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Different weighting methods in business tendency survey indicators in Swiss manufacturing industry

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Arbeitspapiere/ Working Papers

Richard Etter and Eva Köberl

Different Weighting Methods
in Business Tendency Survey Indicators
in Swiss Manufacturing Industry

Different weighting methods in business tendency survey indicators in Swiss manufacturing industry*

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Abstract

In business cycle analysis the development of inventories still plays a crucial role. The strong movements over time have a large effect particularly on the growth rate of GDP. Quantitative data on inventories are generally of rather low quality. As a complement to quantitative statistics, business tendency surveys (BTS) offer actual data on stocks of different categories and on order books (often called negative inventories) to estimate actual values. However, the qualitative data do not show up in the empirical analysis. One reason could be that the aggregation process in BTS of these two items is often not adequate.

Three alternative weighting methods were applied at firm level: no weighting, weighting with the number of employees, weighting with the number of employees plus the ratio of order books/stock to sales. These were compared with the current weighting method which includes stratification and branch weights by value added. The four indicators for each of the BTS questions had a statistically different variance, mean or distribution in most cases.

The comparison of these four versions of weighting with the reference series – growth rate of order books and of stocks of finished products – produced quite different results. For the growth rate of order books, the best fit was with the non-weighted responses of the firms to the question on changes of order books. The match with the growth rate of stocks of finished products was generally lower. The best fit was again with the non-weighted responses on the change question on stocks of finished products.

Key words: weighting, stocks of finished products, order books, business tendency surveys

JEL Classification: C42

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1. Introduction

In business cycle analysis and modelling, the development of inventories still plays a crucial role. It is true that the average size of stocks could be reduced by technical and managerial means. However, they show very strong movements over time and thus have a large effect particularly on the growth rate of GDP. As Blinder/Maccini (1991) observed, drops in inventory investment have accounted for 77% of the reduction in real GNP in the USA during the average post-war recession.

However, quantitative data on inventories are generally of rather low quality as they are often mixed with a number of “statistical differences”. These are values not attributable to a demand category in the national account. Moreover, for the most recent data in Switzerland, they are simply the result of the direct estimation of GDP and the sum of the estimation of the elements from the demand side of the national account.

Apart from the traditional inventories, order books are often viewed as negative inventories. They are not usual in the production of standardised products. They are common in industries such as machinery manufacture and other sectors where production is initiated only if orders are placed. Therefore, order books are by nature a good leading indicator to production.

As a complement to quantitative statistics, business tendency surveys (BTS) offer data on stocks of different categories and on order books. Such surveys could be important sources for the estimation of the actual development of the quantitative statistics. Moreover, they could provide coincident or leading indicators of GDP and improve the quantitative estimations. However, in most cases the qualitative data do not show up in the empirical analysis (e.g. Gübeli S. and M. Wildi, 2006). One reason could be that the weights used in the aggregation process in BTS of these two items are often inadequate.

In the aggregation process of qualitative survey responses, the problem of weighting is a main feature. There are principally two different types of weighting. One is oriented at the total population – e.g. information on the selection probability complemented with the response rate. Auxiliary information on the total population is necessary. The other is oriented at the characteristics of the responding unit, which is the firm in BTS. This paper will focus exclusively on the second type of weighting as this is the first step in the aggregation process.

In qualitative BTS it is quite common to implement firm-specific weights which are intended to be applied to ordinal or categorical data. This imposes additional quantitative information on the responses. Firm-specific weights are not only used for questions on past or future changes but also on judgements. Both the OECD and the European Commission recommend firm- and question-specific weighting for qualitative business and consumer surveys, but only a few countries apply (Donzé et. al., 2004) the latter.

For the implementation of firm-specific weights in the aggregation process, auxiliary information from all participating firms is needed. The auxiliary variable should have a close connection to the response variable, e.g. level of production for questions on production or level of employees for questions on employment. In practice, however, most institutions that conduct BTS use a single auxiliary variable for all response variables. This is acceptable for many of the response variables. However, particularly for order books or for stocks of finished products, there is only a very loose connection to employment and production. As experience with the Swiss BTS shows, a relatively high

proportion of firms do not have order books or stocks of finished products. The others have a non-systematic mix of these two “stock” categories.

In a first step, we will describe the different firm- and question-specific weighting methods. The methods of no weighting, employment weighting and “stock”-weighting will be used for the responses on change and judgement questions on order books and stocks of finished products in the Swiss manufacturing survey. In section 3, the necessary ad hoc survey is presented to test the alternative weighting methods. The calculation and the comparison of the different weighting methods give a first impression of the effects of different weightings. In the last step, the results will be compared with official statistics as a reference series. The paper will conclude with an evaluation of these question-specific weighting methods.

2. Question-Specific Weighting

2.1 Actual Weighting in Swiss BTS

As in many countries, the aggregation method in the Swiss BTS is quite complex (see also European Commission (2004), OECD (2003)). More than one set of auxiliary data are used as weights, which sometimes has the effect of neutralising other sets at least in part.

In a first step, the qualitative response is weighted by firm-specific information. In the manufacturing industry survey, all responses are weighted by firms’ numbers of employees¹. This weight is intended to give the qualitative response a quantitative character. The idea behind this is that a communicated change in large firms covers a higher volume of change than the same response of a small firm. Therefore, the auxiliary data used for weighting the variable should have a high correlation to the variable (Hidiroglou et al., 1995) and thus be a quite good proxy for the questioned item.

For a few questions, we use an additional weighting. As in the results we distinguish the proportion of sales for exports, we have information from the participating firm not only on employees but also on the share of exports in the turnover. Therefore, the question on export expectation is weighted not only by the number of employees but also by the proportion of exports in the firm’s turnover (see section 3). This has the effect that in the response of two firms with an equal number of employees but an unequal proportion of exports, the firm with the higher proportion of sales as exports will have a higher firm-specific weight. Until now there have been no additional weights for order books and stocks. From these weighted responses the balance indicator is calculated².

In a second step, weights calculated from the total population are applied. There are three size categories for which the thresholds are calculated separately for each branch. The results of each size category are weighted by the proportion of the size category in the total population, measured in employees. The branch results are then aggregated by the value added to total manufacturing.

¹ Calculated as full-time employees.

² The balance = the percentage of positive minus the percentage of negative responses.

2.2 The Problem of Order Books and Stocks of Finished Products

The BTS for Swiss manufacturing includes three questions on order books, two questions on stocks of intermediate products and two questions on stocks of finished products (types of inventories: see R.A. Inman, 2006). As mentioned above, the weighting variable should have a close connection to the particular item. Generally it can be argued that bigger firms have larger order books or stocks. However, examining more closely we find firms that do not have order books or stocks of finished products. Other categories of stocks (intermediate products, work-in-progress products) do not have the same asymmetric structure. The size of order books or stocks of finished products differs greatly between business sectors. One reason is that some firms produce to order because they produce unique products and therefore do not have stocks of finished items (production type A). Others produce standardised products from stock and deliver the products according to order income (production type B) but do not have order books. Further, there are also firms with a mix of these two types of production.

Because most firms have several products, they have order books for some products and stocks of finished products for others. Moreover, the size of the order books or stocks depends at least as much on the production process as on the number of employees. Therefore, a uniform weighting scheme is not appropriate. Neglecting the size of order books and stocks of finished products could indeed bias the results in an unknown direction with an unknown size.

2.3 Alternative Firm- and Question-Specific Weighting Methods

Firm-specific weighting should use a variable that is linked as closely as possible to the item questioned. Questions on production should use figures on the firm's production, questions on labour should use figures on the firm's labour force and so on (Kalton/Flores-Cervantes, 2003). In practice, the necessary data on all participating firms are not available for each item. Therefore, information on production or employees is used for most questions. This holds even for order books and stocks.

As an alternative to the method described in section 2.2, we calculate balance indicators with three other firm- and question-specific weights:

- No Weighting

F_{KX}^+ ... number of reporting units responding (+) to the survey

K ...denotes the particular manufacturing industry (D, DL, DJ...)

X ...denotes the specific question in the survey (OBCH, OBJ...)

Resultant

$$N_{KX}^+ = \frac{F_{KX}^+}{F_{KX}^+ + F_{KX}^- + F_{KX}^0} * 100$$

which represents the proportion of reporting units that responded (+) compared to all reporting units. These fractions are computed respectively for the units that responded (-).

Finally the balance is computed by

$$B_{KX}^{NW} = N_{KX}^{+} - N_{KX}^{-}.$$

- Weighting by employees:

E_{KX}^{+} ... number of employees in reporting units that responded (+) to the survey

K ...denotes the particular manufacturing industry (D, DL, DJ...)

X ...denotes the specific question in the survey (OBCH, OBJ...)

Resultant

$$EMP_{KX}^{+} = \frac{E_{KX}^{+}}{E_{KX}^{+} + E_{KX}^{-} + E_{KX}^{=}} * 100$$

which represents the proportion of the balance of employees of reporting units that responded (+) compared to all reporting units. These fractions are computed respectively for the units that responded (-).

Finally the balance is computed by

$$B_{KX}^{EMP} = EMP_{KX}^{+} - EMP_{KX}^{-}.$$

- Weighting by employees and, additionally, weighting by the ratio of order books or stocks to turnover as described in section 3:

$E_K^{+}Q_X$... number of employees in reporting units that responded (+) multiplied by the specific ratio

K ...denotes the particular manufacturing industry (D, DL, DJ...)

X ...denotes the specific question in the survey (OBCH, OBJ...)

Resultant

$$EMPQ_{KX}^{+} = \frac{\sum^K E_K^{+}Q_X}{\sum^K E_K^{+}Q_X + \sum^K E_K^{-}Q_X + \sum^K E_K^{=}Q_X} * 100$$

which represents the proportion of the balance of employees of reporting units that responded (+) weighted by the specific quota compared to all reporting units. These fractions are computed respectively for the units that responded (-).

Finally the balance is computed by

$$B_{KX}^{EMPQ} = EMPQ_{KX}^{+} - EMPQ_{KX}^{-}.$$

There is no second step for the aggregation to branches and total manufacturing because no stratified and aggregation weightings are available for the population. Nevertheless, we calculate the alternative weighting methods at sector level as well as for total manufacturing in a direct way.

3. Special Survey on Order Books and Stocks of Finished Products

As mentioned in section 2, there is no item-specific weighting on order books and stocks of finished products in the Swiss manufacturing BTS. Accordingly, we had no information on the importance of these items at firm level. For this reason, we launched an ad hoc survey in 2003 to collect the missing information.

A straightforward question to the firm would be to ask about the absolute volume of order books or of stocks of finished products. However, the aggregation of volumes to sectors or to total manufacturing is very difficult because for example tonnes are not a representation of the value added in the product. Another possibility would be to ask for the absolute nominal value. Within a simple aggregation process this would be adequate. However, in the Swiss BTS, as in other countries, we use not only firm-specific weighting but also population-based weighting. Unfortunately, we do not have available data on order books and stocks of finished products in the total population.

As the population-based weights are linked to the number of employees, a possible question could have been on stocks/orders in relation to the number of employees. This is not a common indicator in business economics, however. Much more popular is the relation between stocks/orders and sales. Sales are quite a good proxy for employees. For these reasons, in 2003 we asked the following questions to all participating firms in manufacturing industry (including the footnotes):

- In the last 12 months, what is the ratio of the value of stocks of finished products to sales? ³
- In the last 12 months, what is the ratio of the value of order books to sales? ⁴

³ Example: average value of stocks of finished products in the last 12 months: CHF 4 million; sales in the last 12 months: CHF 20 million; ratio = 4/20 = 0.20.

⁴ Example: average value of the order books in the last 12 months: CHF 2 million; sales in the last 12 months: 8 million; ratio = 2/8 = 0.25.

Table 1

Survey of quota of stocks of finished products and order books

Branch	No. of Participants with OB or ST	No. of Participants with OB and ST	No. of participants with ST	Quota of ST	No. of participants with OB	Quota of OB	Relation* between No.OB and No.ST
Food, beverages, tobacco	62	9	60	0.1349	11	0.2509	0.1833
Textiles, Clothing	37	16	25	0.2445	28	0.3146	1.1200
Wood, other non-metallic prod.	81	27	51	0.1920	57	0.2074	1.1176
Paper, publishing and printing	67	23	34	0.1571	56	0.2197	1.6471
Chemicals, plastics	97	66	88	0.1798	75	0.2184	0.8523
Metal products	163	85	106	0.1892	142	0.2423	1.3396
Machinery, motor vehicles	141	71	84	0.2325	128	0.3379	1.5238
Electronics, precision instrum.	133	74	83	0.1738	124	0.2742	1.4940
Manufacturing industries	35	14	20	0.1449	29	0.2231	1.4500
Total manufacturing	816	385	551	0.1853	650	0.2618	1.1797
OB	order books						
ST	stocks of finished products						
Quota	ST/sales and OB/sales						
*	value > 1 = quota of order books is higher than quota of stocks of finished products						

If a firm participated in the survey for several product groups, it responded to the questions for each product group separately. The results of this ad hoc survey show that in Swiss manufacturing industry there is no clear division between firms with type A and type B production. In manufacturing overall, more than 47% of the firms have both order books and stocks of finished products. They more often have order books than stocks of finished products. Moreover, the value of order books is on average higher than the value of the stocks of finished products. For manufacturing overall, the quota of 0.1853 of stocks of finished products covers 2.2 months of sales, and the quota of 0.2618 of order books corresponds to 3.1 months of sales. All this information indicates that Swiss manufacturing is dominated by production type B, which is typical for a small but technologically highly developed country.

Examination of the disaggregated level is also interesting. For stocks of finished products Food/beverages/tobacco has the minimum quota, although this sector is – apart from Chemicals/plastics – the only one where the number of participants with stocks of finished products is greater than those with order books. The highest quota of stocks of finished products was in Textiles/clothing. One reason could be that this sector faces particularly strong seasonal movements and erratic weather conditions.

For order books, Wood/other non-metallic industry has the lowest quota. These producers of intermediary products are quite flexible in reacting to changing demand because the production time of a unit is generally short. The opposite is the case for producers of Machinery/motor vehicles. Here the production process of a unit can take several months, in some cases even more than a year. Therefore, the level of order books has to be higher in relation to sales. Not surprisingly, this branch reports the highest quota.

The quotas indicate fairly well that production type A and type B are quite different. These results support the idea of introducing an additional weighting for stocks of finished products and order books.

4. Effect of Different Weighting Methods

The BTS for Swiss manufacturing includes two questions on stocks of finished products and three on order books. For both items, one question addresses changes that have taken place, and one is a judgement of the actual level (the third question on order books is a judgement of orders from abroad which we will not consider further here). The methods described in section 2 were applied to total manufacturing and the nine main branches of this sector. The resulting indicators should all give an appropriate picture of the actual development of the items in question. Before we look at the explanatory power of these indicators, we will describe and analyse their characteristics. Do the indicators created by alternative weighting methods differ statistically in their variance, their mean value or the distribution of values? Does the traditional weighting scheme applied currently in the regular calculations with stratification and additional branch weights for total manufacturing perform differently? Only with a positive answer can all indicators be compared with their reference series.

4.1 Changes of Order Books

The first question we will examine is on changes in order books, concentrating on the balance indicators. For total manufacturing, chart (41a) indicates for changes of order books (OBCH) a partially similar development of the indicators D_OBCH_NW, D_OBCH_EMP and D_OBCH_ACT, whereas D_OBCH_EMPOQ displays a much higher volatility. Accordingly, the standard deviation of the latter is at 22.6 the highest of all four indicators. The standard deviation is smallest for the indicator with no weights. This means that all implemented weighting procedures have increased the variance. For two out of six pairs the correlation coefficients (table 2) are over 0.9. In these cases, the additional information is limited. The lowest coherence was found with D_OBCH_EMPOQ, which is promising but could also result from the strong variance. All time series show the same general underlying economic trend over time.

The pairwise variance equality test (F-Test) indicates for the majority of cases that the equality of variance can be rejected. There is initial evidence that the different weighting methods indeed produce time series with significantly unequal information. Exceptions are the pairs D_OBCH_EMP/D_OBCH_ACT and D_OBCH_NW/D_OBCH_ACT.

The mean values are situated between +5.2 (D_OBCH_EMPOQ) and -5.5 (D_OBCH_NW), which is a relatively high difference. Therefore, the mean equality test rejects the null hypothesis of equal mean at a 95% level in three out of six cases. A non-equal mean particularly for change questions can have a considerable effect on the economic interpretation. The balance indicator of a change variable with a value of zero is interpreted as “no change” of the item. With a positive value, we assume an increase in order books during the period of analysis (2000-2005), otherwise a decrease.

Looking at the distribution of the values, the indicators disperse differently. The box (chart 41b) for the two middle quartiles of D_OBCH_EMPOQ is the biggest, indicating that the values are scattered over a large scale. Statistically near outliers are identified only in D_OBCH_ACT. The upper whisker of this series is the longest and confirms the large spread of this variable. Another measure is the Jarque-Bera residual normality test, giving additional information on the distribution. For all indicators the Jarque-Bera statistic is not significant, and does not reject the hypothesis of normal distribution.

Chart 41a

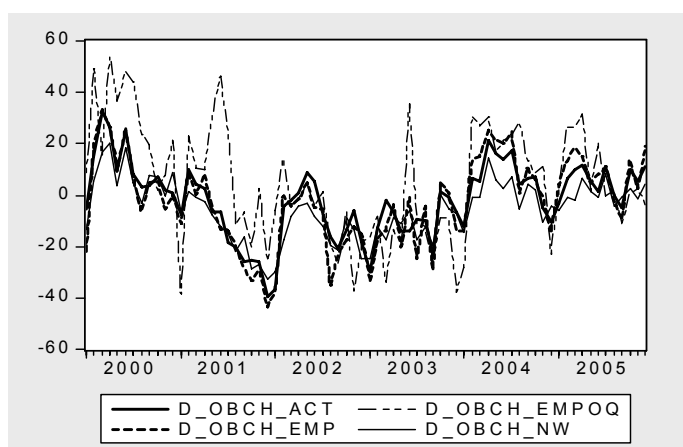
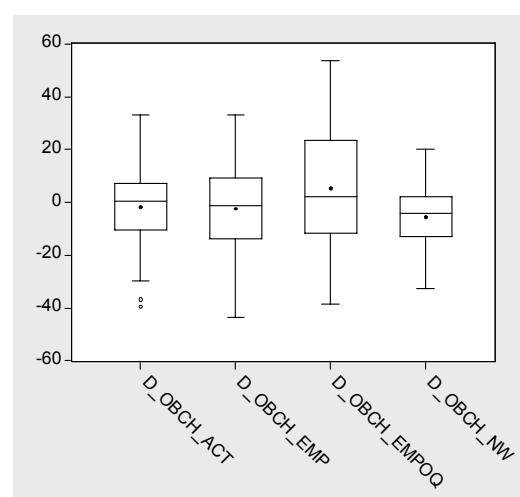


Chart 41b



Branches:

For total manufacturing the results could be somewhat distorted by the inclusion of all types of firms. At branch level this effect is strongly reduced. Some branches have a high concentration of firms with production type A or B, which could help in finding the most appropriate weighting scheme.

The correlation coefficients between the four weighting methods are remarkably lower than for total manufacturing. Looking at the variance test at branch level, again the equal variance of the pair OBCH_NW/OBCH_ACT cannot be rejected in 8 out of 9 branches. For the other 45 pairs, however, in 43 cases they do not have equal variance. A quite astonishing fact is that only in 42 cases are the mean values statistically identical. In the other 22 cases, the weighting methods not only influence the variance but also the level of the indicators. According to the Jarque-Bera statistics, all indicators of changes in order books show a normal distribution, except branch DN (details can be obtained from the authors).

4.2 Judgement of Order Books

The synchronous performance of all four balance indicators of the judgement of order books (OBJ), as shown in chart (42a), is stronger than for the changes. The differences of the standard deviations are small and the correlation coefficients are all above 0.8. The test for equal variance confirms this impression: the equality of the variance is confirmed at a 95% significance level for all pairs.

The mean values lie between -20.6 and -30.5, a difference of about 10 points, which is quite similar to the difference for the question on changes of order books. Again, however, for three out of six pairs an equal mean value cannot be rejected. All pairs with the indicator D_OBJ_NW have a significantly different mean. Such a level shift can influence the interpretation greatly. The situation of the order books can be judged as normal in one case and as unsatisfactory/good in another case (and vice versa).

The boxes in chart (42b) are of similar size. In all cases, the second quartile is larger than the third. Particularly for D_OBJ_EMPOQ, the whiskers indicate a large spread of the data. No outliers are identified. A normal distribution is found for all indicators.

Chart 42a

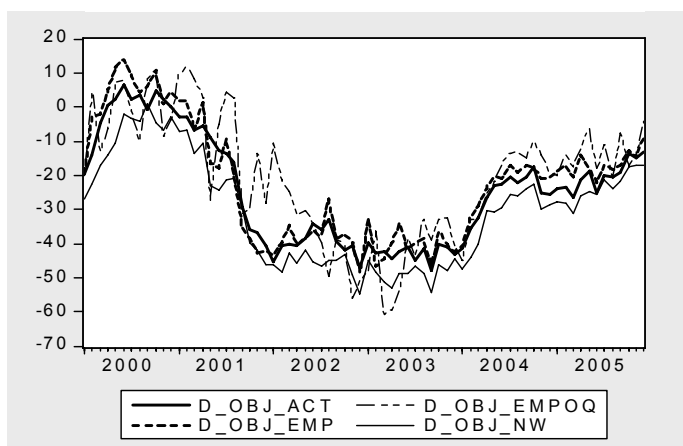
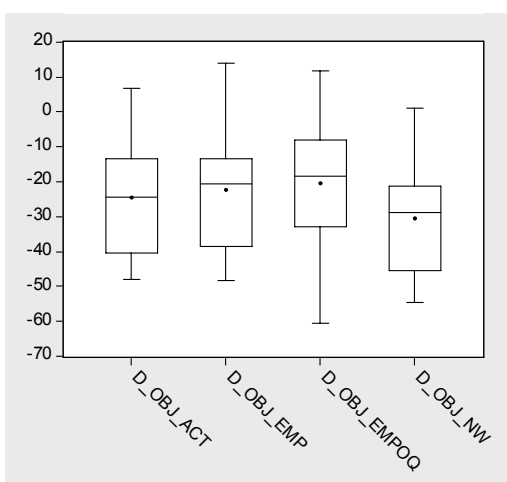


Chart 42b



Branches:

The correlation coefficients for the branches are distinctly lower than for total manufacturing, and again this is particularly true for the coherence with the double-weighted indicators OBJ_EMPOQ. The variance between the indicators in all branches does not differ between OBJ_ACT and OBJ_NW. In most other cases, a difference cannot be rejected. One exception is the branch DKM where the variances are not statistically different in five out of six cases. Only in 28 out of 64 combinations, an identical mean value cannot be rejected. This underlines again the strong effects of the different weighting methods.

4.3 Changes of Stocks of Finished Products

In general, the economic tendency does not show up particularly well for questions on stocks of finished products. However, the effects of different weighting methods are more impressive. First we will examine the balances of the question on changes. Chart (43a) gives us the first hint in this direction. Moreover, the correlation coefficients between the indicators are low, with the pair D_SFPCH_ACT/D_SFPCH_EMP registering the highest value with 0.77. Except for this pair, the equality of variance has to be rejected in all other cases.

Equal variance between the six pairs must be rejected for all except D_SFPCH_ACT/D_SFPCH_NW. There is one indicator – D_SFPCH_EMPSQ – that performs quite differently and this is shown in a much higher standard deviation. The different character of D_SFPCH_EMPSQ can be expressed even better in a box plot (43b). The box is stretched compared to the others, and the whiskers, particularly the upper one, are longer. According to the Jarque-Bera residual normality test, only for D_SFPCH_EMP a normal distribution cannot be rejected.

In contrast to the order book indicators, the highest and the lowest mean value differ by only 4 points. Just two pairs have a significantly different mean. In most cases, therefore, interpretation is not hampered by a level shift.

Chart 43a

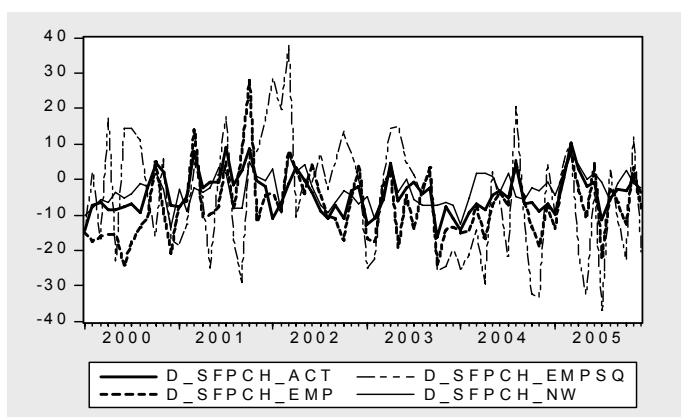
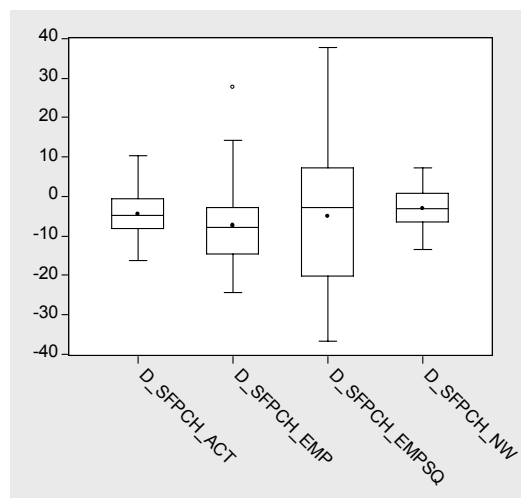


Chart 43b



Branches:

Concerning the correlation coefficients, they are generally lower for branches than for total manufacturing. Those of branches are not systematically higher than those for the questions on order books. In some cases, however, we found no correlation at all between some indicators. The variance tests accepted equality only in very few cases: this holds particularly for the indicators SFPCH_NW/SFPCH_ACT. In a bivariate comparison of the mean values, only in three branches (DL, DFG and DKM) did the equal mean have to be rejected at a 95% significance level and SFPCH_NW was always involved.

4.4 Judgement of Stocks of Finished Products

The four different balance indicators from the question on the judgement of stocks of finished products (SFPJ) have the lowest standard deviation of all four questions: possible cyclical elements are identifiable only for EMPSQ. Chart (44a) shows a completely different development of D_SFPJ_EMPSQ than the other three indicators. The correlation coefficients of all pairs are low and between D_SFPJ_EMP and D_SFPJ_EMPSQ there is no correlation at all.

The mean of D_SFPJ_EMPSQ is up to 7 points higher than the means of the three other indicators. On the other hand, the means of the latter three are very close together. Therefore it is not surprising that all three pairs of D_SFPJ_EMPSQ have statistically an unequal mean.

As for the change question of this item, equal variance between the six pairs has to be rejected for all except D_SFPCH_ACT/ D_SFPCH_NW. Taking the box plots – chart (44b) – into consideration, the completely different distribution of the values of D_SFPJ_EMPSQ is obvious. However, according to the Jarque-Bera test, the normal distribution must be rejected not only for D_SFPJ_EMPSQ but also for D_SFPJ_EMP and D_SFPJ_NW.

Chart 44a

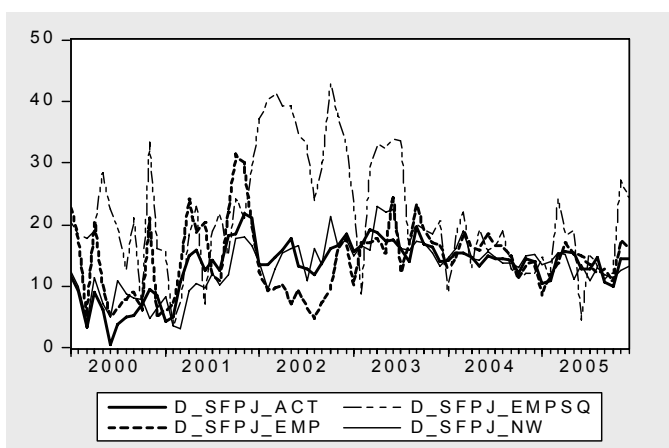
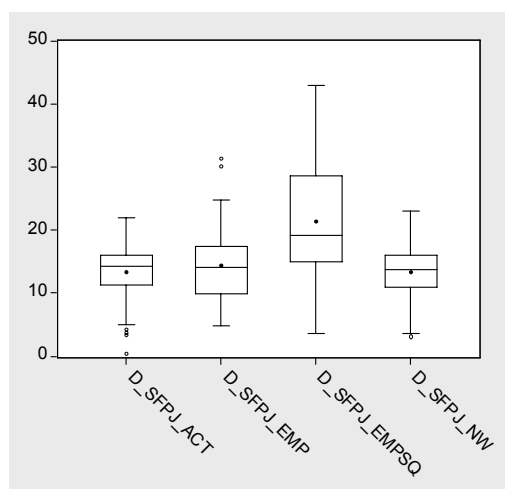


Chart 44b



Branches:

The correlation coefficients between the indicators of the nine branches are of a similar size as for total manufacturing. The lowest values are realised at pairs where SFPJ_EMPSQ was involved. The variances are equal only in few cases, mostly between SFPJ_ACT and SFPJ_NW. An equal mean value cannot be rejected in all combinations of the branches DBC and DE. In the other branches the results are quite mixed.

Conclusions

The properties of the indicators and the results of the pairwise comparisons depend strongly on the item and its type of question. In general, however, the variation of the weighting elements has a strong effect on the results. This is particularly true if the double-weighted indicators were involved. In some cases it even reverses the business trend. Moreover, the shift in the indicators, expressed by remarkably different mean values, can lead to different interpretations. At the branch level the results differ even more strongly. The selection of the “correct” weighting method is therefore an unconditioned necessity to obtain informative indicators.

As we have seen, the four different weighting methods produce indicators which on the one hand have some common information but on the other incorporate additional, unique information which can probably better explain the quantitative development of the items. The selection of the appropriate weighting method can only be done with a performance comparison of the indicators with some reference series.

Table 2

a. Correlations

D_SFPCH_EMP	D_SFPCH_EMP	D_SFPCH_EMP	D_SFPCH_ACT
D_SFPCH_EMP	1	.	.
D_SFPCH_EMP	0.375039222	1	.
D_SFPCH_ACT	0.772523635	0.314684376	1
D_SFPCH_NW	0.445197264	0.238526791	0.551638174
D_SFPJ_EMP	D_SFPJ_EMP	D_SFPJ_EMP	D_SFPJ_ACT
D_SFPJ_EMP	1	.	.
D_SFPJ_EMP	-0.012173812	1	.
D_SFPJ_ACT	0.617833308	0.331980486	1
D_SFPJ_NW	0.403537709	0.372390561	0.769530272
D_OBCH_EMP	D_OBCH_EMP	D_OBCH_EMP	D_OBCH_ACT
D_OBCH_EMP	1	.	.
D_OBCH_EMP	0.65397	1	.
D_OBCH_ACT	0.940726581	0.599695548	1
D_OBCH_NW	0.899841983	0.608511807	0.926174147
D_OBJ_EMP	D_OBJ_EMP	D_OBJ_EMP	D_OBJ_ACT
D_OBJ_EMP	1	.	.
D_OBJ_EMP	0.831290674	1	.
D_OBJ_ACT	0.977830526	0.841320828	1
D_OBJ_NW	0.962180278	0.87021605	0.977666514

Does Question-Specific Weighting Improve Data on Order Books and Stocks of Finished Products?

b. F-Test on variance

D_SFPCH_EMP	D_SFPCH_EMPD_SFPCH_EMPSQ	D_SFPCH_ACT
D_SFPCH_EMPSQ	3.033413 (0.00)	.
D_SFPCH_ACT	2.846553 (0.00)	8.634772 (0.00)
D_SFPCH_NW	4.325098 (0.00)	13.11981 (0.00) 1.519416 (0.0801)
D_SFPJ_EMP	D_SFPJ_EMP	D_SFPJ_ACT
D_SFPJ_EMPSQ	2.785006 (0.00)	.
D_SFPJ_ACT	1.756104 (0.0188)	4.890760 (0.00)
D_SFPJ_NW	1.84054 (0.011)	5.125915 (0.00) 1.048081 (0.8437)
D_OBCH_EMP	D_OBCH_EMP	D_OBCH_ACT
D_OBCH_EMPOQ	1.710828 (0.025)	.
D_OBCH_ACT	1.452542 (0.1181)	2.485049 (0.0002)
D_OBCH_NW	2.264903 (0.0007)	3.874859 (0.00) 1.559269 (0.0633)
D_OBJ_EMP	D_OBJ_EMP	D_OBJ_ACT
D_OBJ_EMPOQ	1.16409 (0.5237)	.
D_OBJ_ACT	1.167814 (0.5151)	1.35944 (0.1982)
D_OBJ_NW	1.206012 (0.432)	1.403906 (0.1553) 1.032709 (0.8925)

(...) probability

c. F-Test on mean

D_SFPCH_EMP	D_SFPCH_EMPD_SFPCH_EMPSQ	D_SFPCH_ACT
D_SFPCH_EMPSQ	1.055272 (0.293)	.
D_SFPCH_ACT	2.405207 (0.0175)	0.328006 (0.7434)
D_SFPCH_NW	3.503358 (0.0006)	0.978637 (0.3294) 1.64656 (0.1019)
D_SFPJ_EMP	D_SFPJ_EMP	D_SFPJ_ACT
D_SFPJ_EMPSQ	5.36585 (0.00)	.
D_SFPJ_ACT	1.157952 (0.2488)	6.491872 (0.00)
D_SFPJ_NW	1.225526 (0.2224)	6.556668 (0.00) 0.068087 (0.9458)
D_OBCH_EMP	D_OBCH_EMP	D_OBCH_ACT
D_OBCH_EMPOQ	2.276997 (0.0243)	.
D_OBCH_ACT	0.253366 (0.8004)	2.207777 (0.0289)
D_OBCH_NW	1.255309 (0.2114)	3.582707 (0.0005) 1.727554 (0.0862)
D_OBJ_EMP	D_OBJ_EMP	D_OBJ_ACT
D_OBJ_EMPOQ	0.557742 (0.5779)	.
D_OBJ_ACT	0.830414 (0.4077)	1.373214 (0.1719)
D_OBJ_NW	3.010704 (0.0031)	3.465269 (0.0007) 2.264942 (0.025)

(...) probability

5. Comparison with Reference Series

5.1 Reference Series

The Swiss Federal Statistical Office (SFSO) publishes the following series every quarter, which serve as reference series for BTS indicators:

- Index of order books: total manufacturing (excluding chemicals) and different sectors
- Index of stocks of finished products (excluding chemicals) and different sectors

The SFSO has data from 13 sectors, excluding the chemical sector. There are also some data problems in other sectors. In the aggregation process of the BTS data, the number of main sectors is restricted to nine, which means that some main sectors of SFSO data exist only in an aggregated form in BTS data. Our analysis at branch level will therefore be restricted to comparable branches:

Subsection DE: Manufacture of pulp, paper and paper products; publishing and printing

Subsection DJ: Production of basic metals and metal products

Subsection DL: Manufacture of electrical and optical equipment

Further, we do not exclude chemicals from total manufacturing in the BTS data.

We use the quarter-on-quarter (qoq) growth rate of these two indices, which makes it comparable to the BTS data and the data become stationary. The BTS data are stationary by definition.

5.2 Transformation of Data

a) Deseasonalisation

The original SFSO data are dominated by strong seasonal variations. To extract the business cycle movement from the time series, the data must pass through a seasonal filter. This is done by the traditional Census X11. For the BTS data, firms were asked to respond excluding seasonal effects. However, they are not successful in eliminating all seasonal effects from their qualitative response. Therefore, in most cases BTS time series still include a seasonal pattern. We apply the Census X11 filter again.

b) monthly to quarterly

The reference series are available only on a quarterly basis. To make our BTS data compatible with the reference series, we aggregate the monthly data to quarterly data by calculating the average of the three months of each quarter.

5.3 Determination of the Lead/Lag Structure

A priori, BTS data on changes on stocks and on order books should coincide with its respective quarter-on-quarter growth rate of the reference series. But for the question on judgements it is not clear if they should lag, lead or coincide with the SFSO reference series. Before the OLS estimation can be applied, correlograms have to be produced to determine leads or lags of the explanatory variable (see table 3). For total manufacturing⁵, the results of order books are not uniform. Changes of order books are, as expected, coincident indicators in all cases with the maximal correlation at lag 0. All coefficients have a correct positive sign.

But the picture for judgements is somewhat mixed. D_OBJ_ACT and D_OBJ_EMPOQ lag, D_OBJ_NW leads and D_OBJ_EMP coincides with the reference series. All correlations with the judgement questions show a positive sign.

For stocks of finished products, the results for indicators of changes are non-uniform. Two variables (D_SFPCH_ACT and D_SFPCH_NW) show a positive coherence to the reference series and additionally have a lag of 2 and 4 respectively. The other two variables produce negative correlations, which is difficult to interpret.

For the correlation between BTS judgements on stocks of finished products and the SFSO changes of this inventory category, the direction of the sign is not a priori clear. There are two effects that go in the opposite direction. Let us assume that the stocks of finished products at time t are normal. If the stocks increase in time $t+1$, there are three different reactions on the part of the firm concerning the judgement:

- If the increase of stocks coincidences with the demand then the judgement stays at “normal”.
- If the increase of stocks is less than the increase in demand, the judgement will change to “too low”.
- Conversely, if the increase happened because of a negative demand shock, the judgement changes to “too high”.

The non-uniform reaction of stocks of finished products to changing demand is the core element of the well-known production-smoothing/buffer-stock motive, which seems to apply most naturally to the stocks of finished products in manufacturing (Blinder/Maccini, 1991).

The correlations at branch level are quite heterogeneous. The correlation coefficient is higher for DL than for total manufacturing. However, for DJ and particularly for DE the correlation could not improve in all alternatives – this holds for order books as well as stocks of finished products. This is a first hint of the fact that the data problems with stocks and order books do not come from the population-based aggregation process to total manufacturing.

⁵ Branch results can be obtained from the authors.

Table 3

Cross-Correlations

Total Manufacturing	Corr. max.	Lead BTS (-)
Order books:		
qoq D_OB_SFSO and D_OBCH_ACT	0.6947	0
qoq D_OB_SFSO and D_OBCH_NW	0.7953	0
qoq D_OB_SFSO and D_OBCH_EMP	0.6652	0
qoq D_OB_SFSO and D_OBCH_EMPOQ	0.5373	0
qoq D_OB_SFSO and D_OBJ_ACT	0.6486	2
qoq D_OB_SFSO and D_OBJ_NW	0.6701	-1
qoq D_OB_SFSO and D_OBJ_EMP	0.6801	0
qoq D_OB_SFSO and D_OBJ_EMPOQ	0.5821	2
Stocks of finished products:		
qoq D_SFP_SFSO and D_SFPCH_ACT	0.4637	2
qoq D_SFP_SFSO and D_SFPCH_NW	0.4895	4
qoq D_SFP_SFSO and D_SFPCH_EMP	-0.4596	-1
qoq D_SFP_SFSO and D_SFPCH_EMPSQ	-0.332	0
qoq D_SFP_SFSO and D_SFPJ_ACT	-0.6212	-1
qoq D_SFP_SFSO and D_SFPJ_NW	-0.4808	1
qoq D_SFP_SFSO and D_SFPJ_EMP	-0.3891	-1
qoq D_SFP_SFSO and D_SFPJ_EMPSQ	-0.5769	1

5.4 OLS Estimation with Reference Series

In a next step we can proceed to judge the coherences between the SFSO and the BTS time series. The quantitative time series are made stationary by calculating the growth rate, and the BTS data fulfil this condition for the application for OLS estimations by definition. The balance values are limited between -100 and 100. The estimation equation is therefore defined as follows:

$$Y_t^k = a_0^k + b_t^k X_{t-\lambda}^k + \varepsilon_t^k$$

where Y is the reference series of SFSO, X is the balance of one of the indicators, λ is the lag operator which was a priori determined with a correlogram between Y and X, k indicates the branch and ε the unexplained residuals. The equation is applied to total manufacturing as well as to the three above-mentioned branches.

5.4.1 Changes of Order Books

The OLS regressions with qoq changes of SFSO data of total manufacturing as dependent variable and the four weighting versions produce quite different results. The Durbin-Watson statistic (DW) does not detect any serial correlation in the residuals of all equations. The highest explanatory

power by far ($R^2 \text{ adj} = 0.62$) comes from the variable D_OBCH_NW . The fit with D_OBCH_ACT and D_OBCH_EMP is also acceptable. However, the result for the double-weighted (employees and quota of order books) variable D_OBCH_EMPOQ is disappointing. The unexplained variance in this equation does not come from a misspecification but from the strong stochastic component within the explanatory variable.

According to the t-statistics, the coefficient b is significantly different from zero for all alternatives and all have a correct positive sign. The indicator D_OBCH_NW shows the strongest evidence and the highest coefficient. The level of the coefficient is not explainable because growth rates and balances are of different dimensions.

Looking at the constant term a , only the one of D_OBCH_EMPOQ is not statistically different from zero and therefore does not imply a bias of the BTS data. All three other equations have a constant term a which is significantly different from zero and has a positive sign. If we presume a representative panel, this fact indicates a general underestimation of the changes of order books by the firms or that the additional weighting with order book ratios is an adequate measure for this question. Another explanation is given by the different information incorporated in the explanatory rather than the dependent variable. The quantitative SFSO data on order books consists of nominal values. The firms participating in the BTS in manufacturing are told to report the development of order books in real terms. At least some of the size of the positive constant terms can be explained by this effect.

With the disaggregation to the branch level we reduce the steps of aggregation. If we look at the results of the three branches, the fit with the reference series of its own branch did in some cases improve. The growth rate of order books of branch DL is better explained with the BTS change question exclusively from firms of branch DL. For DE and DJ, the explanatory power could not be strengthened compared to total manufacturing. These results indicate that the aggregation effect is, if at all, at least not very important.

5.4.2 Judgement of Order Books

It is obvious that from BTS data the change question on order books is from its wording the most appropriate indicator to “explain” the changes of order books from the SFSO. However, as we have available judgements on order books, we wish to check whether this question could also have some explanatory power. This is indeed the case: according to the $R^2 \text{ adj}$., the best fit comes from D_OBJ_NW , closely followed by D_OBJ_EMP . The results with D_OBJ_EMP and D_OBJ_EMPOQ improved even compared to the change question. Again there is no serial correlation in the residuals.

The coefficient b of all versions is significantly different from zero. A comparison of the size of the coefficients with the results on changes (section 5.4.2) cannot be made because of the different characteristics of judgements and changes. The constant term a is significantly positive. The values are considerably higher than those of the equation with change variables. This is a confirmation of the fact that judgements on order books have in BTS data generally a negative bias. The size of the coefficient cannot be interpreted.

The branch results of the equations with judgements did improve compared to total manufacturing for branches DJ and DL. However, the branch results of judgements explain the growth rate of order books better than those of the change question only for DJ.

5.4.3 Changes of Stocks of Finished Products

According to the OLS regression results with qoq changes of stocks of finished products from SFSO data for total manufacturing as dependent variable and changes of stocks of finished products from BTS data, all four different weighting methods explain the development of the reference series statistically significantly, but the explained variance is rather small. One reason could be some measurement problems (evaluation) of the stocks. There is no serial correlation in the residuals. The highest R^2 adj. is only 0.33 and stems from D_SFPCH_NW.

Only the results from the equation with the right-hand variables D_SFPCH_ACT and D_SFPCH_NW are economically explainable. The reason for this is that the coefficients b are positive and significantly different from zero only in these two cases. The negative sign in the other two equations forces us to abandon these two alternatives. From the relevant two equations, the constant term a shows a significant positive sign. The size of these coefficients is comparable with those for the changes of order books. Accordingly the same explanations can be applied.

This question produced interpretable results only for branches DE and DL. In both cases the branch results are better than that for total manufacturing. However, the explanatory power of the BTS data remains rather small.

5.4.4 Judgement of Stocks of Finished Products

The general remarks on judgements in section 5.4.2 on order books also hold for the judgement of stocks of finished products. However, the results are as good as with the indicators of change questions, though again the explanatory power is quite low. Only for D_SFPJ_ACT and D_SFPJ_EMPSQ did we find some explanatory power that was higher than with the change questions. The residuals do not contain any first order serial correlation.

At least all coefficients b are significantly different from zero. Moreover they show a negative sign. This can be interpreted as a buffer stock effect. With a strong increase/decrease of demand the stocks increased/decreased too, but not in the volumes required. Therefore the judgement of the stock level could move from normal to too low/too high.

The positive and statistically significant constant term is again difficult to interpret. As with order books, the values are higher than with the change question, which indicates some bias in the response of the participants.

The results at branch level cannot be interpreted because they explain a non-significant size of the variance.

Table 4

OLS Regression-Results**D Total Manufacturing****Changes:**

	a0 coefficient	t-statistics	b coefficient	t-statistics	R2 adj.	DW
qoq D_OB_SF50 and D_OBCH_ACT	0.7790	2.42	0.1255	4.43	0.46	1.92
qoq D_OB_SF50 and D_OBCH_NW	1.4595	4.67	0.1665	6.01	0.62	1.82
qoq D_OB_SF50 and D_OBCH_EMP	0.7784	2.32	0.1023	4.08	0.42	1.50
qoq D_OB_SF50 and D_OBCH_EMPOQ	0.1396	0.36	0.0741	2.92	0.25	1.98
qoq D_SFP_SF50 and D_SFPCH_ACT(+2)	1.0369	2.35	0.2090	2.53	0.21	2.33
qoq D_SFP_SF50 and D_SFPCH_NW(+4)	1.1636	2.63	0.4067	3.17	0.33	1.94
qoq D_SFP_SF50 and D_SFPCH_EMP(-1)	-0.6446	-1.31	-0.1190	-2.30	0.16	1.96
qoq D_SFP_SF50 and D_SFPCH_EMPSQ	0.0560	0.16	-0.0425	-1.61	0.07	1.97

Judgements:

qoq D_OB_SF50 and D_OBJ_ACT(+2)	3.4212	5.57	0.1143	5.73	0.61	2.95
qoq D_OB_SF50 and D_OBJ_NW(-1)	3.4190	4.59	0.0953	4.50	0.48	2.66
qoq D_OB_SF50 and D_OBJ_EMP	2.3734	4.30	0.0834	4.25	0.44	2.10
qoq D_OB_SF50 and D_OBJ_EMPOQ(+2)	2.1441	3.58	0.0807	3.81	0.40	2.05
qoq D_SFP_SF50 and D_SFPJ_ACT(-1)	3.5755	3.65	-0.2488	-3.54	0.34	2.55
qoq D_SFP_SF50 and D_SFPJ_NW(+1)	3.2911	2.79	-0.2246	-2.70	0.23	2.16
qoq D_SFP_SF50 and D_SFPJ_EMP(-1)	2.2778	2.03	-0.1416	-1.89	0.11	2.10
qoq D_SFP_SF50 and D_SFPJ_EMPSQ(+1)	2.5592	3.23	-0.1087	-3.18	0.30	2.30

6. Conclusions

The use of different question-specific weightings of firms' responses in the BTS for manufacturing in Switzerland indeed produces at the items order books and stocks of finished products significantly different time series. This could be shown for the questions on order books as well as for questions on stocks of finished products. The four alternative balance-indicators for each question had a statistically different variance, mean or distribution in most cases. However, the indicator with a double-weight – with employees and with a quota of stocks or of order books – showed a clearly higher volatility than the other three indicators. The four indicators at branch level had generally a greater discrepancy than was seen for total manufacturing. There are even clearer alternatives to compare with the reference series.

The comparison of these four versions of weighting with the reference series – growth rate of order books and of stocks of finished products – ended accordingly with quite different results. For the growth rate of order books, the best fit in an OLS-regression was with the non-weighted responses of firms to the question on changes of order books, closely followed by the results of the actual weighting method. The double-weighted indicators performed relatively poorly regarding the explanatory power. But it was the only indicator with an unbiased BTS-variable. All the other three indicators showed up with a significant positive constant term.

The match with the growth rate of stocks of finished products was generally lower; one reason for this could be the difficult evaluation of stocks. The best fit was again with the non-weighted responses to the change question on stocks of finished products. In some cases, the equations at branch level did show a better fit. This indicates that a disaggregated approach can improve the coherence with the reference series.

The problem of finding indicators for the development of order books or stocks of finished products was also apparent in this analysis. The additional weighting as it was applied in this paper is not the definitive way to proceed. However, not using any weighting scheme at least at the firm level seems to be an interesting alternative to the current weighting method.

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Appendix

Abbreviations

OBCH	Changes of order books
OBJ	Judgement of order books
SFPCH	Changes of stocks of finished products
SFPJ	Judgement of stocks of finished products
NW	No weight
EMP	weighted by employees of the firm
EMPOQ	weighted by employees of the firm and the quota of order books/sales
EMPSQ	weighted by employees of the firm and the quota of stocks of finished products/sales
ACT	Actual values (weighted by employees of the firm, stratified by three size classes and for total manufacturing the branches weighted by the value added)
D	Total manufacturing
DA	Manufacture of food products, beverages and tobacco
DBC	Manufacture of textiles, textile products, leather and leather products
DE	Manufacture of pulp, paper and paper products; publishing and printing
DDI	Manufacture of wood and wood products and other non-metallic mineral products
DFG	Manufacture of chemicals, chemical products, man-made fibres, rubber and plastic products
DJ	Production of basic metals and metal products
DKM	Manufacture of machinery and transport equipment
DL	Manufacture of electrical and optical equipment
DN	Manufacturing

Example D_OBCH_NW: Total manufacturing, order book changes, no weighting