Elżbieta Adamowicz, Sławomir Dudek, Konrad Walczyk*

The Use of Business Survey Data in Macroeconomic Analysis and Forecasting

1. Introduction

Business tendency surveys (BTS) have long tradition in mature market economies. The survey results are used to diagnose economic conditions of a country and to forecast the direction of changes of business activity. Economic units, i.e. business firms, financial institutions, municipal organisations and administration entities, are all much interested in data obtained from the surveys. There are also economic and political authorities among the recipients of business surveys results.

Slightly different situation has been noticed in Poland. The interest in BTS has been barely taken since the beginning of economic transformation. In the system of central planning there was no place for business surveys. Even after the start of transformation in 1990 not all potential users were convinced of the need to do such analyses. The research initiatives came mostly from scientific institutes such as the Research Institute of Economic Development (RIED), at the Warsaw School of Economics. The recent increase of interest in business surveys proves that the attitude in this respect is changing. Demand for information from the BTS rises but the data are still not used in satisfactory degree.

There are many reasons for which data obtained from BTS are a valuable source of information for all economic agents. The most important are:

- speed of receipt. As a rule quantitative data are available with a considerable delay to the phenomena they describe whereas BTS data give their description almost immediately, at the time economic processes take place;
- dual description of economic performance. BTS provide us with information on both the current situation and business expectations;
- microeconomic roots. Opinions gathered are made by economic agents, i.e. firms and households. Using the information to describe macroeconomic phenomena provides the analysis with solid microeconomic foundations;
- observation of variables of different characteristics, which response variously at every stage of business cycle: coincidently, with some lags or leads. This lets us

* Elżbieta Adamowicz is Professor of Economics, Director of the Research Institute of Economic Development, Warsaw School of Economics; Sławomir Dudek and Dr Konrad Walczyk are Economists associated with the Department of Economic Analysis, Warsaw School of Economics.

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describe economic fluctuations with more accuracy and forecast potential changes faster;

- observation of events that appear on both sides of the market, i.e. demand and supply. This enables to make use of BTS results by the representatives of various economic schools, irrespective of their theoretical orientation;
- possibility of international comparisons. BTS are run on a harmonised basis, facilitating international comparative analyses.

The above mentioned and other features of BTS data enlarge the possibilities of description of economic activity, giving a valuable supplement to quantitative data.

When asking why BTS data are not fully used in Poland, we considered many reasons. One may be the lack of confidence in firms' opinions. It needs to be noted that many respondents of the current business surveys had been acted under the central planning regime many years. Then they passed through a transformation shock. For more than ten years they have been "learning" the market economy. Furthermore, business terms have undergone frequent changes due to political reasons. This brings about more uncertainty in economic activity. Our respondents can therefore be not accurate in formulating their current opinions and expectations. In order to stimulate more interest in BTS data the RIED began research work on their usefulness for economic policy.

The goals of the analysis

The authors investigate the following questions:

- do BTS data reflect the real dynamics of economic processes?
- what contribution do they make to the information set essential for the economic decision-making process?
- are they useful for predicting the course of business activity?

In 2000 similar research was done with the use of raw business survey data (see Adamowicz, ed., 2001). In the present study we present the results of the analysis based on seasonally adjusted data series from the RIED business survey for industry.

2. The methods

The index of total sold production in manufacturing industry, published by the Central Statistical Office (CSO), was assumed to be an endogenous variable. Four forms of the index are taken into account, assuming sold production being equal to 100 in:

- 1995 yearly average (_ip95),
- previous month (_ipmom),
- corresponding period of the previous year (_ipyoy), and
- three previous months – a quarterly average (say 'moving quarter') (_ip3m).

The single-base index (_ip95) describes changes in sold production volume and constitutes a base for developing three other chain indexes.

Monthly business survey data (RIED) from the manufacturing industry, covering the years 1993-2000, are used as explanatory variables in the analysis. From the set of BTS data we chose 6 variables that proved most useful in the earlier research:

- production (q1),
- total orders (q2),
- export orders (q3),
- stocks (q4),
- opinion about general situation of the economy (q8), and
- the RIED general business indicator for industry (gbi).

All the variables (besides the RIED business indicator) are analysed in two forms: (a) change in relation to the previous month, i.e. the state (s), and (b) expected change in the next 3 or 4 months, i.e. expectation (p).

Before 1997, the business survey data for industry were gathered for public and private sectors separately. In order to combine both time series, we used two weights: shares of each sector in total production sold and in total employment in manufacturing (quarterly data from the CSO). Data series were adjusted using Hodrick-Prescott's filter. Cyclical fluctuations were removed with the use of e-views. In the result we obtained smoothed time series of both weights which follow a similar course and concluded that any of the weights could be applied alternatively. In the subsequent work we combined the partial time series using the "production" weight. The time series so calculated were then linked to the single time series for the whole industry, starting in January 1997.

The RIED data are analysed in three forms: (a) balances, (b) cumulated balances, and (c) 12-month changes of balances ($\_\Delta^{12}$).

Time series were adjusted for seasonal (_sa) and irregular (_trd) fluctuations, with the use of TRAMO-SEATS models.

In the analysis we applied the following methods:

- graphical analysis,
- cross-correlation,
- Granger causality test,
- econometric modelling.

The graphical analysis enabled an initial selection of potential variables explaining variability of manufacturing production. Its aim was to catch a convergence in the course of analysed variables and to show relations between qualitative and quantitative data.

The purpose of the correlation analysis was to quantify the conclusions from the graphical analysis. On the one hand, we tried to find independent variables (RIED) that were most correlated with the index of industrial production (CSO), on the other hand we analysed the direction of change of explanatory variables, i.e. whether they led the trends of manufacturing production indexes or reacted with lags. The correlation analysis was supplemented by the Granger causality test.

When comparing a fit between quantitative and qualitative variables we took into account leads and lags from 1 to 12 months.

The aim of econometric models was to predict sold production in manufacturing, taking advantage of the publication lead as well as of the predictive power of business tendency surveys.

3. The results

Graphical analysis

The graphical analysis focused on four reference variables (ip95, ipyoy, ipmom, ip3m), defined as above, and eleven qualitative variables (states and expectations). In total there were over 200 pairs of variables to analyse but the single-base index (ip95) had to be examined only with respect to cumulated BTS balances because it describes the level of business activity while survey balances refer to changes of the level.

Index of manufacturing production (ip95) against the cumulated BTS balance

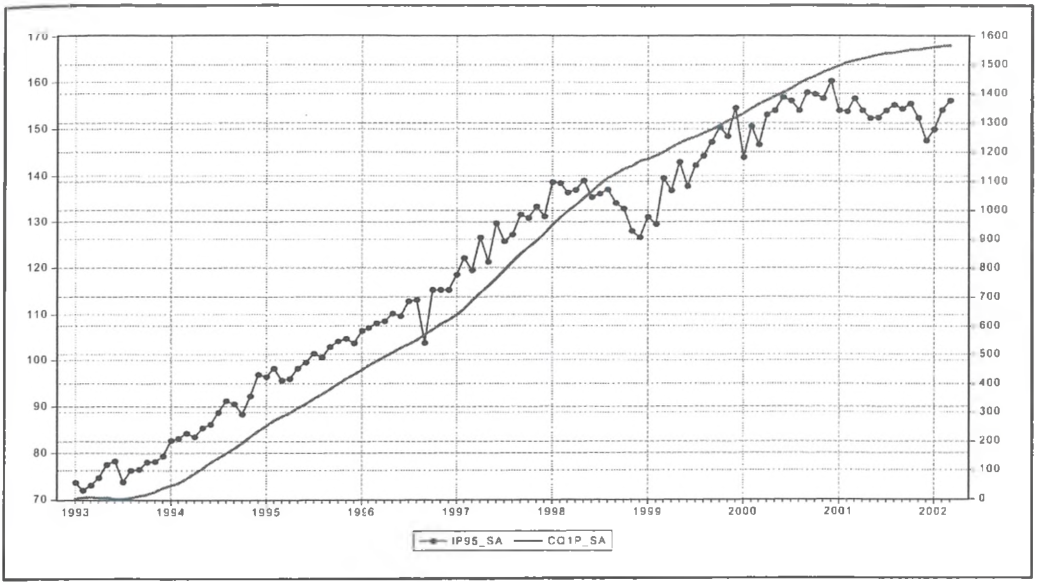
The idea to compare the cumulated BTS balance with the level of industrial production was proposed by Gerli and Petrucci (1995). It is grounded on the assumption that firms act rationally and changes in the production volume are proportional to corresponding BTS balances.

The results show that the RIED general business indicator (gbi) and the production expectations balance (q1p) reflect long-term tendency of sold production quite well. It is particularly clear for seasonally adjusted time series. High convergence (in some periods) is also observed if expected total orders (q2p), export orders (q3p) and stocks (q4p) are considered; stocks were analysed with an opposite sign. In case of other qualitative variables negative balances dominated in the analysed period, and in the cumulation process we obtained time series of a negative gradient unlike the rising level of sold production. Graph 1 shows the convergence between the single-base manufacturing production index and the cumulated balance of expected production.

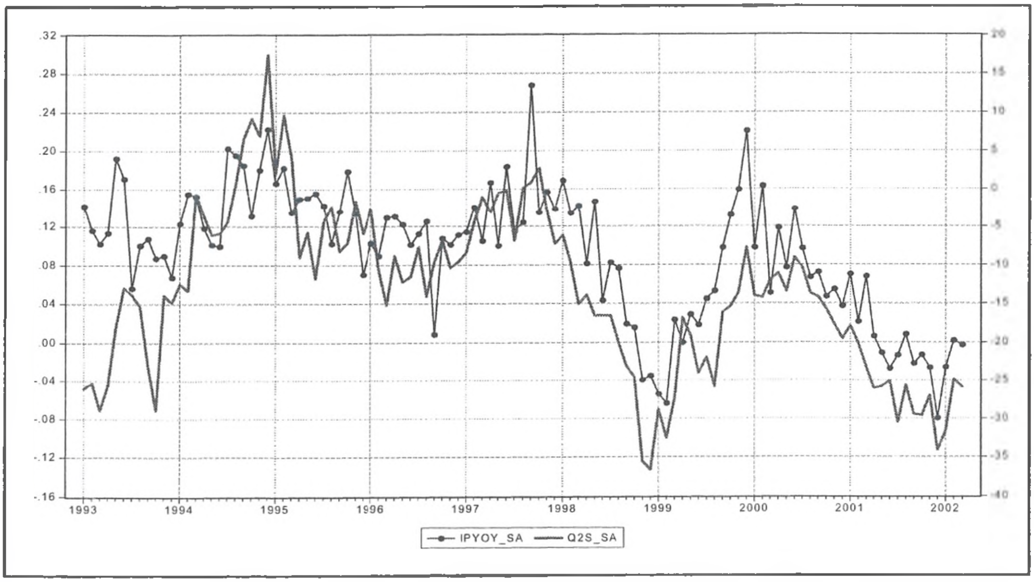
Monthly changes of manufacturing production (ipmom) against BTS balances

Although diagnostic questions in the business survey are formulated in such a way that opinions on changes in production should refer to the previous month, it is difficult to notice a clear convergence between qualitative data and the sold production month-over-month index (_mom). The lack of a convergence is also evident for prognostic variables. After an adjustment for seasonal and irregular fluctuations was made some improvement occurs, but great variability of the _mom index makes an interpretation of the results ambiguous and a perceptive conclusion about the course of production is impossible.

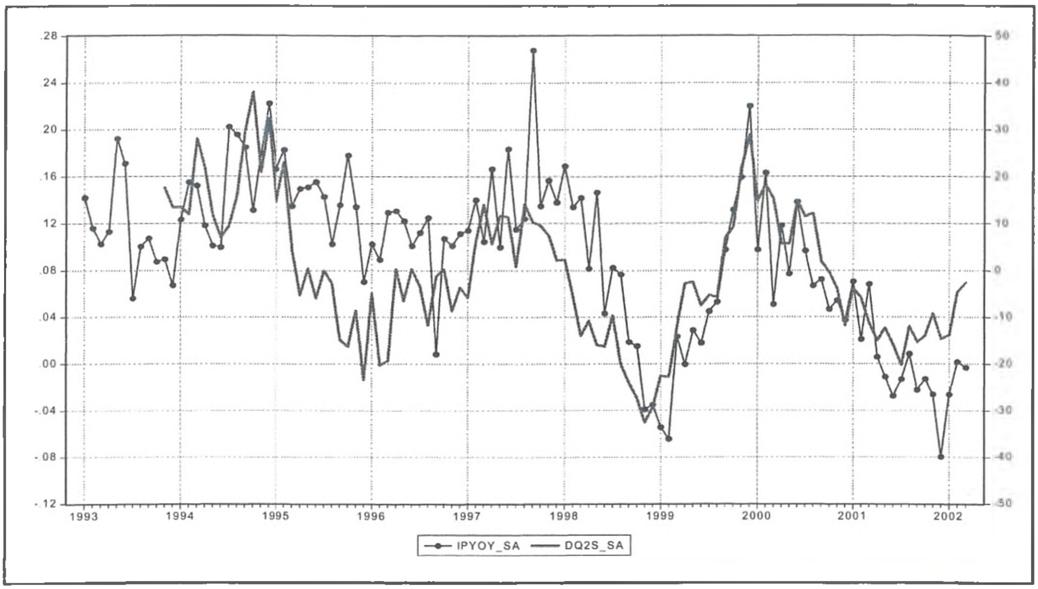
Graph 1. Single-base manufacturing production index (ip95_sa) against the cumulated balance of expected production (cq1p_sa); seasonally adjusted time series



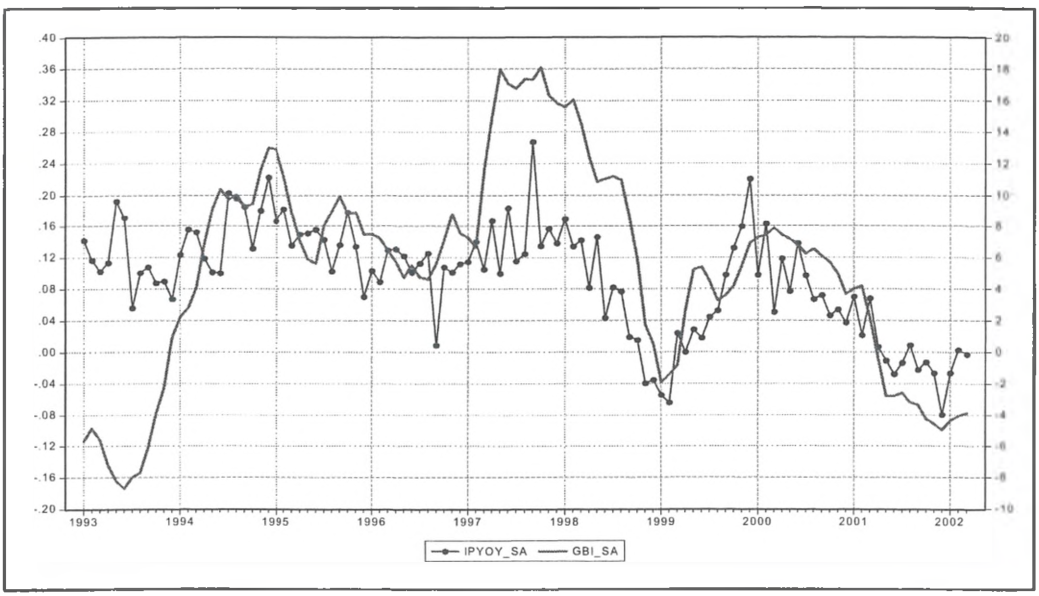
Graph 2. 12-month changes of manufacturing production (ipyoy_sa) against total orders balance (q2s_sa); Seasonally adjusted time series



Graph 3. 12-month changes of manufacturing production (ipyoy_sa) against 12-months change of total orders balance (dq2s_sa); seasonally adjusted time series



Graph 4. 12-month changes of manufacturing production (ipyoy_sa) against the RIED business indicator for industry (gbi_sa); seasonally adjusted time series



12-month changes of manufacturing production (ipyoy) against BTS balances and their 12-month changes

The best fit of qualitative data has been noted in relation to the yearly index of manufacturing production (ipyoy). The convergence can be seen for all explanatory variables, both balances and 12-month changes of balances. The graphical analysis lets us state that:

- convergence of analysed variables is more evident after removing seasonal and irregular fluctuations,
- the best indicator of the yearly index of sold production is 12-month changes of BTC balances,
- convergence and the fit differ in time; generally, convergence is closer in the second half of the period, i.e. after 1997,
- slightly better fits have been noticed for diagnostic balances (s); less pessimism in slowdowns and less optimism in booms are revealed in prognostic balances (p),
- relatively best fits have been noted for total and export orders (q2 and q3),
- qualitative data (balances and their changes) are quite a good indicator of cyclical behaviour of the yearly index of sold production; they do not reflect changes from one month to another, but rather their average value in 3-4-month period,
- in most cases turning points of the production index are projected well.

Graphs 2, 3 and 4 illustrate the convergence between 12-month changes of industrial production and the three qualitative indicators: total orders, 12-month change of total orders, and the RIED business indicator for industry.

Quarterly dynamics of manufacturing production (ip3m) against BTS balances and their 12-month changes

The graphic analysis shows a very good convergence in dynamic behaviour of raw time series. Raw BTS balances can explain very well the seasonal pattern of the 3-month-over-3-month production index. Similarity in the seasonal patterns of analysed time series is especially evident for the years 1997-2002. Among qualitative balances quite a high convergence with the ip3m index has been observed in relation to production (q1s) and expected change of production (q1p). We have noticed a good fit for total orders (q2s) and export orders (q3s). The opinion on general economic situation (q8s, q8p) does not show satisfactory results in explaining the dynamics of industrial production.

Cross-correlation

In the analysis we assumed that a correlation between a pair of variables is "strong" when a correlation coefficient is greater than 0.45 ($|r_{xy}| > 0.45$). It is certainly a simplified assumption, which was not based on any statistical test. Taking into account an economic sense of qualitative variables we looked for positive correlation with industrial production. Stocks were the only exception.

In the cross-correlation analysis[1] we had in mind the conclusions stemming from the graphic analysis. As was mentioned above the convergence of analysed qualitative and quantitative variables is much better for years 1997-2002. According to this conclusion we conducted cross-correlation analysis for two periods: for the whole period of 1993-2002 and for the sub-period 1997-2002. Correlation coefficients evaluated for the second sample are much higher than for the whole period. Therefore, calculations made in this paragraph refer to the years 1997-2002. These results seem to support some general proposition concerning business surveys conducted in transition countries; it says that the accuracy of expectations formulated by firms increases proportionally to the length of the transition process.

The correlation analysis confirms the results of the graphic analysis.

Index of manufacturing production (ip95) and BTS cumulated balances

The cumulated balances selected in the graphic analysis are strongly correlated with the single-base index of manufacturing production (ip95). However, it needs to be noted that – in the period under the analysis – the absolute level of sold production is characterised by a lack of cyclical movements; behaviour of the index is determined by an upward trend. For that reason it seems unnecessary to analyse cross-correlations that are in principle equal for the assumed 12 leads and lags. For example, for the expected level of production (cq1p) the difference between the highest and the lowest correlation coefficients equals 0.032 for all leads and lags.

Unsatisfactory results have been obtained for the expected export orders (cq3p); correlation coefficients are negative. It should be noticed however that this variable was strongly correlated with the index manufacturing production in 1993-1996.

Seasonal adjustment increases the power of correlation between the analysed pairs of variables. The cumulated balance of expected production is a variable most correlated with the index of sold production (cq1p_sa); the correlation coefficient amounts to 0.9 (0.721 for raw data). For the seasonally adjusted RIED general business indicator (cgbi_sa) the correlation coefficient amounts to 0.879 (raw data 0.714), for total orders (cq2p_sa) 0.690 (raw data 0.605), for changes in stocks (cq4p_sa) -0.597 (raw data -0.410). All other qualitative variables are negatively correlated with the single-base index of sold production; this makes it impossible to use them as potential regressors of a production level.

The correlation analysis confirms the results obtained for time series adjusted for seasonal and irregular fluctuations. Correlation coefficients have risen significantly, amounting to 0.953, 0.965, 0.781, -0.652 for cgbi_trd, cq1p_trd, cq2p_trd, and cq4p_trd respectively.

Summing up, potentially the best indicators of the single-base index of sold industrial production are:

- cumulated RIED business indicator for industry (cgbi, cgbi_sa, cgbi_trd), and

[1] Cross-correlation coefficients were calculated using formulas presented in another paper by Dudek and Walczyk included in this book. Detailed results of cross-correlation analysis are kept in the archives of the research project.

- cumulated balance of expected production (cq1p, cq1p_sa, cq1p_trd).

Monthly changes of manufacturing production (ipmom) and BTS balances

The cross-correlation analysis of monthly changes of manufacturing production confirms the results of the graphical analysis. The qualitative variables are weakly correlated with the reference variable. In the case of seasonally adjusted time series the correlation coefficient merely amounts to 0.265 (for expected general situation of the economy - q8p_sa, 11-month lag). Better results have been obtained for raw data; the highest correlation coefficient is equal to 0.559 for production (q1s), 1-month lag. Other qualitative variables are very weakly correlated with the index of sold production. No variable is leading.

Much better results have been obtained for seasonally adjusted time series (_trd). However, the highest correlation coefficients have been noticed for big lags, which make it impossible to use those variables to predict changes of the production.

12-month changes of manufacturing production (ipyoy) and BTS balances or their 12-month changes

The correlation analysis confirms the results of the graphical analysis: qualitative variables, both balances and 12-month changes, are good indicators of variability of the yearly index of sold production in manufacturing (ipyoy). Table 1 shows the highest and the lowest correlation coefficients for seasonally adjusted time series, including leads or lags.

One may see that balances regarding total orders are a variable most correlated with the yearly production index (q2s_sa); the correlation coefficient amounts to 0.867 (coincident variable). In the case of 12-month changes of BTS balances the highest correlation coefficient (0.836) has been noted for the RIED business indicator (gbi_sa), one-month lag.

Stocks reflect the weakest correlation (q4p_sa, q4s_sa), but they have best leading characteristics. The highest absolute values have been obtained for 2-3-month leads.

Taking into account the results of cross-correlation it may be said that, as confronted with the yearly index of industrial production:

- three indicators are leading (production – current state, stocks – current state and expectation),
- three indicators are coincident (total orders – current state, export orders – current state and expectation),
- five indicators are lagged (the RIED business indicator, production expectation, total orders – expectation, and general economic situation – current state and expectation).

Among the coincident and lagged variables three are strongly correlated with one-month lead: q1p_sa, q2p_sa, q3p_sa.

The above results are confirmed by the yearly change of the response balance for expectation variables. Furthermore, the following variables take leading characteristics: production level – expectation and total orders – current state and expectation. For coincident variables, export orders (state and expectation) behave as formerly. Other variables are lagged.

As mentioned, for both balances and 12-month changes some variables (q8p_sa, q8s_sa, gbi_sa) act with lags. The reason might be that firms appraise general economic situation having in mind the yearly dynamics of industry observed in the latest one or two months.

All the analysed variables might be used as regressors of the yearly index of industrial production because correlation coefficients for 1-2-month leads are very high, slightly differing from the highest values.

Seasonal adjustment improves the results. However, raw data could be of use as prognostic variables; for most variables the correlation coefficient is the highest with one-month leads. Five variables are leading, two are coincident and four are lagged. Similarly to seasonally adjusted time series, general economic situation acts with a lag in relation to the yearly index of sold production.

The analysis of 'trend + cycle' component shows the strongest correlation for some variables. The highest coefficient has been noted for the RIED general business indicator; it amounts to 0.970, with 1-month lag.

'Moving' quarterly industrial production (ip3m) and BTS balances or their 12-month changes

The results of cross-correlations of qualitative data with 'moving' quarterly dynamics of manufacturing production are satisfactory. Relatively high correlations have been noticed for raw balances; yearly changes of balances are weakly correlated with the reference variable.

For raw time series the ip3m index has a regular component of frequency shorter than 12 months and cross-correlation coefficients within 25 months (from –12 to 12) change the sign and have two extremes. In the analysis we consider maximal values close to coincidence.

The highest correlation coefficient (0.799) has been noted for production assessments with 1-month lead. High coefficients have been also noticed for the RIED business indicator for industry (gbi, 1-month lead), expected production level (q1p), current and expected total orders and export orders (q2p, q2s, q3p, q3s).

Seasonal adjustment does not improve the correlation power; the highest coefficient amounts to 0.646 (no lead) for the assessment of the production level (q1s_sa).

Table 1. The highest cross-correlation coefficients against the ipyoy index (seasonally adjusted time series)

Reference variable: ipyoy_sa				
	BTS balance		Δ^{12}	
	L	*R*	*L*	*R*
gbi_sa	+1	0.822	+1	**0.836**[a]
q1p_sa	+2	0.713[b]	-1	0.764
q1s_sa	-1	0.823	-1	0.794
q2p_sa	+1	0.756[c]	-1	0.786
q2s_sa	0	**0.867**	-1	0.738
q3p_sa	0	0.789[d]	0	0.662[e]
q3s_sa	0	0.822	0	0.770
q4p_sa	-2	-0.431	-2	-0.490
q4s_sa	-3	-0.475	-3	-0.607
q8p_sa	+2	0.702	+2	0.655
q8s_sa	+2	0.738	+1	0.708

L – lead/lag. *R* – correlation coefficient.

[a] For $L = -1$, $R = 0.808$; [b] For $L = -1$, $R = 0.695$; [c] For $L = -1$, $R = 0.720$; [d] For $L = -1$, $R = 0.748$; [e] For $L = -1$, $R = 0.632$.

Table 2. The highest cross-correlation coefficients against the ipyoy index (raw time series)

Reference variable: ipyoy				
	BTS balance		Δ^{12}	
	L	*R*	*L*	*R*
gbi	+1	0.652	+1	**0.771**
q1p	-1	0.453	-1	0.717
q1s	+1	0.564	-1	0.708
q2p	0	0.538	+1	0.728
q2s	0	0.655	0	0.682
q3p	-1	0.619	0	0.620
q3s	-1	**0.713**	0	0.716
q4p	-1	-0.319	-1	-0.434
q4s	-5	-0.268	-3	-0.572
q8p	+2	0.699	+2	0.635
q8s	+2	0.675	+1	0.677

L – lag/lead. *R* – correlation coefficient.

Granger causality test

Granger causality is defined as follows:

"Variable *x* is a cause of *y* in Granger's sense (denoted $x \rightarrow y$), if current values of *y* can be predicted using past values of *x* with more accuracy than when not using them and with other information unchanged." (Charemza and Deadman, 1997, p. 158).

In order to pass the Granger causality test we estimated two equations for a pair of variables (x, y), separately:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} \ldots + \alpha_l y_{t-l} + \beta_1 x_{t-1} \ldots + \beta_l x_{t-l} + \varepsilon_t$$
$$x_t = \alpha_0 + \alpha_1 x_{t-1} \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} \ldots + \beta_l y_{t-l} + \varepsilon_t \quad (1)$$

Then we tested the hypothesis of non-importance of parameters using Wald's statistics, i.e. we tested the hypothesis that x is not a cause of y in Granger's sense:

$$\beta_1 = \beta_2 = \ldots = \beta_l = 0 \quad (2)$$

Rejecting the zero hypothesis means that x is a cause of y in Granger's sense. Assuming that x represents BTS variables, and y – the index of sold production in manufacturing we require the zero hypothesis to be rejected in the first equation and to be accepted in the second. Then it is justified to say that Granger causality is one-sided. This test also enables to determine an order of lags (l), for which variable x is a cause of y.

It is assumed that the test is credible when the examined variables are stationary. For non-stationary variables the test is true only approximately and in some cases cannot be applied. Variables analysed in our study are non-stationary and, therefore, the results obtained in this paragraph should be assessed with caution.

Granger causality test was run for the yearly index of sold production (seasonally adjusted time series) and the 'moving' quarterly index (raw series). The results are presented in Tables 3 and 4. They contain probabilities above which the zero hypothesis should be rejected. Empirical probability exceeding 0.05 means that there is no ground to reject the zero hypothesis with importance threshold of 5%. In the column denoted with x not $\rightarrow y$ there are estimations of the probability that the BTS variable is not a cause – in Granger's sense – of the changes in the index of sold production. In the column y not $\rightarrow x$ we find probabilities that the production index is not a cause of the changes in qualitative variable.

The obtained results show that only expected stocks balance (q4p_sa) and general economic situation balance (q8s_sa) do not cause changes of sold production (in Granger's sense) for importance threshold of 10%. In the case of 12-month changes of BTS balances three variables (q4s_sa, q8s_sa, q8p_sa) are not a cause of changes of the production index.

On the basis of this test we may separate the variables, which are supposed to cause changes in the production index and the variables which are rather dependent on it (in Granger's sense). Another group would consist of the variables for which two-sided causality was noted.

One-sided causality, i.e. occurring when a BTS variable causes changes of the ip3m index and – on the other side – the production index is not a cause of that variable, has been noticed for five pairs of variables. These are:

- the RIED business indicator (gbi_sa),
- expected production (q1p_sa),
- total orders (q2s_sa),

- export orders (q3s_sa),
- stocks (q4s_sa).

Table 3. Granger causality test of BTS variables and ipyoy (seasonally adjusted time series)

Reference variable: y – ipyoy_sa						
	BTS balance			Δ^{12}		
x	L	x not → y	y not → x	L	x not → y	y not → x
gbi_sa	5	**0.047**	**0.153**	2	0.005	0.000
q1p_sa	4	**0.044**	**0.330**	4	**0.004**	**0.053**
q1s_sa	1	0.000	0.000	2	**0.001**	**0.093**
q2p_sa	1	0.003	0.013	2	0.023	0.021
q2s_sa	2	**0.024**	**0.423**	2	**0.003**	**0.889**
q3p_sa	1	0.002	0.025	1	**0.040**	**0.143**
q3s_sa	3	**0.055**	**0.355**	1	**0.051**	**0.865**
q4p_sa	1	0.179	0.204	2	0.036	0.045
q4s_sa	1	**0.085**	**0.396**	1	0.330	0.381
q8p_sa	5	0.016	0.053	2	0.135	0.001
q8s_sa	5	0.102	0.047	2	0.315	0.002

L – order of the test equation.
x not→y – empirical level of importance for the hypothesis that x is not a cause of y in Granger's sense.
y not→x – empirical level of importance for the hypothesis that y is not a cause of x in Granger's sense.

Table 4. Granger causality test of BTS variables and ip3m (raw time series)

Reference variable: y – ip3m			
	BTS balance		
x	L	x not → y	y not → x
gbi	3	**0.000**	**0.204**
q1p	1	**0.001**	**0.483**
q1s	2	**0.000**	**0.602**
q2p	1	**0.003**	**0.752**
q2s	2	**0.000**	**0.150**
q3p	2	**0.002**	**0.222**
q3s	2	**0.004**	**0.104**
q4p	4	**0.000**	**0.060**
q4s	2	**0.003**	**0.181**
q8p	2	0.460	0.742
q8s	2	0.288	0.100

L – order of the test equation (equation 2).
x not → y – empirical level of importance for the hypothesis that x is not a cause of y in Granger's sense.
y not → x – empirical level of importance for the hypothesis that y is not a cause of x in Granger's sense.

For changes in the BTS balances we have observed one-sided causality in case of:

- expected production(q1p_sa),
- production (q1s_sa),
- total orders (q2s_sa),
- expected export orders (q3p_sa),
- export orders (q3s_sa).

In the case of 'moving' quarterly production the causality test was run for raw balances. Calculations indicate that only general economic situation balance is not a cause, in Granger's sense, of the ip3m index. For other variables we have found one-sided causality; this means that BTS variables are a cause of the ip3m index and could by used as prognostic variables.

Econometric models

General model specification

A starting point of econometric analysis was determination of general model specification to be tested as a short-term forecasting tool. In the case of single-base index of sold production as a starting specification we used the model proposed in the study by Gerli and Petrucci (1995):[2]

$$ip95_t = a + \sum_{i=1}^{11} b_i S_{it} + cD_t + dcumx_t + \sum_{i \in BS} e_i(L)x_{it} + f(L)ip95_{t-1} + \varepsilon_t \quad (3a)$$

$$ip95\_sa_t = a + bcumx_t + \sum_{i \in BS} c_i(L)x_{it} + d(L)\,ip95_{t-1} + \varepsilon_t \quad (3b)$$

where:

$ip95_t$ – log of single-base index of sold industrial production,
D_t – number of working days in the month,
S_{it} – seasonal dummy,
x_{it}, $cumx_{it}$ – BTS variables (balance and cumulated balance),
$e_i(L), f(L)$ – lag operator polynomials,
ε_t – residual,
a, b_i, c, d, e_i, f – coefficients.

In addition, we also analysed models which explain 12-month changes of sold manufacturing production. Since the previous analysis showed that convergence of qualitative and quantitative variables after seasonal adjustment is much better than for raw series, in this specification we used only seasonally adjusted time series:

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[2] The same approach was used in our recent research on industrial production in the private sector in Poland – see Dudek (2001). Other quantification methods of qualitative data can be found i.a. in Rocki and Tabeau (1995) and Kudrycka and Radziukiewicz (1998).

$$\Delta^{12}(IP95\_sa_t) = a + \sum_{i \in BS} b_i(L)X\_sa_{it} + c(L)\Delta^{12}(IP95\_sa_{t-1}) + \varepsilon_t \tag{4a}$$

$$\Delta^{12}(IP95\_sa_t) = a + \sum_{i \in BS} b_i(L)\Delta^{12}X\_sa_{it} + c(L)\Delta^{12}(IP95\_sa_{t-1}) + \varepsilon_t \tag{4b}$$

$$\Delta\Delta^{12}(IP95\_sa_t) = a + \sum_{i \in BS} b_i(L)\Delta\Delta^{12}X\_sa_{it} + $$
$$+ c(L)\Delta\Delta^{12}(IP95\_sa_{t-1}) + dECM + \varepsilon_t \tag{4c}$$

where:

Δ^{12}, Δ – back difference operator, 12-month and 1-month respectively,

ECM_t – error correction term,

the remaining symbols as above.

Moreover, a model for 3-month-over-3-month production index for raw time series was analysed:

$$ip3m_t = a + \sum_{i=1}^{11} b_i S_{it} + cD_t + \sum_{i \in BS} e_i(L)x_{it} + f(L)ip3m_{t-1} + \varepsilon_t \tag{5}$$

where:

$ip3m_t$ – 3-month-over-3-month production index,

the rest symbols as above.

Estimation results

The selection of explanatory BTS variables takes into account the conclusions derived from graphic analysis, cross-correlation analysis and Granger causality analysis. We analysed different sets of explanatory variables to get good econometric model in terms of statistical properties. We tested also forecasting properties in an ex-ante prognosis. The estimation sample did not cover the first quarter of 2002. For this period we made ex-ante forecasts and made traditional tests of its accuracy (RMSE - root mean squared average error, MAE - mean absolute error, MAPE - mean absolute percentage error). We tested also the stability of the estimated model using recursive estimation procedures.

The best model properties (in terms of determination coefficient and adjusted determination coefficient – R^2 and R^2 adj.) and forecasting properties (in terms of mean absolute percentage error – MAPE) were obtained for model (3b). Determination coefficient was 0.92, mean absolute percentage error 1.39%. In addition, this model has some leading property. Using the model we can forecast single-base manufacturing production index with 1-month lead plus publication lead (lead of publication of BTS results against the industrial production index).

For the rest of models, the results are also plausible. The mean absolute percentage error is in the range between 2.56% and 3.14%. In models (3a) and (4a) we get only the publication lead whereas for model (5) we have 3-month lead plus publication lead.

Table 5. Estimation results

Model	Explanatory variables	Model properties		Forecasting properties	
Model 3a	cgbi(-1)	R^2	0.83	RMSE	5.32
ip95	Δgbi	R^2 adj	0.82	MAE	3.87
	q2s(-1)	SE	6.36	MAPE	2.56
	D	DW	1.87		
	const	LMF(2)	[0.62]		
		ARCH LMF(1)	[0.40]		
		JB	[0.17]		
Model 3b	cq1p_sa(-1)	R^2	0.92	RMSE	2.28
ip95_sa	q1p_sa(-1)	R^2 adj	0.92	MAE	2.14
	q3p_sa(-1)	SE	3.36	MAPE	1.39
	Δ (ip95_sa(-2))	DW	1.55		
	const	LMF(2)	[0.16]		
		ARCH LMF(1)	[0.79]		
		JB	[0.57]		
Model 4a	q2s_sa(-1)	R^2	0.71	RMSE	4.84
Δ^{12}(ip95_sa)	q8s_sa	R^2 adj	0.69	MAE	4.81
	q4s_sa(-3)	SE	5.03	MAPE	3.14
	const	DW	1.67		
		LMF(2)	[0.14]		
		ARCH LMF(1)	[0.03]**		
		JB	[0.13]		
Model 4b	Δ^{12}q2p_sa(-1)	R^2	0.71	RMSE	4.83
Δ^{12}(ip95_sa)	Δ^{12}q4s_sa(-3)	R^2 adj	0.69	MAE	4.81
	Δ^{12}(ip95_sa(-1))	SE	5.05	MAPE	3.13
	const	DW	1.95		
		LMF(4)	[0.06]*		
		ARCH LMF(1)	[0.55]		
		JB	[0.54]		
Model 4c	ECM(-1)	R^2	0.45	RMSE	4.80
$\Delta\Delta^{12}$(ip95_sa)	$\Delta\Delta^{12}$q2s_sa(-1)	R^2 adj	0.43	MAE	4.71
	$\Delta\Delta^{12}$(ip95_sa(-1))	SE	4.80	MAPE	3.14
	const	DW	1.83		
		LMF(2)	[0.92]		
		ARCH LMF(1)	[0.41]		
		JB	[0.60]		
Model 5	q1p(-3)	R^2	0.79	RMSE	4.29
ip3m	S(1)	R^2 adj	0.77	MAE	3.69
	S(2)	SE	0.03	MAPE	2.65
	S(3)	DW	1.70		
	AR(1)	LMF(4)	[0.21]		
	const	ARCH LMF(1)	[0.12]		
		JB	[0.003]***		

The presented above estimation results show that business tendency survey in industry conducted by RIED can be used to forecast sold production in manufacturing with 1-3-month lead.

However, it has to be noticed that short term forecasting is highly biased by subjective and unpredictable factors. According to this the short-term forecasts based on BTS variables have to be interpreted carefully. It is necessary to check properties of the models very often, moreover the models should be sometimes re-estimated. In this context it is reasonable to build quite simple and structurally transparent econometric models, which are easy to current and constant verification and eventual re-estimation.

5. Conclusions

To assess the usefulness of qualitative data from business tendency surveys for economic analysis, we concentrated on two aspects: accuracy of BTS in explaining the production level and possibility of using BTS to forecast direction of changes in the production level. It the both aspects we were successful, we received plausible results. The methods used in this paper showed that qualitative data correctly explain dynamic behaviour of industrial output and allow formulating short-term forecasts. Business tendency survey data are a very useful source of information, supplementing quantitative time series.

In particular, the results of our analysis allow for the following conclusions:

1. Manufacturing enterprises correctly assess economic situation. The data gathered in the business tendency survey in manufacturing very well explain real behaviour of economic activity. The graphic analysis showed that manufacturing production is very well modelled by the following qualitative variables from business tendency survey: the RIED business indicator for industry and the expected production. A little worse results were noted for: total orders, export orders, and stocks.

2. The graphic as well as cross-correlation analyses proved that the business tendency survey balances and 12-month changes of balances very well describe yearly index of manufacturing production. Simultaneously we proved that qualitative balances are not good explanatory variables for monthly change of production.

3. Cumulated qualitative balances for expectation questions very well describe a trend of manufacturing production.

4. The diagnostic and forecasting usefulness of business tendency surveys improves along with progress of transition of the Polish economy. We can say that enterprises learn the rules of market economy. The accuracy of BTS has evidently increased since 1997. The improvement in answer accuracy is also connected with some changes in survey questionnaires.

5. Seasonal adjustment as well as irregular factor adjustment of business tendency results allow for achieving better accuracy in explaining dynamic behaviour of economic activity. Elimination of seasonal and irregular components allows for an increase in forecasting power of qualitative variables.

6. Cross-correlation analysis and Granger causality tests showed that most of the analysed qualitative variables are leading or coincident against manufacturing production indexes. The leads range from 1 to 3 months. The set of leading indicators includes production assessments, total orders, export orders and stocks. The lagged variables include opinion on general economic situation and RIED business indicator.

7. The estimated econometric models showed that business tendency survey results could be used for short-term forecasting of quantitative variables. The plausible results were achieved for 1-3-month lead. Taking into account the publication lead, this can give quite early forecasts of changes in manufacturing production.

We can conclude that business tendency survey results gathered by the RIED are a valuable source of information on the real standing of the Polish economy. In particular, BTS results very well describe the dynamics of industrial production. Seasonal adjustment and irregular component reduction allow for better analysis of cyclical behaviour of economic activity; especially, it allows to determine trend and direction of changes of industrial output. The special character of qualitative data gathered in business tendency surveys, the ease and rapidity of their collection, as well as their strong microeconomic foundation contribute to reducing uncertainty and delay in diagnosis of the state of economy, what increases chances for the realisation of an effective macroeconomic policy.

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