Composite Leading Indicators Based on Business Surveys: Case of the Czech Economy

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Abstract

Consistent and countercyclical economic policies are conditioned on an accurate assessment of the position of an economy within the economic cycle and also on its prediction. The indicators of economic cycles represent a frequently used tool for monitoring and predicting economic cycles. In the paper we present the current practice in this area as it is has evolved over the years at the Ministry of Finance of the CR. At the same time, we point out the critical issues connected with the construction and interpretation of the indicators both in general sense but especially in the environment of the Czech economy. Finally, we present two composite leading indicators for the Czech economy and assess their prediction capacity in relation to the economic cycle.

INTRODUCTION

Market economies typically experience fluctuations in economic activity. From the point of view of economic policy it is the mid-term fluctuations which are in the centre of interest and which are referred to as economic (business) cycles. Consistent and countercyclical economic policies are conditioned on a precise assessment of the position of the economy within the economic cycle and also on its prediction. The indicators of economic cycles represent a frequently used tool for monitoring and predicting economic cycles.

The paper presents the methodology of leading indicators as it has been applied at the Ministry of Finance of the Czech Republic (MF CR) for several years with only minor changes. At the same time we follow up on the recent discussion given in pa-

pers by Czesany and Jeřábková [1] and Czesaný and Jeřábková [2]. As far as older domestic sources are concerned we refer to Filáček [3]. The paper represents an update and an extension of Valenta [4]. First we summarize the basic principles on which the use of the indicators of economic cycles for the purpose of analysis and prediction rests. In the second part we focus on the methodology of construction of composite leading indicators, and, finally, we present the results of our analysis for the case of the Czech economy.

1 FUNDAMENTALS OF THE INDICATORS OF ECONOMIC CYCLES

An economic cycle may be defined as mid-term repetitive fluctuations in the deviation of economic

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activity from its long-term trend. It is characterized by alternation of expansions and contractions. To carry out a quantitative analysis, it is necessary to find a proxy series which captures the fluctuations of the economy – a reference series.

In principle, economic cycles can be predicted if the sources of the fluctuations lie inside the economic system or are represented by exogenous variables which themselves are predictible and also whose effects are predictable. The approach followed in this paper can be classified as a qualitative prediction of economic cycles. It is focused on the estimation of the position of the economy within the cycle, prediction of the trend of economic activity and, in particular, prediction of turning points of economic cycles.

Potential indicators of economic cycles must meet several criteria. They must have economic interpretation, they must exhibit cyclical behaviour themselves, they must show a statistically significant relationship to the economic cycle (reference series) and they must be regularly and timely available in sufficient quality. From the point of view of economic forecasting the most interesting group of indicators meeting these criteria are indicators that move ahead of the economic cycle. Such indicators can be used to forecast future trends and turning points in the level of economic activity. The predictive capacity of the indicators is, however, usually limited to a relatively short horizon.

For the purspose of predictions, it is useful to aggregate individual leading indicators into composite indicators. The aggregation may help to achieve a higher correlation of the composite indicator with the reference series and, thus, to limit both the risk of misinterpretation of the information given by the indicators and the number of false signals of turning points.

Czesany and Jeřábková [1] both give a standard classification of composite leading indicators as leading, coincident and lagging indicators and discuss the principles of their use. They also present the general approach to the construction of composite indicators. Hence, we do not discuss those general aspects of the issue in this paper and rather focus on the description of the practice with leading composite indicators at the MF CR.

Reliability of leading indicators is critically dependent on the quality and length of the input time series. The data for the Czech economy do not fully meet these requirements; this will be further pointed out below. Compared to developed market economies, the Czech time series are significantly shorter and suffer from structural breaks on account of rapidly changing economic environment. It is important to take account of these limitations when interpreting the composite leading indicators in the Czech Republic.

2 CONSTRUCTION OF A COMPOSITE LEADING INDICATOR

The very principle of the use of composite leading indicators is the existence of correlation between these indicators and the reference series. The procedure of constructing a composite leading indicator given in this paper makes use of statistical methods and is fully formalized. The assessment of the results is, however, qualitative and to some extent rests on expert's judgement. The method presented below does not allow a quantitative prediction of the reference series.

The procedure which is applied at the MF CR is based on the methodology developed by the OECD [6] and [7] while the method of composition follows the approach of the U.S. Department of Commerce. This method is also used by, for example, The Conference Board, Inc. [5].

The procedure of construction of a leading composite indicator can be divided into several steps. First, it is necessary to choose a suitable reference series, which will serve as a proxy of the economic cycle. At the same time, potential leading indicators needs to be identified. Second, it is necessary to adjust the input series for seasonality and calender effects and then to extract their trends. Third, the input series must be synchronized and standardized. When this is completed, in the fourth step, the individual indicators which will enter into the composite indicator are selected according to several criteria. In the next step the weights of the individual indicators are computed. Finally, the composite indicator itself is calculated.

As regards requirements for the reference series, it should capture the economic activity as widely as

possible. This condition is sufficiently met by the series of gross domestic product (GDP). At the same time the reference series should reflect the cyclical nature of economic development. In this regard the statistics of production, e.g. index of industrial production, may seem preferable. In the practice at the MF CR the series of GDP at constant prices has been selected. We discuss this choise later.

Candidates for individual leading indicators have been selected from the set of business survey indicators as published by the Czech Statistical Office (CSO). Business survey indicators are presented in the form of a balance of answers „it will improve" or „it will deteriorate" to questions concerning the economic situation of respondents. The third possible answer „it will not change" can also be given, but it does not affect the value of the indicator. Moreover, it may be also useful to monitor also correlation between the economic cycle and the answers „it will improve" or „it will deteriorate", not just the balance. We did not consider the composite sentiment indicators, which generally meet the given criteria but are themselves aggregates of individual indicators of which some are only weakly correlated to the economic cycle. During the process of construction we consider indicators from four sectors: industry, construction, trade and services.

The fact that the composite leading indicators used at the MF CR are based solely on business survey indicator, so-called soft data, makes it different when compared to the indicators based on both soft and hard data, which is a common practice. Recently such indicators have been presented in the paper by Czesaný and Jeřábková [2].

While the quarterly series of real GDP runs from the first quarter of 1996, as published by the CSO, the series of business survey indicators start in January 2003. This is due to the switch to the new classification of economic activity CZ-NACE (national version of NACE Rev. 2) from the previous classification OKEC (national version of NACE Rev. 1.1) in May 2010. The new data cannot be linked to the original series, thus limiting reliability of the composite leading indicator. However, it should also be noted that first years of business surveys, that have been lost, may have been of a lower quality due to

the inexperience of the respondents. What is even more, one should take account of the fact that the nature of the economic cyle of the Czech economy changed during the transition from the transformation to post-transformation period. Therefore, the prediction capacity of surveys from 1990s for the curent situation would likely be questionable.

The series of real GDP is officially published as seasonally adjusted by the CSO and we use it in this form in the process of construction of the composite leading indicators. The other time series (almost 200) are seasonally adjusted using Census X12. In the cases where we find the estimated model within the framework of Census X12 unsatisfactory, we use Tramo-Seats instead. The analysis is carried out within the EViews package.

Estimation of the trend output of the economy, the output gap, has been a controversial issue ever since this question was raised. Two kinds of methods are at hand: purely statistical model or econometrical model which at least partially draws from the economic theory. For the purpose of this analysis we use a purely statistical method of a decomposition of the time series of GDP into trend and cycle: Hodrick-Prescott filter. The main advantage of this method is the fact that it is easy and fast. On the other hand the problem of „end points" is well documented. At this time when the economy has been recovering from a recent recession and we can see significant revisions of the time series of GDP done by the CSO, the estimate of the output gap is all the more a demanding task.

The set of potential indicators based on business survey comes in a monthly frequency while the series of GDP is published quarterly. To avoid losing the monthly information available, we intrapolate the quarterly series of GDP into monthly series. Due to the fact that we did not find a suitable baseline series to accomplish the time desaggregation of GDP series we chose a purely statistical method. The method rests on using quadratic polynomial. Based on every three consecutives elements of the original quarterly series a quadratic polynomial is estimated which is further used to estimate the monthly elements associated with the particular quarter so that the average of the monthly estimates of a given quarter equals the actual value

of the quarter in the original series. We apply the method within the EViews package.

The choice of the GDP as a reference series and the method of time desaggregation to monthly series is not straightforward and may require some defense. First, we assert that a typical candidate series for the reference series in the form of index of industrial production is not satisfactory for mainly two reasons: (i) index of industrial production does not capture the development of the whole economy while we later compose an indicator which reflects virtually all the sectors of the economy (industry, construction, trade and services) and also (ii) index of industrial production is, in the CR, a much less prominent indicator than GDP is. Second, the series of the corresponding relative cyclical component of the index of industrial production is much more volatile than the series of relative cyclical component of GDP (the volatility of relative cyclical component of industrial production index is more than double than that of GDP as measured by standard deviation on quarterly data from 2000Q1 to 2009Q3), which increases the risk of misinterpretation of the model and poses risks during the composition of the model in the first place. Third, the fact that monthly series of GDP does not exist is not a problem for interpreting the results of the model because (i) the monthly GDP series is used only in the phase of a selection of the individual leading indicators and (ii) regarding the intervals when data are published by the CSO and Macroeconomic Forecasts of MF CR are made, we are able to make qualitative forecasts based on CLI one or two quarters ahead depending on the actual lead of the model (three or five months, respectively).

Determination of the actual leads and the following synchronization are often based on the comparison of the average lead of turning points of the individual time series. Given the fact that in the CR the individual indicator series run from 2003, and therefore their turnng points can be assessed only against two turning points in the economic activity, it is not possible to use this approach as the primary method. The alternative method is cross-correlation. The visual analysis of the time series with the emphasis on their behavior near the turn-

ing points is, thus, due to the insufficient length of the series, just a supporting method.

The primary method of cross-correlation was used in almost all the 200 cases of potential leading indicators and it served as the main screen to select the candidates. In the next step we applied visual analysis with the focus on turning point prediction and we also excluded potential duplicities, i.e. the composite leading indicator should not include both three-month outlook of total demand in industry and three-month outlook of foreign demand in industry as it is highly probable than there are the same economic factors behind both indicators. The leads were not necessarily set at the highest correlation between the indicator and relative cyclical component of GDP. The difference in correlation at neighboring points of the series are very often negligible regarding the length of the series and relatively high instability of the relative cyclical component of GDP. Hence, we also paid attention to the results of visual analysis.

To make the time series comparable, it is necessary to transform them so that their levels of variability are the same. This is achieved by assigning weights to the individual indicators which are equal to inverse values of their variabilities. Hence, the individual components contribute the composite indicator equally. We do not apply weights in the sense of assigning some of the individual components a higher economic importance within the composite indicator.

As we have already pointed out, the selection of the individual components is based on the key criteria in the first place: sufficient correlation between the indicator and the relative cyclical component of GDP and timely availability on a regular basis. The other criteria are the stability of the lead and a capacity to predict the turning points.

It is a common practice to finally choose the individual indicators so that they cover all the sectors of the economy. On the other hand, there is another line of reasoning asserting that if the economy is governed by a particular sector, perhaps with a strong link to the world economy, the other sectors of the economy are under significant influence of this dominant sector. The composite indicator may then reflect especially this domi-

nant sector. In practice, we can see that there is a relatively stronger link between the individual indicators of industrial sector and the relative cyclical component of GDP and those links are at longer leads than in the cases of the other sectors. This, in turn, enables to construct a composite indicator with a longer lead.

The composition procedure itself is based on the calculation of symmetric month-on-month changes in the individual components. The monthly changes in the composite indicator are then computed as weighted average of the changes in the individual components where the weights are defined as inverse standard deviations of the respective components. The composite leading indicator is finally calculated by chaining its monthly changes.

3 COMPOSITE LEADING INDICATORS FOR THE CZECH ECONOMY

In this section, we will present two composite leading indicators: one with the lead of three months which is based on surveys from all sectors of the economy and one with the lead of five months which is based on the sector of industry only.

Both composite indicators draw from the new set of business survey indicators, i.e. after the switch to the new classification of economic activity CZ-NACE (national version NACE Rev. 2) in May 2010.

The first composite leading indicator covers all sectors covered by the business surveys, i.e. industry, construction, trade and services. If we want to cover all sectors of the economy, we are able to construct a composite indicator with the lead of three months. However, indicators from industrial sector show a prediction capacity for a longer horizen, thus alowing for a longer lead if only industrial surveys are taken into account. In such a case, the composite indicator has a lead of five months. Tables 1 and 2 show the composition of both indicators.

Both the all-sector and the industrial-sector composite indicators show correlation with the reference series at the level of around 88%. The key turning points in the GDP cycle were reflected by both of them. It is important to bear in mind that the actual shape of relative GDP cyclical component is still subject to possible changes due to data revisions. It is also important to note that the recent economic recession was set off by such a huge shock that it is captured by several dozens of individual indicators.

In the cases of such abrupt changes the interpretation of composite indicators is typicallly easy. The tough part is the assessment of the indicators within periods of normal fluctuations. The OECD recommends that some signal statistics are accepted, e.g. an annualized six-month change in the level of

Table 1 Composition of the indicator with the lead of 3 months

name of component			lead (months)	correlation (%)
sector	individual indicator	type		
industry	economic situation of firm	balance	3	76,0
industry	foreign demand level	balance	3	68,7
industry	employment: 3-month outlook	balance	3	81,1
industry	production capacitiy relative to orders: 3-month outlook	decrease	3	73,7
construction	total demand: 3-month outlook	balance	3	48,2
trade	economic situation of firm	balance	3	45,6
trade	number of employees: 3-month outlook	balance	3	55,3
trade	economic situation of firm: 6-month outlook	balance	3	57,2
services	number of employees: 3-month outlook	balance	3	72,3
services	economic situation of firm: 6-month outlook	increase	3	69,9

Source: Own calculations
Note: Type of the series may include a balance (difference between answers "it will improve" and "it will deteriorate", an increase (only answers "it will improve") and a decrease (only answers "it will deteriorate").

Table 2 Composition of the indicator with the lead of 5 months

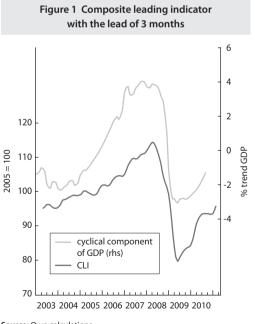| name of component			lead (months)	correlation (%)
sector	individual indicator	type		
industry	economic situation of firm: 6-month outlook	balance	5	67,7
industry	solvency: 3-month outlook	balance	5	67,5
industry	total demand	increase	5	66,9
industry	economic situation of firm: 3-month outlook	balance	6	53,9
industry	number of employees: 3-month outlook	balance	5	76,5
industry	total demand: 3-month outlook	balance	6	54,8
industry	production capacitiy relative to orders: 3-month outlook	decrease	5	63,2

Source: Own calculations
Note: We report lags at which the individual indicator enters into the composite indicator. We also report the correlation coefficient between the individual series and relative cyclical component of GDP at the particular lag.

the indicator. A common rule is to take as a signal when there are continual changes in the level of the indicator in the opposite direction of the last trend for a given period of time. To some extent the interpretation of the indicators is, however, arbitrary and based on experience.
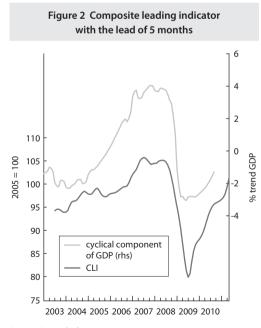
Both indicators signal a further increase in the economic activity in the near future. This may be interpreted as signal of quarter-on-quarter GDP growth leading to a gradual closure of the negative output gap.

CONCLUSION

The database of the Czech economy provides indicators which possess the basic properties of leading indicators. Among others, some indicators based on business survey run by the CSO meet those criteria. The composite leading indicators we presented in

Figure 1 Composite leading indicator with the lead of 3 months

Source: Own calculations
Note: Synchronized with the GDP cycle.

Figure 2 Composite leading indicator with the lead of 5 months

Source: Own calculations
Note: Synchronized with GDP cycle.

this paper show a capacity to predict the key turning points in the economic cycle and show a high correlation with the relative cyclical component of GDP. Both composite indicators are based solely on the results of the CSO's business surveys. This fact makes our approach different from the usual practice which is inclusion of both the „soft" and „hard" data.

The available time series are of an insufficient length due to the switch to the new classification of economic activity CZ-NACE in May 2010. They are also less stable as a result of a changing economic environment as compared with more developed market economies. Therefore, it is neces-

sary to interpret the composite leading indicators with caution.

Indicators of the economic cycle are widely used for a short-term prediction of the turning points in the economic cycle or underlying trends in the economic activity. They represent a relatively easy-to-implement forecasting method and it is reasonable to expect they will become even more reliable and useful in the future. The presented approach allows only a qualitative assessment. The possibility of the use of business survey indicators as a tool for a quantitative prediction of the reference series is a subject to the current research.

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