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Abstract

The objective of the paper is to evaluate 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, GDP 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. The forecasting time of the leading composite index in Macedonia is found to be between one and two quarters.

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

JEL classification: E37

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[1] *An earlier version of this study existed as a working paper of the Ministry of finance. The author thanks all commentators who provided valued feedback. All remaining errors are solely of the author.*

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 leading composite index for Macedonia since 2007 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 assessing the forecasting power of the leading composite index and hence to provide the initial contribution in the academic thought and the empirical research of the business cycles in Macedonia.

The paper 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.

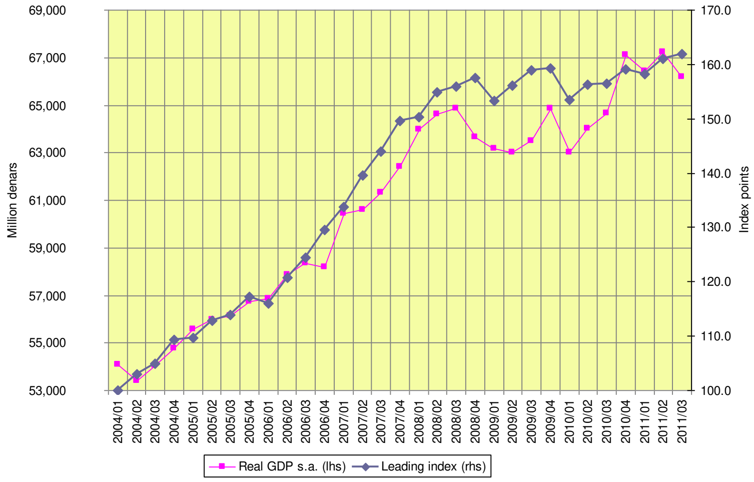
III. Empirical analysis

1. Data

The leading composite index for Macedonia has been calculated quarterly since 2007 and starting back from the first quarter of 2003 until the third quarter of 2011 inclusive (the latest available data). This provides a total of 31 observations of the index, which is sufficient for an early assessment of the forecasting power of the index in view of the real GDP in Macedonia. One should bear on mind that the construction of the index for the period before the one specified here is subject to the problem of lack of data on certain indicators, as well to the problem of the reliability of certain series. 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. Real GDP is obtained from the State Statistical Office and then desezonalized with the Census X12 method.

The movement of the leading index and real GDP (seasonally adjusted) is given in Chart 1 below. Movements of the two variables are similar, though the ‘leading’ component of the leading index is not readily apparent. For instance, it may be the case that the index moderation in 2008:1 might be forecasting the weak activity toward the end of the same year, when the crisis hit Macedonia, but the subsequent weak improvement of the index is not in line with the subsequent GDP movement. Further index movements may be reconciled with the GDP movements. However, the picture does not suggest any causality nor it might 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.

Chart 1 - The movement of the real GDP (s.a.) and the leading index in Macedonia



Source: Calculated by the author, 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 real GDP and the leading composite index is the linear vector autoregression model (VAR), given in the following equation:

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

Whereby: GDP refers to the real GDP, 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 four quarters, so that j takes values from 1 to 4. The choice of the number of quarters we will use here is 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 (four quarters). 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 4. The possibility that the 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 GDP 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=1,2,3,4*), and the number of included lags in the VAR model (*i=1,2,3,4*), we get 16 dynamic lag-models in total. The results for the root mean squared forecasting error (RMSFE), one quarter ahead, for each model are presented in Table 1. Each model is firstly estimated with lags of the GDP 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.

Table 1 - Results

Width of the growth rate of the incl. index	Number of incl. lags	RMSFE – Root mean squared forecasting error	
		Included GDP only	Included both, GDP and the leading index
1	1	0.01442	0.01482*
1	**2**	**0.01474**	**0.01434**
1	3	0.01486	0.01449
1	4	0.01515	0.01438
2	1	0.01877	0.01663
2	2	0.01847	0.01650
2	3	0.01884	0.01610
2	4	0.01920	0.01658
3	1	0.02391	0.02108
3	2	0.02384	0.02137
3	3	0.02442	0.02260
3	4	0.02484	0.02192
4	1	0.02509	0.02199
4	2	0.02521	0.01751
4	3	0.02594	0.01872
4	4	0.02670	0.01637

** points to cases where VAR models including time lag values of the leading index are less accurate (have higher MSFE) compared to the simple AR model.*

Source: Author's calculations

In all cases except one, the distributed-lag model that includes the leading index exerts greater forecasting power onto GDP 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 4, 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 RMSFE is registered for the span of the growth rate of one quarter (the first row after the heading row in Table 1). And, *third,* increasing the number of regressors (lags), increases the forecasting power of the leading index over GDP, but with a peculiar pattern: lag 1 or 3 has the largest RMSFE, while lag 2 or 4 the lowest one, depending on the span of the growth rate. For a growth span of one quarter (producing the lowest RMSFEs in general, row 1 of Table 1), the lowest RMSFE is produced for the two lags (bolded line in row 1 of Table 1).

Overall, we can conclude that the leading index contains significant indicative forecasting information in relation to the real economic activity in Macedonia. There is sufficient empirical evidence that, for width of the growth rate of the leading index and GDP of one quarter and a lag of two quarters, including the leading index in the model reduces the forecasting error at the minimum among a variety of distributed lag models**.** This points to the finding that the information contained in the leading composite index will be effectuated over the economic activity in the next one to two quarters, i.e. that the leading time of the leading index is one to two quarters. The latter is in line with the findings of other studies which, by using monthly data, discovered that the leading time of the leading index is 5-6 months (The Conference Board, 2001). This clearly points that the leading index is a useful ex-ante tool for forecasting the direction of the aggregate economic activity in Macedonia for a short period.

IV. Conclusion

The objective of the study is to quantify 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 GDP 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 root mean squared forecasting error is the smallest at a width of the growth rate of one quarter and a time distribution of the explanatory power of the index of two quarters. Hence, the leading time of the composite index in Macedonia is between one and two quarters. The last statement points to the main conclusion from the research and the contribution of this study in the analysis of the business cycles in Macedonia.

This research is only an indicative analysis of the leading time of the leading composite index in Macedonia in explaining the aggregate economic activity. This means that by adhering to more criteria in reviewing the time distribution of lags, working with multiple time spans of the growth rate, as well as taking into account longer-term forecasts than one quarter, will significantly improve this analysis. Probably, utilizing more advanced models and techniques of examination will disclose more information on the forecasting power of the Macedonian leading index. These considerations can serve direction for future research on the topic.

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