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CONSTRUCTION OF COMPOSITE LEADING INDICATOR FOR THE SLOVAK ECONOMY

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Abstract

Cyclical performance of economies in a turbulent environment is forcing researchers to search for early signals of turning points between the phases of slowdowns and accelerations. The most appropriate tool to solve this problem is the composite leading indicator (CLI), which is an aggregate index of several individual indicators proved to be statistical relevant for analyzing and forecasting of significant macro-economic indicators (reference series). The leading indicator provides qualitative information of the most probable performance of a reference cycle (i.e. GDP, Industrial production) with a significant lead-time of several months. INFOSTAT (the research institution of the Statistical Office of the Slovak Republic) is about to create and use its own periodically published composite leading indicator (now the only CLI for Slovakia is published by OECD) as a source of new information about so far non-investigated economic relations with the aim to improve the quality of short-term forecasts.

Keywords: Composite leading indicator, turning points, cyclical analysis, time series
JEL classification codes: C16, C32, C51, C53, C87, E32

1. Introduction

Cyclical performance of economies in a turbulent environment is forcing researchers to search for early signals of turning points between the phases of slowdowns and accelerations. The most appropriate tool to solve this problem is the composite leading indicator (CLI). CLI is an aggregate index of several individual indicators proved to be statistical relevant for analyzing and forecasting of significant macro-economic indicators (reference series). The leading indicator provides qualitative information of the most probable performance of a reference cycle (i.e. GDP, Industrial production) with a significant lead-time of several months.

The idea of constructing the composite leading indicator (CLI) for the Slovak economy has come from the absence of an own periodically published indicator of this type. The CLI can be used for analyses of the cyclical development of the Slovak economy or for predictions of business cycle turning points. There were some attempts of building a leading indicator in the past; however the research in this area was not based on a systematic long-

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run approach. The main problems were short time series and the instability of macro-economic conditions connected mainly with the economic transition. Furthermore, statistical data have been continuously revised as a consequence of the necessity to harmonize the methodology for compilation of the system of national accounts.

Nowadays the only CLI for the Slovak economy is created and regularly published by the OECD. INFOSTAT (the research institution of the Statistical Office of the Slovak Republic), which is engaged on a long-term basis in analyses and forecasts of macro-economic development of the Slovak economy with support of model tools, is intending to create and use its own composite leading indicator (SK-CLI). As a source of new information about so far non-exploited economic relations, the SK-CLI can improve the quality of short-term prognoses of the Slovak economy as a whole or its sectors.

2. The business cycles

Business cycle theories found their way into the economic theories at the beginning of 20th century. The research in this area was concentrated mainly at the National Bureau of Economic Research (NBER) in United States. The business cycles (called sometimes economic cycles) are regular fluctuations of economic variables in market economies. There are two different approaches to the fluctuations: business cycles (classical view) and deviation cycles.

The classical view is concerned with the changes of economic indicators in level, i.e. up- and downturns of variable in its level. The classical business cycle consists of four consecutive phases. The phase of expansion (1) enters after the peak point (2) into the slowdown (3) phase (recession) and then runs through to the lowest point – the through (4) into the first phase again and the whole cycle repeats itself (Figure 1). The phase of the expansion is generally longer than the one of a slowdown. The overall trend of economic indicators is therefore increasing. The Great Depression during the 1930s proved that the particular cycles vary in duration and intensity. The focus came therefore into the effort of recognizing the turning points with a few months leadtime. The analysis was based on the finding that the performance of the economy reflects itself into some partial indicators with a different time-shift. With reference to this time-shift the indicators were divided into three groups: leading, coincident and lagging. Hence, leading indicators can serve as prognostic tools that provide early stage information about incoming recession or expansion of the economy. The leading indicator became an important research tool of business cycle analysis mainly in the US and the member countries of OECD.

The classical view of business cycles is the simplest and most accurate approach in cyclical analysis. But the experience of many countries proves that a long-term slowdown of growth can cause more damage to the economy than the recession itself. In the second half of 20th century the classic business cycle didn't even occur in some countries – the growth of the output in level continued without break. That's why the attention is devoted also to deviation cycles (called also growth cycles) – fluctuations of time series around its long-term trend (Figure 2). The original time series have to be decomposed into four components – seasonal, trend (long-term), irregular and cyclical component. The objects of the cyclical analysis are the cyclical components of economic indicators with different time resolutions (leading, coincident, lagging). The time series decomposition is contrary to the classical cycle view connected with more inaccuracy. Deviation cycles provide the information about the trend-cycle relation, recognize the turning points in the case of a slowdown or an accel-

eration of the economy (in the case of continuous growth) and also bring more sensitive insight into the shock analysis. Compared to the classical view the interpretation of deviation cycles differs too. As we talk about expansion or recession in the classical view, deviation cycles describe only the slowdown or an acceleration of the economy. For instance all phases of the deviation cycle pass over during only one phase of the classical cycle (e.g. expansion). Nowadays the research in OECD countries is focused both on the classical as well as on the deviation cycle.

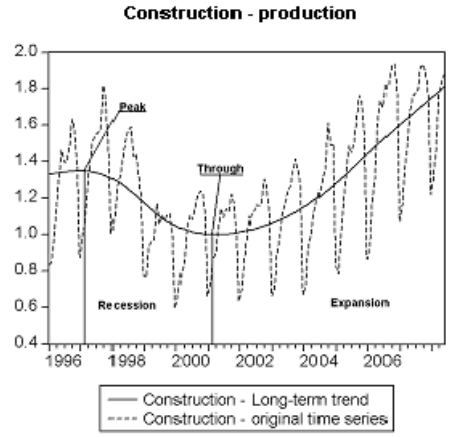

Figure 1 – Classical cycle

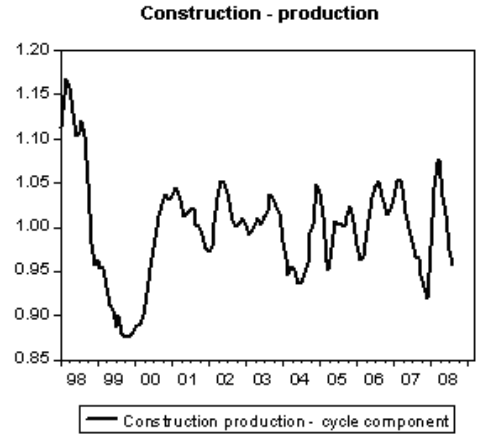

Figure 2 – Deviation cycle

3. The system of construction of the SK-CLI

The methodological starting point for the SK-CLI construction is the OECD system of leading indicators, which is mainly based on a system approach developed by NBER. This system recommends various methods for each step of the CLI creating process – that is – in the process of data transformation (seasonal adjustment, detrending, smoothing of time series), selecting a reference cycle, selecting and evaluating the potential components of the leading indicator and in the process of constructing the CLI itself so as by the interpretation of its performance.

The basis for selection of reference series and construction of the composite indicator for the Slovak economy is the database of monthly time series. The SK-CLI database contains about 200 series released by the official statistics (Statistical Office of the SR, Ministry of Finance and National Bank of Slovakia). The time series have been transformed into real indices on the base of 2000. The beginning of time series is set to January 1998. They all contain information on business cycles, which is the basic precondition for the components of CLI. The database is built of quantitative and qualitative monthly data (Business and Consumer Tendency Surveys). The containing time series come from different areas of economy (real and financial sector). The overview can be seen in the Table 1.

Table 1 – 13 economic areas

Economic Area	No. of Time Series	Economic Area	No. of Time Series
Industry	*27*	State Budget	*19*
Construction	*5*	Balance of Payment	*25*
Trade	*3*	External Trade	*26*
Services	*3*	Monetary data	*35*
Employment	*8*	Expectations (Surveys)	*23*
Wages	*7*		
Producer Prices	*12*		
Consumer Prices	*14*		
Total series			*207*

The analysis of database components and the construction of the CLI are based on so-called deviation cycles. The time series in database are ready now for decomposition into four components (cyclical, trend, seasonal, and irregular). Various methods were used for the decomposition of time series. Most of them are implemented in the software application EViews. Further analysis was performed using other software – BUSY and DEMETRA.

The tools Census X12, X11 (Historical) and Tramo/Seats were tested for the seasonal adjustment. Although all of the methods gave similar results, the performance of seasonally adjusted series using Tramo/Seats were markedly smoother. For detrending of series we have a number of different tools available: Hodrick-Prescott Filter (HP filter), X12 Henderson Moving Average (HMA), Tramo/Seats, Christiano-Fitzgerald Filter (CF filter), Baxter King filter (BK filter) or a simple moving average. A specific method is so called PAT method, which is used mostly by the OECD.

The HMA gives a non-smooth final cyclical component with too many turning points and the simple moving average shortens the series too much and moves the turning points to the right. The HP filter, BK filter and CF filter results are similar and satisfying. But with regards to the critique of BK and CF filters (e.g. deterministic trend) we have chosen the HP filter for detrending the series. For determining the irregular component we have used the estimates of Tramo/Seats method. The final cyclical components are smoothed by means of the MCD method (Months for Cyclical Dominance).

Once we have extracted the cyclical component for all of the time series in our database, the next crucial step is the selection of reference time series. GDP is the most reliable indicator reflecting the state of the economy as a whole. Therefore the cyclical factor of quarterly Gross Domestic Product is used as a proxy variable for the reference series selection. GDP‘s cyclical component is extracted using CF filter because other filters gave a series with turning points only at the beginning and end of the series. Comparing the turning points of cyclical components of GDP and other important sectors indicators of the economy, the results show us that industrial production index as well as construction production time series are at most matching the GDP’s cyclical movements. Following this analysis it is relatively easy to identify long cycles in economy, while the turning points are markedly similar for GDP, industrial and construction production. On the other side these sectors of

the economy are showing redundant turning points and cycles (sub-cycles). It is important to emphasize that this approach represents just a rough approximation with reference to the difficulty of extracting GDP's cycle (only 40 observations at disposal).

Finally, the industrial production index is chosen as the reference series. The reasons lie in relatively high ratio of industry on the real GDP formation (above 35% in 2007) and its wide usage throughout the world by various researchers (including the OECD). The share of construction in GDP is only around 5% and other cycle components do not correspond enough with the GDP's cycle performance. Apart from an individual reference series, we will later try to verify the possibility of creating a composite reference series (i.e. industrial production, construction production and other coincidence indicators), which might be a better way to approximate the performance of the Slovak economy.

At this stage of process we have available a reference series (cycle component) and cycle components of all potential individual components of a leading indicator. For identification of relation with the reference series we apply a correlation analysis. The results of cross correlation give us coefficients with various time resolutions (0-24 months). Through the comparison of cyclical components with cyclical patterns of the reference series it is now possible to divide all time series into three groups – coincident, leading and lagging. Following the NBER and OECD analysis the leading indicator components have to be composed of indicators from the area of new orders, economic expectations (business and consumer surveys), contracts and building permits, share prices and industrial material prices. Coincident indicators include employment, industry production, manufacturing sales, GDP or personal income. The most frequent lagging indicators are investment indicators, stock change, producer prices or interest rates. It is not expected that the final results will confirm all necessary assumptions in the case of the Slovak economy, which is a very small and open economy facing continual economic changes.

We determined two basic conditions for time series to enter the process of CLI construction. Firstly, the leading time of series has to be minimally 5 months and in the second place the coefficient of correlation has to be higher than 0.55. After filtering the final set of time series the phase differences are equalized by taking lags.

Only 16 time series from the group of leading series can be regarded as statistically significant considering the leading time and the coefficient of correlation. The selection of particular components of the SK-CLI is based on the scoring method. We have chosen three main criteria to ensure objectivity of selection the most appropriate series - economic significance, statistical significance and statistical quality of time series. **Economic significance** is connected with the approximate share in GDP and individual characteristics of the series regarding economic theory. The leading series should represent an early stage production process. It can occur as an early stage indicator, rapidly responsive indicator, expectations sensitive indicator, prime mover or others (OECD). **Statistical significance** is measured through the correlation coefficient, number of months of leading time, correspondence with turning points of reference series and smoothness. Finally, **statistical quality** estimation is based on timeliness, frequency of revisions, and the authenticity of series (level of transformation of original series – e.g. extrapolation). The scoring method is summarized in Table 2.

Table 2 – Scoring method criteria

10 points **Economic significance** - economic interpretation (5p) - share on economy as a whole (GDP) (5p)	30 points **Statistical significance** - coefficient of correlation (10p) - number of months leading time (10p) - smoothness (3p) - correspondence with turning points (7p)	10 points **Statistical quality** - timeliness (5p) - updates (3p) - authenticity (2p)

The given criteria yielded four indicators with best scores:

Loans granted to households – loans of households could be regarded as a strong accelerator of economic activities, mainly in the consumption sector or in construction. The curve of the cyclical component of loans is covering sufficiently the reference series turning points. Its leading time is 7 months and the correlation coefficient of 0.58. The National Bank of Slovakia publishes the data right after the end of the next month.

Exports of goods – SITC Nomenclature sections 0, 1, 2 and 5 – contains export of food and live animals, beverages and tobacco, crude materials and chemicals. Its leading time is 16 months and has correlation of 0.55. Its cyclical performance can be understood as a signal for the whole economy (positive or negative). The Statistical Office of Slovakia disseminates the data. The main disadvantage lies in its updates with monthly frequency. Data are available approximately with one-month delay after the reference series.

Employment expectations in Retail Trade – is a part of the retail trade confidence indicator. Expectations of respondents of the business tendency survey can be regarded as an early signal of worsening or improving of the general business environment. It has a time lead of seven months but is published during the end of the reference month. The series correlates with a high coefficient of 0.57.

Money M1 (Deposits) – is a prime mover, contains information about the monetary policy. Decrease or increase of money supply influences economic activities of various subjects. This series has a lead of 11 months and is published at the beginning of next month (one month earlier than reference series). It has a correlation coefficient of 0.56. Data are available through the National Bank of Slovakia.

4. The SK-CLI construction

We have four time series ready to enter the leading indicator. We can use a simple average with the same weights, different weights or other method. We decided to combine two methods: The Principal Component Analysis (PCA) and weighted average.

The first component (output of PCA) of our four time series can be used as a leading indicator. But we use the first component just as a proxy variable for computing the weights of the individual indicators. We apply the correlation analysis. Correlation coefficients are then used as factor loadings (weights) of individual leading series. The final equation for SK-CLI computation is:

SKCLI=(0.7502445*esirtciee +0.6144961*loanhouse+0.850719*expsitc0-5+0.8579709*m1)/3.0734305

The final leading indicator is 7 months ahead of the reference series (index of industrial production). To finish the construction we have to extrapolate some of the series (towards January 1998) because of their relative long leading time and finally normalize the series with a mean of 100. The results are displayed on the Figure 3.

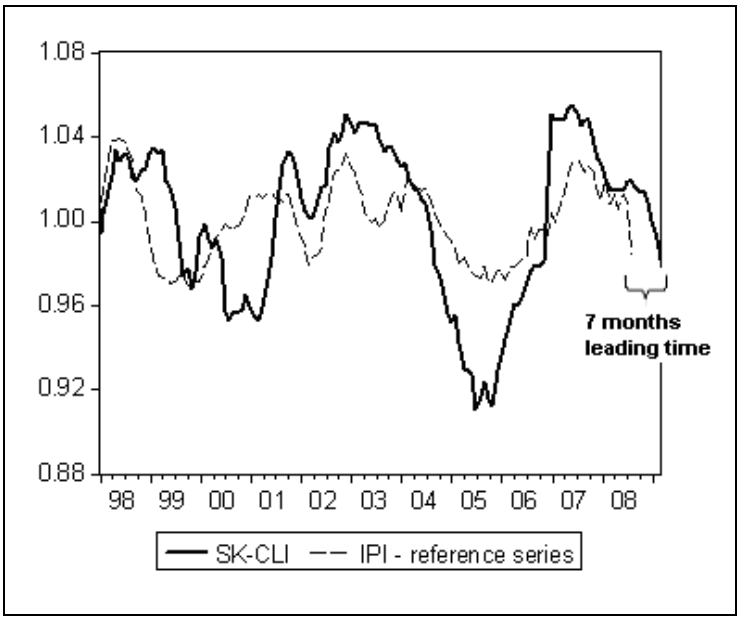

Figure 3 – The SK-CLI

The SK-CLI indicator does not follow all the turning points right, as we can see it clearly in 2000. But other turning points, as in 2001/2002, 2003, 2005 and 2007 are covered very satisfactory. As a first experimental result the SK-CLI can be regarded as sufficient.

5. Conclusions

The first experiment with CLI construction can be assumed as successful. The next phases of research will be based on verification of the results. It is eventually possible that the composition of our SK-CLI indicators will change after few months and become more stable. To improve the whole process of construction the CLI we will try to complete the SK-CLI database with new time series (with co-operation of the Statistical Office of Slovakia). In the future the EU-countries are facing a revision of NACE classification of economic activities. What impact on the monthly series this step will bring we might now just guess. Other possibility to develop our method lies in new tools for detrending or for construction the CLI, which are now just emerging.

The leading indicator SK-CLI suitably renews and at the same time completes model tools used by INFOSTAT for analyses, flash estimates and short-time prognoses of development of the Slovak economy. However, verification of its reliability and predicative ability requires a long-term experimental application, including many revisions as confirmed by experience of other countries.

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