Leading composite index produced by Finance Think:
Forecasting power reassessed

Policy study

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Abstract

The objective of the study is to reevaluate the forecasting power of the leading composite index of Macedonia. The leading index is a weighted index of indicators which are considered to lead the economic cycle. The main dynamic model in which, first, industrial production is represented as autoregressive process, and then lags of the leading index are added, is used to measure the forecasting error behavior with the addition of the leading index and with the imposition of larger time span in the model. The main finding is that the inclusion of the leading index in the model reduces the forecasting error for certain time spans. The forecasting time of the leading composite index in Macedonia is found to be about nine months, which is slightly longer time than compared to earlier estimates. The finding could be utilized by policymakers in the processes of forecasting GDP, as well as for planning purposes, especially for budget preparation.

Keywords: economic cycle, leading index, root mean squared error, distributed lags model

JEL classification: E37

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I. Introduction

Business cycles have been long researched in the literature since the pioneering study of Mitchell and Burns (1938). However, this type of analysis is relatively new in Macedonia. Until recently, the interest in the economic cycles in Macedonia has been weak due to the prevalence of analyses related to the transition problems. The calculation of a monthly leading composite index for Macedonia since 2010 enabled an interactive tool to serve the process of policymaking and, as such, opens an analytic field to deal with the issues of business cycles in Macedonia. The purpose of this study is to present a simplified model for (re)assessing the forecasting power of the leading composite index and hence to provide the grounds for evaluating the methodology behind the index computed by Finance Think and to serve yardstick against the forecasting power will be measured.

The study proceeds as follows: The next section provides a brief overview of the related referent literature and reviews the advantages of combining the economic indicators in composite indices. The third section presents the empirical analysis of the linear model for assessing the time by which the leading composite index leads or forecasts the economic activity. The last section concludes.

II. Literature on the business cycle indicators

Business cycle indicators historically originate from the pioneering study of Mitchell and Burns (1938) who offer statistical tools for forecasting economic activity. Though, their proposal caused mixed reactions among econometricians, forecasters and applied economists in the years following publication. A part of the critique considered it as a "measurement without any theoretical background", while other as a significant tool for forecasting business cycles. Still, a result of this debate today is a large volume of literature dealing with broad range of issues on forecasting business cycles, from combining indicators into composite indices of the business activity, to complex modeling of the causality between indices and indicators of the current economic activity.

A significant shift in the history of business cycle indicators was made in 1989 with the important work of Stock and Watson (1989), which formalizes the idea that business cycles represent a joint movement of a set of series, combined in a composite index, which is an unobservable factor in a dynamic model of four coincident indicators. Marcellino (2004) evaluates the contribution of Stock and Watson in other significant areas, those being the following:

- selection of indicators for the leading composite index, on the basis of regression and correlation analysis of a large set of indicators, most of which have demonstrated to lead the economic cycle;
- construction of a model for forecasting the current activity on the basis of the movement of the leading index;
- resolving problems such as dealing with outliers, reviewing and re-composition of the indices and so on.

Ultimately, the contribution of Stock and Watson can be observed in the creation of an early warning system with the help of the leading composite index, which, with a certain level of probability, should detect the turning point of the business cycle. The last idea is also considered by Diebold and Ruderbush (1989) in their prominent work in this area and it is one of the basic objectives in designing and modeling business indicators in the US today.

Several decades of work on business cycle composite indices resulted not only in numerous studies (Stock and Watson, 1993; 1999a; 1999b), but in an increasingly widespread acceptance of the methodology for their composition and application in forecasting by many countries worldwide.

Although a series of indicators can be used in forecasting the direction of the economic cycle, the widely used way in the literature is to combine them into a so-called economic cycle indices (Stock and Watson, 1989). Combining the indicators into an index achieves several objectives (McGuckin *et al*, 2003):

- first, the composite index appropriately reflects the multi-causal and multifactor nature of economic trends;
- second, it summarizes the cyclical movements of its components;

- third, it overcomes the problem of variability of each series, i.e. it narrows the dispersion of the observations around their average value; and
- fourth, to a certain level, it eliminates the seasonal fluctuation in the series.

These objectives are achieved by approximating the contribution of each series in the total index, with the so-called standardization factor, which bases on the variability of each of the contributing series (The Conference Board, 2001). The contribution of the individual series changes over time, as the variability of the series changes, and depending on the characteristics of the economic cycle. The composite index is a portfolio of series that vary in their persistence, variability, the manner in which they are expressed and so on. Still, the application of the standardizing factor for eliminating the seasonal fluctuations is limited, if the included indicators follow the same seasonal pattern; in such a case, the seasonal component should be eliminated from the series using the conventional techniques.

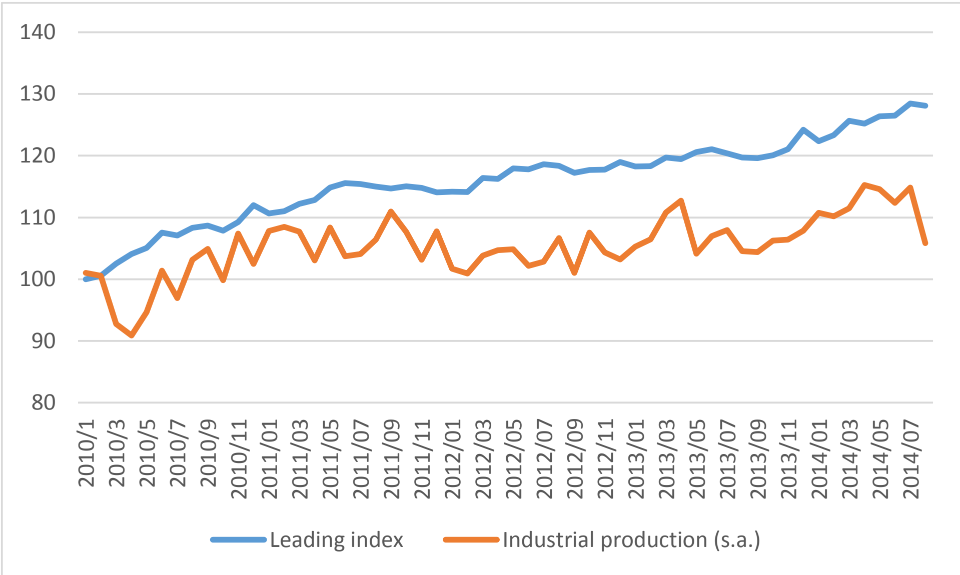
III. Empirical analysis

1. Data

The leading composite index for Macedonia has been calculated monthly since 2010 until the last available month, August 2014. This provides a total of 56 observations of the index, which is sufficient for a proper assessment of the forecasting power. The leading index is composed of eight series: Average number of people registered for money compensation; Average salary in manufacturing; Manufacturer's new orders index; Index of the estimate of new construction orders; Imports of intermediate goods and goods for reproduction; Corporate loans; Stock market index; Money supply M2; Interest rate spread. According to Stock and Watson (1989), all these are considered to containing a leading component in determining the future movement of the economy. The index is constructed by following the methodology of the Conference Board (2001) whereby the variance of each indicator has a role in weighting the composite index. These indicators are compiled from the State Statistical office, the National Bank of Macedonia, Ministry of Finance and the Agency for unemployment. Industrial production is obtained from the State Statistical Office and then cleaned of the seasonal component.

The movement of the leading index and industrial production (seasonally adjusted) is given in Figure 1 below. Movements of the two variables are similar, though the 'leading' component of the leading index is not readily apparent. A notable blur in the relation is imposed by industrial production's higher variability than index movements which are calmer. The picture does not suggest any causality nor does it give clearer idea of the time with which the index leads or forecasts economic activity. Hence, we proceed with econometric investigation of the issue in the next section.

Figure 1 - The movement of the industrial production (s.a.) and the leading index in Macedonia



Source: Calculated by Finance Think, based on the data from the State Statistical Office, Ministry of Finance, National Bank of Macedonia and the Agency for unemployment

2. *Linear model for assessment of the forecasting power of the leading composite index*

The history of the composite indices has differentiated several ways of modeling the forecasting power of the leading composite index. Still, the largest steps in modeling were made in the past two decades. Several models have been developed, among which: linear models, factor-based models, Markov-switching models, smooth-transition models, neural-network and non-parametric models, binary models, etc. Still, the starting point and the simplest framework to comprehend the relation between industrial production and the leading composite index is the linear vector autoregression model (VAR), given in the following equation:

$$\begin{pmatrix} \Delta_j Ind_t \\ \Delta_j Lead_t \end{pmatrix} = \begin{pmatrix} \alpha_{Ind} \\ \alpha_{Lead} \end{pmatrix} + \begin{pmatrix} e(L) & f(L) \\ g(L) & h(L) \end{pmatrix} \begin{pmatrix} \Delta_j Ind_{t-i} \\ \Delta_j Lead_{t-i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{Ind_t} \\ \varepsilon_{Lead_t} \end{pmatrix} \quad (1)$$

Whereby: Ind refers to the industrial production, seasonally adjusted; Lead refers to the leading composite index, α's are the intercepts, L is the lag operator, and ε's are the error terms. t refers to the time period, j to the span of the growth rate of the series and i for the time lags.

Given series are trending (as evident from Chart 1), we start our investigation by testing for unit roots. We use the conventional unit root tests and, expectedly, all those suggested existence of a unit root (results are not presented to save space, but also since they all led to unique conclusion of unit-root presence). The differencing of the series refers to the previous 12 months, so that j takes values from 1 to 12 in a sequence of 3, 6, 9 and 12 months, so as to preserve space and reflect quarters rather than months. The choice of the number of months is hence not arbitrary, but rests on the suggestion in the literature that the index has a short-term leading power, which in this case is taken to be a year (12 months). In many studies, the leading time of the leading index is not taken to be longer than 5-6 months. Because of the same reasons, the order of the VAR, i, also takes values from 1 to 12. The possibility that both series are cointegrated is tested with the Johansen method, but series appear not cointegrated at the conventional statistical levels. This finding is expected, given that series co-move but with certain leading time exercised by the leading composite index over the industrial series. Thus, we carry on with an unrestricted VAR model.

Taking into account the width of the period for which a growth rate of the indices is applied (*j=1 to 12*), and the number of included lags in the VAR model (*i=1 to 12*), both in four sequences (3, 6, 9, 12), we obtain 16 dynamic lag-models in total. The results for the root mean squared forecasting error (RMSE), for each model are presented in Table 1. Each model is firstly estimated with lags of the industrial production only (autoregressive model; column 3 of Table 1) and then lags of the leading composite index are added (VAR model with two variables; column 4 of Table 1). In the estimation, the predictive specifications of the regressions are not optimized, which means that including information criteria such as

Akaike and Schwarz would improve the forecasts of those models. However, we have chosen a simpler approach, which has an indicative function, i.e. points to the ways of assessing the forecasting power of the index and highlights how this index could contribute to the analysis of the business cycles and the policymaking.

Table 1 - Results

Width of the growth rate of the incl. index	Number of incl. lags	RMSE – Root mean squared error		
		Included industrial product only	Included both, industrial product and the leading index	Improvement brought by the leading index (%)
3	3	3.593	3.627*	0.9%
3	6	3.759	3.708	-1.4%
3	**9**	**3.695**	**3.618**	**-2.1%**
3	12	3.396	3.643	7.3%
6	3	4.403	4.356	-1.1%
6	6	3.937	4.002*	1.7%
6	9	3.68	3.904*	6.1%
6	12	3.767	3.815*	1.3%
9	3	4.995	4.965	-0.6%
9	6	4.763	4.749	-0.3%
9	9	4.134	4.147*	0.3%
9	**12**	**4.119**	**3.622**	**-12.1%**
12	3	4.568	4.469	-2.2%
12	6	4.601	4.083	-11.3%
12	9	4.728	4.185	-11.5%
12	12	4.627	5.156*	11.4%

** points to cases where VAR models including time lag values of the leading index are less accurate (have higher RMSE) compared to the simple AR model.*
Source: Calculations of Finance Think

In majority of the cases, the distributed-lag model that includes the leading index exerts greater forecasting power onto industrial production than a simple AR representation. Three patterns can be observed in the obtained results. *First,* RMSFEs increase as the number of the periods (time span) for which growth rates of series are calculated increases (from 1 to 12, the first column of Table 1), given the number of explanatory variables (lags; the second column of Table 1). This finding is consistent with the conclusion in McGukin and Ozyildrim (2003). *Second,* the lowest value of RMSE is registered for the span of the growth rate of 9 months (the first row after the heading row in Table 1). And, *third,* increasing the number of regressors (lags), generally (but not exclusively) increases the forecasting power of the leading index over industrial production. For a growth span of 3 months (producing the lowest RMSEs in general, rows group 1 of Table 1), the lowest RMSE is produced for the 9 lags. However, the largest improvement brought by the inclusion of the leading index is obtained for a growth span of 9 months and 12 lags included.

Overall, we can conclude that the leading index contains significant indicative forecasting information in relation to the real economic activity in Macedonia. However, results are somehow inconclusive: the lowest forecasting error is obtained for a growth span of 3 months, while the largest improvement brought by the inclusion of the leading index, for a growth span of 9 months. In both cases, including more lags than the growth span improves the forecasting power. Overall, we could conclude that the forecasting power of the index extends to a period of about 9 months, which is slightly longer than compared to the previous findings of 5-6 months.

IV. Conclusion policy relevance

The objective of the study is to (re)assess the forecasting power of the leading composite index of Macedonia. The leading index is a weighted index of indicators which are considered to lead the economic cycle. The main dynamic model in which industrial production is represented as autoregressive (AR) process, and afterwards lags of the leading index are added (VAR process), is used as a main forecasting tool for determining the forecasting power of the leading index. The main indicative finding is that the forecasting power of the index extends to a period of about 9 months. Hence, the leading time of the composite index in Macedonia is about three quarters. This finding is useful for policymaking purposes. It implies that what the index suggests today will likely be effectuated in about three quarters. Policymakers hence may be interested in considering this advanced information in their forecasts of the economic activity, as well considering in various planning purposes, especially when projecting the budget.

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