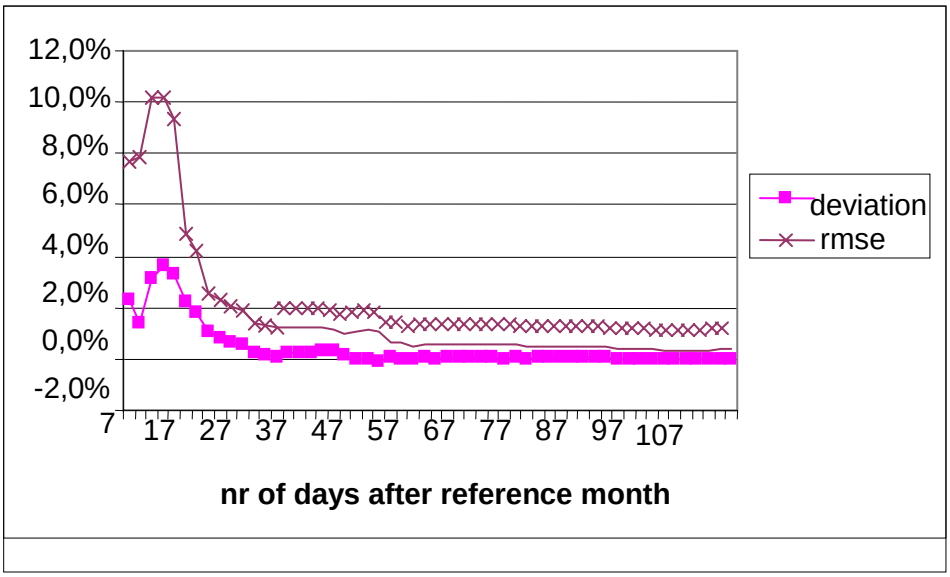

Figure 1: Development of the deviation ρ_{day} and the root mean square error (rmse) σ_{day} for the present method.

3. Methods

There are several possibilities to improve the timeliness of statistics. They are divided into three categories. The first methods try to use the same data as the present method in a more efficient way. Another is speeding up the present production process by putting a lot effort in response chasing. The last is the expected value approach. In this section the methods for redesigning the compilation process are described.

3.1 Traditional methods

Traditional methods use the same data source as the present method. The difference with the present method is the method for calculating estimates for missing values (imputations). There are two options. Firstly there are simple methods, with minor changes compared to the method presently used. Secondly there is a more sophisticated approach that uses time series analysis.

3.1.1 Imputations based on simple methods

Imputation methods based on simple methods are divided into three groups. The imputation process consists of three choices. For each, some possibilities are presented.

1 Missing values are imputed by multiplying a factor times a previous value. There are two choices for this value: previous month this year and the same month last year. Previous month has the advantage that it minimizes long-term trend effects. The advantage of the same month last year is that it minimizes seasonal effects and that the file with this month's data contains the final data. The present method uses the values of the previous month this year.

2 The turnover of enterprises that have not responded is based on multiplication of a factor times the turnover in the previous month (or the corresponding month last year). This factor can be based on domestic or total (domestic plus foreign) turnover. The present method uses domestic turnover.

3 Imputations can be made at different levels of aggregation. The present method uses the 3-digit NACE level. Various other levels can be considered, such as

   a. One category for all enterprises

   b. Size categories

   c. 2 or 3-digit NACE categories

   d. Combination of size and NACE-categories

   e. The turnover proportion over i) the same month last year and previous month last year or ii) previous month this year and previous month last year.

These possibilities are programmed in a simulation model and the results will be compared.

3.1.2 Imputations based on time series analysis

One of the more elaborate imputation procedures that will be examined makes use of time series analysis. The official imputation procedure uses data for two consecutive months only, so the interesting question is whether using data covering a longer period leads to improvement. The technique we propose is the following. First, the units of response are divided into two groups, viz a group with units that have

responded for time period t (group I) and a group with units that have not yet responded (group II). The idea is to estimate the total turnover of group II in time period t with the help of the time series for group I up and until period t and the time series for group II up and until period t-1. The technique that will be used is the so-called regARIMA method.

3.2 Subsampling

Better contact and cooperation with enterprises and trying to get their response as early as possible may significantly speed up the response. However, it may be too costly to do this for the entire sample. Concentrating on the most important enterprises may then be an option. About 3% of the enterprises (with 500 employees or more) are responsible for more than 40% of industrial turnover, see Table 2. Assuming that chasing these enterprises actively would result in a response of 100% within 21 days, the response measured as percentage of the total turnover is increased significantly. Thereby the accuracy of the estimate is increased.

	size category					Total
nr of employees	>=20 & <50	>=50 & <100	>=100 & <250	>=250 & <500	>=500	
nr of enterprises	3660	1462	775	467	190	6554
% turnover	12%	10%	14%	21%	42%	100%

Table 1: The percentage turnover per size category and the number of enterprises in that category

3.3 Expected Value approach

A considerable part of the research will be devoted to the Expected Value Approach. At first glance, this approach seems to offer an attractive combination of nowcasting and measuring. Instead of starting the statistical process with “observed values”, the process begins with “expected values”. This will be done on meso level for an aggregate of enterprises or, if possible for each enterprise on micro level. These expected values or nowcasts could be obtained using related indicators (for example energy consumption as a proxy for production) or tendency surveys. These expected values are then replaced by statistical data from enterprises as soon as they become available. The estimates for the other missing values are also improved with this data. The processing system could be structured in such a way that an intermediate result can be produced at any given moment. In the first days following the end of the reporting period this provisional result is based primarily on models and approximations, but in the course of time the provisional result will gradually turn into a statistical result. At a certain point in time the aggregates will be reliable enough to be published. At a later point in time, results at a more detailed level can be released.[3]

[3] See also: Algera, S.B., 2001, Process redesign of short-term indicators and the role of Eurostat and NSI’s, paper presented at the 3rd Meeting of the Task Force on Benchmarking in infra-annual economic statistics, Stockholm, 11 May 2001.

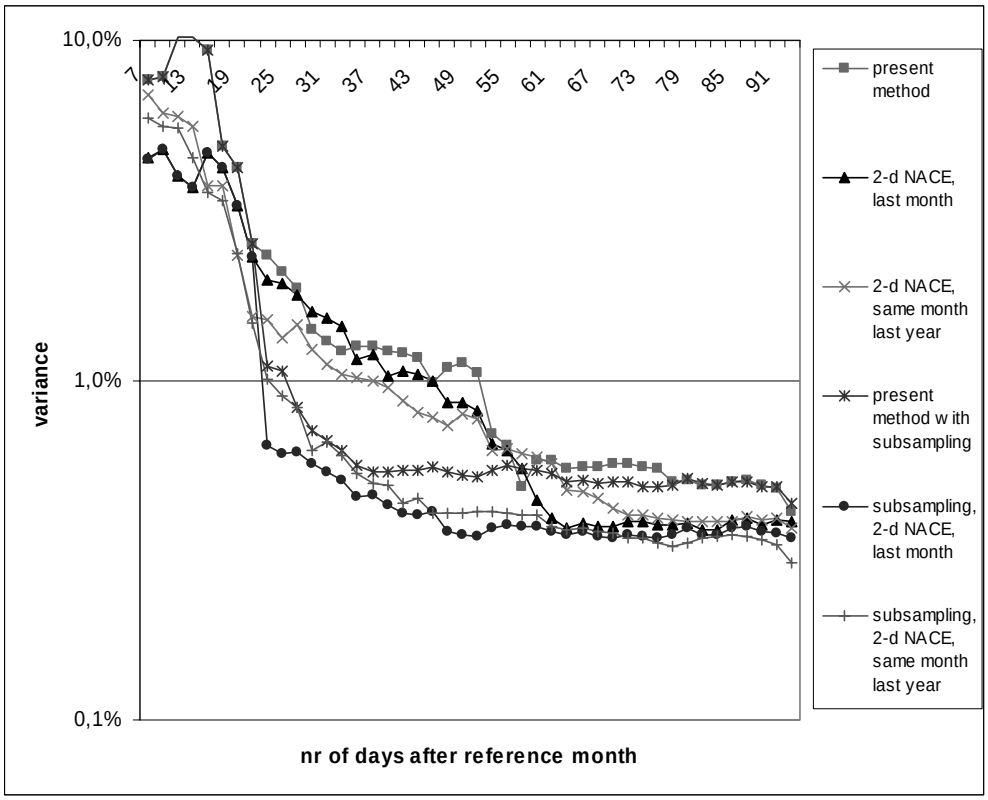

Figure 2: Rmse through time for several simulations. Note that the y-axis is logarithmic.

4. Results

Simulation models are programmed to compare the different methods. The rmse as a function of the number of days after the reference month is calculated for every simulation over the period April 2000 up till March 2002. The best performing methods are presented in Figure 2.

4.1 Traditional methods

4.1.1 Imputations based on simple methods

The best performing imputation methods use a distribution of enterprises based on 2-digit NACE. These methods give better results then the present method, based on a 3-digit NACE distribution. In general, it can be said that methods with less categories perform better than methods with more categories in the first 3 weeks after the end of the reference month. Other possibilities were also investigated. The month used for calculating the missing values (previous month or same month last year) in the imputation is of minor importance. The difference between interpolating with domestic or total turnover has negligible influence on the accuracy.

4.1.2 Imputations based on time series analysis

The model is still under construction; therefore no results could be presented.

4.2 Subsampling

It is simulated that the response of the largest enterprises (more than 500 employees) is chased actively and received within 21 days. The average turnover rate increases from 42 up to 65 % after 22 days, see Table 2 in the appendix. Contacting these largest enterprises in an early stage of the data collection period and trying to get their response as early as possible pays off. The simulated results are plotted in Figure 2. This results in a significant drop in the rmse compared to the present method and the methods with improved imputation techniques but without subsampling. The result after 21 days with response chasing is even better than the present result, published after 37 days. However the improved methods, mentioned in section 0, perform after approximately 60 days betters than the present method in combination with subsampling.

4.3 Traditional methods in combination with subsampling

The combination of subsampling and an imputation method based on a 2-digit NACE distribution gives the results with the minimum rmse, see Figure 2. This result is better than the present method with subsampling. The month used for calculating the missing values (previous month or same month last year) in the imputation is of minor importance. After somewhere between 60 to 80 days, the effect of subsampling has worn off and the increase in accuracy results from improved imputation techniques.

4.4 Expected value approach

There are several sources of data available which could be used for calculating expected values; one of them is the business tendency survey.

Business tendency surveys are carried out by Statistics Netherlands since 1989. Approximately 1700 manufacturing companies are surveyed every month. The survey aims to report on the monthly development of several indicators: production, production expectations for the coming months, received orders, stocks etc., within three weeks after the beginning of a month. By asking simple, mainly qualitative questions, the survey hopes to provide prompt, relevant information. Enterprises are not asked to specify exact quantities. The business tendency survey asks two types of questions, i.e. those focusing on developments: have certain indicators "increased", "remained fairly stable" or "decreased"; and those focusing on opinions, which invite the enterprises to assess a number of indicators.

Tendency survey data at the micro level over a number of years are available for our research. How these data are going to be used within the Expected Value Approach will require some further study.

5. Conclusion

Simulations demonstrate that the rmse can be reduced compared to the present method by improved imputation methods and by response chasing of the largest companies. The latter is the most effective for making earlier estimates. However, enterprises need some time to respond and the gap between the end of the month and response can be filled by an estimate based on the expected value approach. A final report on the complete project is expected at the end of this year.

Appendix

Nr. Of days after reference month	Average response rate % of the value of total turnover	
	Present Situation	Response Chasing
7	4	4
15	22	22
22	42	65
30	59	73
37	68	78
45	73	81
60	82	85
75	85	88
90	88	89
120	90	91
150	92	92
180	93	93
210	93	93
240	94	94
270	94	94
300	95	95
330	95	95
360	96	96

Table 2: Industrial turnover; development of response rate through time; response rates averaged with the present situation (column 2) and with response chasing (column 3).