THE USE OF BUSINESS SURVEY RESULTS FOR GDP FLASH ESTIMATES

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1. Introduction

In the developed world, the computation of flash yet objective estimates for core macroeconomic indicators is based on the use of model tools. Although the same way of computation of flash estimates for GDP and certain other macroeconomic indicators of the Slovak economy has also been verified in the branch of the Statistical Office of the Slovak Republic (ŠÚ SR), it does not, for objective reasons, have a long history. In fact, the assumptions for systematic using of model tools in Slovakia have emerged gradually, partly in dependence on the expanding base of statistical data and the improvement in its quality, and partly in relation to the reduced instability of the macroeconomic indicators themselves, resulting from the steady process of economic transformation.

In the branch of the ŠÚ SR the research in regard to the construction and use of models has for a long time been carried out by INFOSTAT. From the methodology point of view, these are econometric-type models [6,11]. Since 2005, their development has received a further stimulus in the fact that the ŠÚ SR is required to compute and publish in advance a flash estimate of GDP and total employment – always within 45 days after the end of each quarter. It is in this context that model tools for computing flash estimates of these indicators were created and applied during the course of 2005. Their construction is based on time series of either quantitative or qualitative nature, in other words, on business and consumer survey results [7].

As far as GDP is concerned, the first approach is based on an indicator representing a weighted average of the basic indices of four selected quantitative indicators. These indicators significantly determine GDP development in terms of supply (industrial production and construction production) and demand (retail turnover and exports). The second approach uses the economic sentiment indicator (ESI) as a main explanatory factor of GDP development. This complex indicator is compiled on the basis of business surveys and it is used as the reference (qualitative) indicator of GDP. The model tools for the ESI-based GDP flash estimates are presented in this article.

2. Business surveys and the economic sentiment indicator

Among the undisputed benefits of business survey results are especially the speed and timeliness of the information. These results come out in the form of business balances and confidence indicators expressing the generalized expectations of economic entities for the state and development of the economic environment (in which they operate) over the next three months. As a result, they can be an important source of information for computing flash estimates or short-term predictions for the development of macroeconomic indicators.

When constructing model tools for the computation of flash estimates or short-term predications, the time series of business balances may either be used independently in their original form or they may be presented as components of so-called composite confidence indicators. In accordance with the methodology recommended by the European Commission, the ŠÚ SR compiles confidence indicators in industry, construction, retail, and services [3]. They are constructed in order to provide a more detailed description of the development in the given sectors and thereby to signalise in advance potential improvement or deterioration in their current development trends. This is where their main advantage lies in comparison with reference statistical indicators compiled according to the principles of quantitative statistics.

Nevertheless, it should be noted that the practical experience of using such information in Slovakia has so far been minimal. It is clear from published articles that there is experience concerning the use of partial time series of business balances for estimating the parameters of model relations and their application for short-term estimates of selected sectoral indicators of industry and construction [2,9,10].

[1] The generalizing of economic entities' expectations is based on differentiating the nature of the expected development in terms of three possible variants: growth, no change, and decline. The business balance represents the difference between the responses in the variants of growth (+) and decline (-) expressed in %.

Unlike sectoral confidence indicators, the ESI is a complex indicator that reflects what a relatively high number of economic entities from several sectors think about the present and expected economic development. Its construction involves not only the industry, construction, and retail confidence indicators but also the so-called consumer confidence indicator. This is an overall rating expressing the general expected consumer confidence among the public. The respective survey is conducted on a representative sample of the public by the Institute for Public Opinion Research (UVVM) at the ŠÚ SR.

The ESI is calculated as a weighted arithmetic average of the industry confidence indicator (40%), the construction confidence indicator, (20%), the retail confidence indicator (20%) and the consumer confidence indicator (20%). All four confidence indicators are entered into the calculations as balances; the ŠÚ SR then transforms the final ESI, publishing it as an index that has a base of 100 equal to the average for the year 2000. In order to compare the ESI development over time at the macro-level, the time series of year-on-year relative changes in GDP in constant prices is used as a reference indicator. The ESI takes the form of a monthly time series, which in Slovakia dates back to January 1996.[2]

3. The use of composite indicators in econometric models

One way in which business and consumer surveys may be effectively exploited is to use their results to construct econometric-type model tools and then to use these models to compute flash estimates or short-term predictions for the development of macroeconomic indicators. A model using these results has the comparative advantage of being based on information that is quickly accessible. As a result, it is possible to compute estimates for several indicators directly, at least where there is a short time horizon (one quarter) overlapping with the expectations of the economic entities.

One such model is BUSY, which has been used by the European Commission since 1982 [12]. It is based on the results of harmonized surveys conducted within the EU-15. While the first version of the model, BUSY I, included regression equations only for the four largest EU Member States, the second version, BUSY II, established in 1996, includes regression equations for the EU-15 economy as a whole. It is employed mainly for flash estimates and short-term GDP forecasts and for individual components of GDP usage at the EU-15 level.

BUSY II, a small model based on 15 equations, is focused solely on presenting GDP development in terms of demand. As regards methodology, Error Correction Models (ECMs) and co-integration principles are used to construct its regression equations. In terms of content, the regression equations are based on confidence indicators, especially indicators of consumer confidence. Their relationships so specified are very dynamic, since confidence indicators affect the development of the reference variables with a lead-time of at least one quarter.

The information acquired from the application of BUSY II was used as the basis for creating a new version, BUSY III. The only exogenous variables used in BUSY III, unlike in its predecessor, are the results of business and consumer surveys, in other words, qualitative variables [1]. The European Commission is not the only institution that uses such models – another example is the model created by the Bank of Italy [8].

4. Model relationships for GDP flash estimates based on the ESI

In this part, we show the methodological approach and econometric-type model relationships that use the ESI to represent GDP development. Since the starting hypothesis for the functional form of the model may be differently formulated, the estimated model relationships also have a distinct form. There is either the standard econometric model (not affected by a correction term) or a model relationship in ECM form.

The estimation of their parameters employed the original quarterly time series of the respective quantitative or qualitative indicators (in other words, the non-seasonally- adjusted time series) in combination with seasonal dummies [3,4]. The ESI quarterly time series came from the transformation of the original, monthly, time series. The parameters of the model relationships were estimated using OLS method.

4.1 Model relationship without a correction term

The construction of this model relationship is based on a starting hypothesis according to which the ESI is considered a reference indicator for GDP in constant prices. To be more precise, it is assumed that there is a statistically significant dependence of year-on-year relative changes in GDP on the ESI values. This hypothesis was tested using quarterly time series of such indicators for a period from the 1st quarter of 1996 to

[2] In connection with the EU enlargement in May 2004, a so-called "new ESI" started to be constructed for the euro area alongside the "old ESI". Unlike the old ESI, the new ESI includes the confidence indicator in services. The new ESI also has a changed weight scheme under which industry accounts for 40%, services 30%, consumers 20%, construction 5% and retail 5% [5].

Chart 1

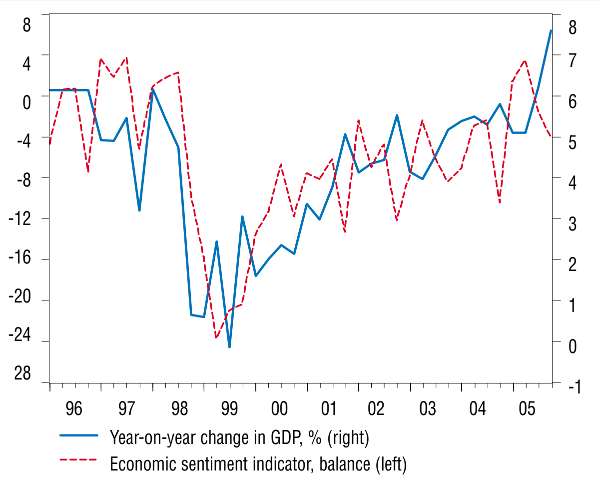


Chart 2

the 4th quarter of 2005, a total of 40 observations. The existence of this correlation may be verified visually by charting the time series values of the year-on-year relative changes in GDP (in %) and the values of the ESI time series expressed as balances (Chart 1).

The correlation analysis for these two time series makes clear that a relatively high statistical dependence exists between them – the correlation coefficient calculated for the whole period, that is for 40 observations, stands at 0.632. If, however, account is taken not of the synchronized development of these two time series but a lead-time of the ESI for one quarter, which may also be identified (especially since 1998), then the coefficient correlation increases to 0.734. It may therefore be assumed that the desired model relationship will more accurately capture the dependence of year-on-year relative changes in GDP on the ESI where it takes into consideration given time shift in their development.

If the starting hypothesis is expanded with the assumption that the modelled relationship is log-linear, then the estimation of the parameters of the linearized regression equations – using OLS method that takes account of the correlation analysis results – gives the following results:[3]

$$\text{dlog(GDP)} = 5.1785 + 0.1745 \,.\, \text{ESI(1)}$$
$$(21.2) \qquad (6.6)$$

Coefficient of determination	0.5399
Standard deviation of regression	1.1367
Durbin-Watson index	1.7512

[3] Year-on-year growth in GDP may be approximated by the difference of the logarithm as follows: dlog(GDP)=log(GDP)-log(GDP(-4))=(GDP-GDP(-4))/GDP(-4).

[4] If the ESI operates without a lead-time of one quarter, the modelled relationship explains around 40% of the variance in GDP year-on-year changes.

The estimate results show that the ESI (shifted one quarter in advance) is a statistically significant explanatory factor for year-on-year relative changes in GDP – over the analysed period, it explains almost 54% of the variance in GDP year-on-year changes[4]. Its parameter is positive, as expected, and its value is interpretable in such a way that a change in the ESI (balance form) by 1 percentage point results in a year-on-year change of GDP by around 0.17 of a percentage point.

Given that the development of the time series of macroeconomic indicators is usually determined to a significant effect by (own) inertia, the specification of the model relationship may be extended with a time-lagged endogenous variable. Estimation of parameters of this model relationship gives the following result:

$$\text{dlog(GDP)} = 3.3738 + 0.1151 \,.\, \text{IES(1)} + 0.3478 \,.\, \text{dlog(GDP(-1))}$$
$$(4.2) \qquad (3.3) \qquad (2.3)$$

Coefficient of determination	0.5917
Standard deviation of regression	1.0820
Durbin-Watson index	2.3874

By taking into account the effect of the time-lagged endogenous variable, the explanatory power of the model relationship is higher – it now explains almost 60% of the variance in the year-on-year changes of GDP. Although the parameter of the time-lagged endogenous variable is relatively small, it is statistically significant. It may therefore be said that the year-on-year changes in GDP are significantly determined also by the effect of inertia within their development. The ESI parameter remained statistically significant, but in comparison with its original size, it is smaller by about one third. It is clear from the value of the Durbin-Watson index (2.39) that the residuals may be considered as mutually uncorrelated.

The charting of the real and model-generated values of the year-on-year relative changes in GDP show that the model relationship captures their main development trends, including changes in their direction. It cannot, however, completely express some extreme fluctuations – especially the slowdown in GDP growth during the 4th quarter of 1998 and the 3rd quarter of 1999. In these quarters, the real slowdown in GDP growth was greater than that indicated by the ESI (one quarter earlier).

The acquired model relationship is relatively simple, but its explanatory power is rather low. The main problem, however, is that the relationship is based on non-stationary time series and therefore it cannot be excluded that it is affected by the problem of so-called spurious regression. Indeed, the ADF test results show the time series of both indicators (GDP, ESI) are of type I(1), which means the time series of their first differences are stationary. For that reason, the model relationship was also estimated in ECM form.

4.2 Model relationship in ECM form

In this case, the construction of the model relationship is based on a modified starting hypothesis according to which GDP grows at a basically constant pace, however, under the effect of changes in the ESI, its pace becomes variable.[5] The hypothesis so formulated results in a following model relationship that is assumed to be long-term:

$$GDP = \alpha \,.\, e^{\,b\,.\,t + c\,.\,IES}$$

or

$$\log(GDP) = a + b\,.\,t + c\,.\,IES$$

As regards methodology, the construction of the ECM model relationship is based on two steps. First, the equilibrium relationship between the non-stationary variables is estimated, and, second, the ECM model relationship is estimated using the stationary time series of residuals derived from long-term relationship. This is a model in which the deviation from long-term equilibrium in one period is partially corrected in the following period.

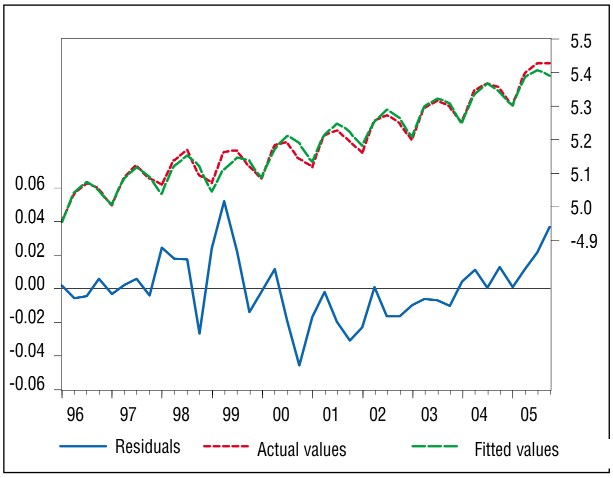
The parameters of the long-term relationship were estimated for the period from the 1st quarter of 1996 to the 4th quarter of 2005 (i.e. from 40 observations) and the estimation gave the following results:

$$\log(GDP) = \underset{(244.5)}{4.8924} + \underset{(1.8)}{0.0018}\,.\,IES + \underset{(17.0)}{0.0381}\,.\,TIME$$

Coefficient of determination	0.8870
Standard deviation of regression	0.0409
Durbin-Watson index	1.8316

[5] The model relationship in BUSY II is based on a starting hypothesis formulated in this way.

Chart 3

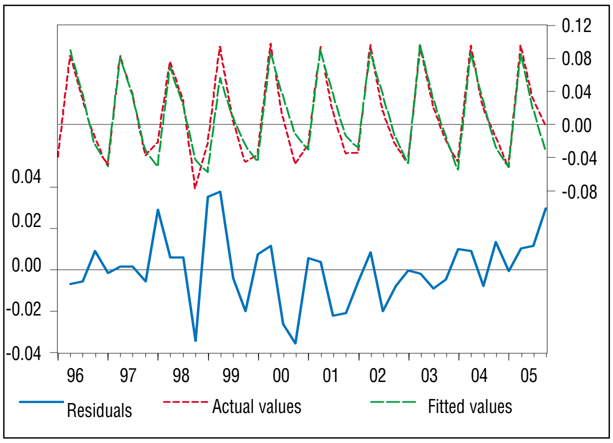


The results show that the estimated parameters are statistically significant. Next experiments showed that the explanatory power of the long-term relationship may be increased by taking into account seasonality in GDP development (seasonal decline in the 1st quarter (SD1) and seasonal increase in the 3rd quarter (SD3)). The resulting long-term relationship is as follows:

$$\log(GDP) = \underset{(463.5)}{4.9128} + \underset{(3.9)}{0.0019}\,.\,IES + \underset{(34.0)}{0.0373}\,.\,TIME - \underset{(-9.1)}{0.0712}\,.\,SD1 + \underset{(2.6)}{0.0203}\,.\,SD3$$

Coefficient of determination	0.9746
Standard deviation of regression	0.0199
Durbin-Watson index	1.0308

Chart 4



From charting the residuals, as well as from the values of the long-term relationship's statistical characteristics, it is clear that the relationship's explanatory power is sufficiently high. The TIME variable's parameter expresses the fact that GDP in the analysed period increased by an average of 3.7% per year. The estimation of ECM model relationship for GDP, using the residuals from the long-term relationship (RZGDP),[6] gave the following results:[7]

$$\text{dlog(GDP)} = 0.0097 + 0.0016 \,.\, \text{d(IES)} - 0.5589 \,.\, \text{RZGDP(-1)} - 0.0725 \,.\, \text{d(SD1)} + 0.0238 \,.\, \text{d(SD3)}$$

(3.4) (2.8) (-3.3) (-16.3) (5.3)

Coefficient of determination	0.9033
Standard deviation of regression	0.0178
Durbin-Watson index	1.7161

From charting the residuals, as well as from the values of the statistical characteristics of the ECM model relationship for GDP, it is clear that the relationship has high explanatory power. The influence of the ESI on GDP is statistically significant also in the short-term period, while the short-term elasticity of GDP to the ESI is not substantially different from the long-term elasticity . The effect of seasonality on GDP is statistically significant from the short-term point of view too. The largest deviation between actual GDP and the GDP values generated by the model relationship occur at the turn of 1998 and 1999, in other words at the beginning of macroeconomic stabilization of the Slovak economy.

Summary

The results presented in this article show that the ESI can be considered a statistically significant indicator of GDP development and that it may be used to construct model relationships for flash estimates of GDP. However, a comparison of the statistical characteristics of the acquired relationships shows that their explanatory power differs – as far as the past is concerned – and that it is significantly higher for the ECM model. In this regard, it may be assumed that the potential how to improve the explanatory power of these model relationships and, thereby to make GDP flash estimates more reliable, depends above all on expanding the ESI with the confidence indicator in services. Indeed, the services sector accounts for more than 50% of Slovakia's GDP. However, the time series of the confidence indicator in services is at present very short as the ŠÚ SR started to compile it in January 2002.

[6] On the basis of the Engle-Granger test, the time series of the residuals may be considered as stationary at a 10% significance level.

[7] In this case, the quarter-to-quarter relative changes in GDP are approximated by the difference of the logarithm as follows: dlog(GDP)=log(GDP)-log(GDP(-1))=(GDP-GDP(-1))/GDP(-1).

[8] The quarter-to-quarter absolute changes in the ESI are expressed by the differences d(ESI) = ESI-ESI(-1).

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