BUSINESS CLIMATE INDICATOR AS A PREDICTOR OF CROATIAN INDUSTRIAL PRODUCTION

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Abstract

Business and Consumer Surveys (BCS) are one of the most frequently used tools to assess economy's cyclical behavior. Croatia has been conducting the surveys continually since 1995. Nevertheless, there is still a research niche in the Croatian BCS framework that has not been adequately represented. The Joint Harmonised EU Programme of Business and Consumer Surveys suggests Business Climate Indicator (BCI) as a composite leading indicator of the economy as a whole. In accordance to the EU methodology, this paper examines managers' qualitative assessments on five important variables related to their economic environment. Using factor analysis one factor was extracted from those five variables, representing the BCI. It's predictive properties were analyzed with regards to Croatian industrial production using Granger causality test, impulse response and variance decomposition analysis. Results strongly confirm the precedence of BCI to the changes of Croatian industrial production, validating the importance of its introduction and utilization in Croatian economic cycles analysis.

Key words: *Business Survey, Business Climate Indicator, Multivariate Analysis, Factor Analysis, Vector autoregression*

1. INTRODUCTION

According to the Joint Harmonised EU Programme of Business and Consumer Surveys, manufacturing industry sector of the euro area is represented by two separate composite indicators, both conceptualized to give timely information about the changes in the direction of the economic cycle.

First indicator is called the Industrial confidence indicator (ICI). It has been calculated and published for Croatian economy[1] since the sole beginning of conducting Business surveys in Croatian manufacturing industry in 1995. As opposed to ICI, Business Climate Indicator (BCI) has not been introduced and published for Croatia up to this point in time.

BCI is a relatively new composite indicator for manufacturing industry in euro area. The Directorate General for Economic and Financial Affairs (DG ECFIN) has introduced this indicator with the aim to track and predict business cycle in the euro area as a whole. Methodological ground of BCI is different from some other composite indicators derived from business survey data in manufacturing industry. ICI as one of the confidence indicators for industrial sector (manufacturing industry) is calculated as a simple average of three variables (seasonally adjusted data): stock of finished products (with inverted sign), production expectations and order books[2]. BCI is defined as a common factor derived from factor analysis conducted on the data sets of five variables. In accordance with the EU methodology, variables components of BCI include all variables components of ICI and additionally two variables: export order books and production trends in recent months (seasonally adjusted data).[3]

EU prefers *Dainties* as the seasonal adjustment method, developed by *Eurostat*, whereas the observations of the past period with addition a new observation are not revised. That is a very important fact since business survey results are primarily aimed to forecast the macroeconomic variables' direction of changes, not the amount of changes. Croatian business survey results are also seasonally adjusted using Dainties.

ICI and BCI are very useful tools in tracking and predicting changes not only in industrial production, but also in explaining and forecasting variations in GDP[4] since industrial production accounts for almost 25 % of GDP in the euro area. Moreover, it has been shown in several Croatian empirical studies that Croatian industrial production cyclically follows the movement of Croatian GDP (e.g. Cerovac, 2005). Extension of the same indicators' calculation in EU for other business survey sectors (retail trade, services and for construction) is also under consideration.

With the intent to produce a new composite indicator for Croatian business survey data[5], BCI was calculated and published, for the first time, in the paper Bahovec, Cizmesija and Kurnoga Zivadinovic (2006). Correlation analysis has been applied on time series of newly calculated Croatia's BCI and the referent series of industrial production volume (manufacturing industry; expressed in accordance with the EU methodology,

[1] ICI is calculated and published by Privredni Vjesnik, Zagreb.
[2] For more details see *The Joint Harmonised EU Programme of Business and Consumer Surveys – User Guide*. European Economy, European Commission, Directorate-General for Economic and Financial Affairs, Updated: 04/07/2007.
[3] Details of the business survey data in: *The Joint Harmonised EU Programme of Business and Consumer Surveys – User Guide*, European Economy. European Commission, Directorate-General for Economic and Financial Affairs, No.6, 1997.
[4] See, e.g. Crevits et al. (2008) or Fusari and Pellissier (2008).
[5] Business survey in Croatia are in detail discussed in: Cizmesija, M., (2008), *Konjunkturni testovi Europske unije i Hrvatske,* Zagreb, Privredni vjesnik.

as a percentage rate of change, y-o-y). The highest correlation between the mentioned variables has been reached for the lead of BCI of two quarters. Additionally, in around 60% cases, changes in the direction of the volume of industrial production were correctly predicted with the changes of BCI for two quarters ahead.

2. METHODOLOGY

Taking in consideration that questions in the Surveys reflect agents' assessments of their economic environment in the previous and in the following 12 months, the official EU methodology suggests that the composite indicators are to be compared with year on year (y-o-y) rates of change in referent macroeconomic series. That has been done in this research, but it has not yielded any significant results. Hence, as an alternative to the EU methodology and as a contribution to enable better understanding of the Croatian economy, here BCI is compared with indices of Croatian industrial production (2005=100). Both Business Survey data and industrial production indices are observed for the time span 1998Q1-2010Q1[6].

The principal component factor analysis was used to calculate BCI. It is a factor model where units are located on the diagonal correlation matrix and factors are based on the total variance. It is also characteristic that the calculated factor scores are actual scores. For these reasons the use of principal component factor analysis is appropriate. The principal component factor analysis was conducted using the following variables[7]: *production* – production trends in recent past, *order* – order books, *stock* – stock of finished products, *export* – export order book and *expectations* – production expectations. On the basis of those variables only one factor was extracted. For further analysis, the factor scores were calculated on the retained factor and were used as BCI. In order to assess the interrelations between Croatian industrial production and BCI, a bivariate VAR model was employed. The dynamic interdependence of the observed variables is questioned via standard VAR tools: causality tests, impulse response function and variance decomposition.

The analysis was performed using the statistical packages SAS and E-Views.

3. RESULTS

Prior to the application of factor analysis the Augmented Dickey–Fuller (ADF) unit root tests were conducted. Following standard econometric practice, first differences of all variables were applied to satisfy the stationarity condition.

The appropriateness of factor analysis was evaluated. Correlation matrix for five variables mentioned above, the Table 1, indicates the appropriateness of applying the factor analysis because all variables have at least one coefficient higher than 0.3. In Table 2 the values of Kaiser's measure of sampling adequacy (MSA)

[6] All time series are seasonally adjusted using DAINTIES method, prior to any econometric modeling.
[7] Balance statistics, in accordance with the EU BCS methodology

are given. As can be seen, the data are suitable for the application of factor analysis because all values, the MSA values for each variable and overall MSA, are greater than 0.5

Table 1: Correlation Matrix.

	production	order	stock	export	expectations
production	1.00000	0.87565	0.31371	0.41774	0.43560
order	0.87565	1.00000	-0.25439	0.60161	0.41463
stock	0.31371	-0.25439	1.00000	-0.06597	-0.03921
export	0.41774	0.60161	-0.06597	1.00000	0.21341
expectations	0.43560	0.41463	-0.03921	0.21341	1.00000

Table 2: Kaiser's Measure of Sampling Adequacy.

	Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.62721392				
variables	production	order	stock	export	expectations
MSA values	0.60299348	0.58543635	0.76775500	0.62005855	0.89607230

After it was determined that the data are suitable for the application of factor analysis, one factor was retained and the factor scores were calculated. Table 3 shows the factor matrix for one extracted factor. In practice, factor loadings between ±0.3 and ±0.4 are considered to meet the minimal level for interpretation of structure, loadings ±0.5 or greater are considered practically significant, whereas loadings exceeding ±0.7 are considered indicative of well-defined structure (Hair, J. F. et al., 2010).

Table 3:Factor Matrix.

Variables	Factor 1
production	0.90534
order	0.94126
stock	-0.36334
export	0.67197
expectations	0.57976

As seen in Table 3, all factor loadings are satisfactory. The extracted factor represents the Business Climate Indicator.

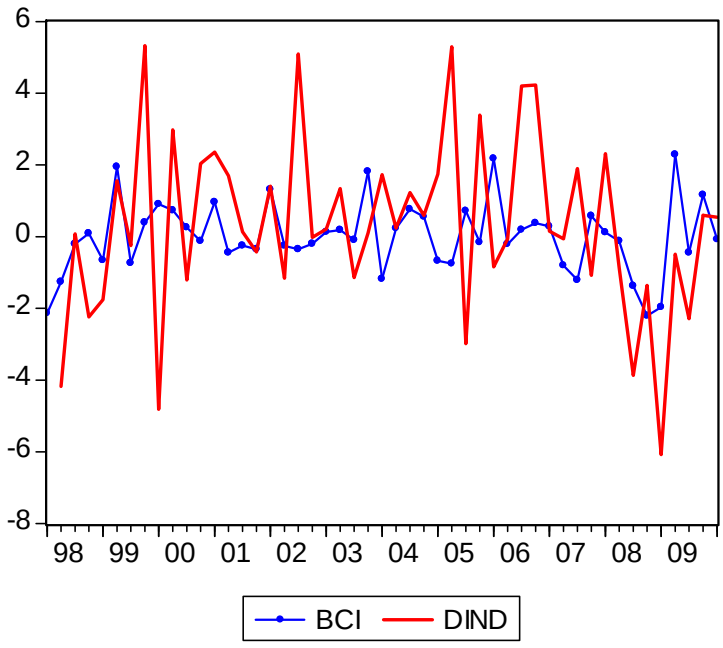
The factor scores should be calculated for the BCI. They were calculated based on the matrix of standardized scoring coefficients, given in the table 4 and used in subsequent analysis.

Table 4: Standardized Scoring Coefficients.

Variables	Factor 1
production	0.34485
order	0.35854
stock	-0.13840
export	0.25596
expectations	0.22084

After obtaining the *BCI,* it was put in relation to Croatian industrial production (*IND*). To obtain stationarity of *IND*, all further econometric analysis is done with *IND* in first differences (*DIND*). Before any econometric modelling of the relationship between *BCI* and *DIND*, those two variables were put in relation graphically.

Figure 1: Graphical presentation of BCI and DIND.



It seems that the economic cycle of Croatian industrial production follows the movement of *BCI* quite good. Such indications will also be formally tested using VAR framework.

Next step of the analysis is to specify the optimal number of time lags in VAR model. Being led by Akaike information criterion, the lag length was set to two quarters.

Since the issue of highest relevance here is the preceding of *BCI* to Croatian industrial production, Granger causality test was conducted and the results are given in the following table.

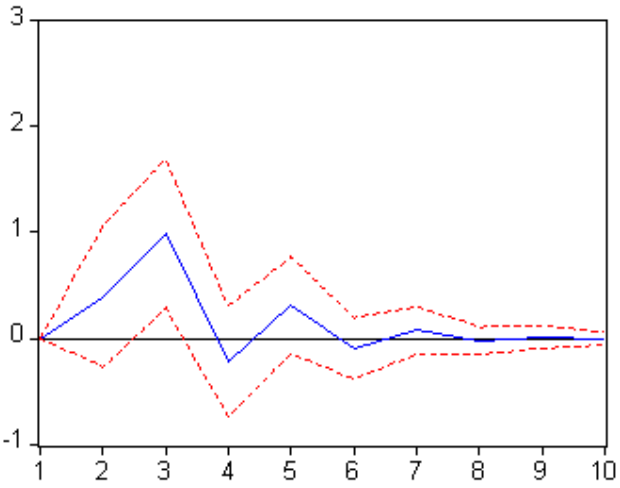
Table 5: Granger causality test results.

	H_0: *BCI* does not Granger cause *DIND*	H_0: *DIND* does not Granger cause *BCI*
F- statistics	5.9049	0.09095
p-value	0.00558	0.91324

It can be seen that the causality goes only in one direction: *BCI* Granger causes *DIND* at 1% significance level. Such conclusions are crucial for the economic policy holders, because they imply the possibility to undertake appropriate countercyclical measures two quarters before the recession actually starts. On the other hand, Croatian industrial production is not found to precede to *BCI*[8].

The exploration of the relationship between *BCI* and industrial production is continued with innovation analysis. The intention was to analyze dynamic interactions between two variables of interest. First of all, impulse response function was observed.

Figure 2: Impulse response function of DIND to a shock in BCI.



Following a unit shock in BCI, industrial production changes by a considerable amount in the first two future periods. To be specific, the influence of a shock in *BCI* is highest in the second future quarter. After that, the influence diminishes and fades away rather quickly. Once again, that finding just corroborates the basic intention of Business Survey to serve primarily as a *short-run* tool for macroeconomic predictions.

Similar results are obtained using the forecasting error variance decomposition, suggesting that the share of *BCI* in the variance of *DIND* forecasting error has continuously increased, from 3.2% in the second forecasting period to even 19.8% in the 12th future quarter (see Table 6).

[8] Since *DIND* was not found to be a satisfactory predictor of *BCI*, further results of innovation analysis were omitted, but can be obtained upon request from the authors.

Table 6: Variance decomposition of DIND[9].

Forecast horizon	DIND	BCI
2	96.78333	3.216672
4	81.46653	18.53347
6	80.24337	19.75663
8	80.17195	19.82805
10	80.16904	19.83096
12	80.16896	19.83104

This result formally confirms the possibility of predicting cyclical movements of overall Croatian economic results using Business Surveys.

Since VAR methodology framework is base on OLS estimates, it is much needed to test for the validity of standard OLS assumptions. An overview of diagnostic tests is given in the following table.

Table 7: Overview of diagnostic tests.

Test	Test statistics	Critical value	p-value
LM (12)	3.29085	Chi2(4)	0.5104
White	51.9195	Chi2(42)	0.1404
Jarque-Berra	0.8819	Chi2(4)	0.9217

All diagnostic tests seem to have satisfactory results. The null hypothesis of no autocorrelation of 12th order cannot be rejected at any conventional significance level using LM test. White test results suggest that the null hypothesis of homoskedasticity also cannot be rejected at any conventional significance level. At the end, Jarque-Berra test confirmed the normality of residuals in the VAR model.

4. CONCLUSION

Recession periods, as this one that Croatian economy is still facing, specially emphasize the need to predict economic cycle's behaviour. A timely signal of the possible recession development would therefore represent a crucial benefit not only for economic policy holders, but also for managers and economic agents of all kinds (investors, consumers, etc.). In the effort to obtain an efficient and timely recession signal surveys of qualitative nature are often more useful than quantitative econometric forecasting models. In accordance with that, a composite Business Climate indicator (BCI) for the Croatian economy was extracted here as a common factor from Croatian Business Survey results.

[9] The share of *BCI* in the variance of *DIND* forecasting error does not change at all after the 12th forecasting quarter.

The newly formed BCI indicator represents a modification of the official EU methodology. It's predictive properties with regards to Croatian industrial production were examined in a bivariate VAR framework. It was shown that changes in BCI precede to those of industrial production, with a lag of two quarters.

Since BCS are generally qualitative surveys, it is recommended to use BCI (as well as all other BCS indicators) primarily in forecasting the direction of change in referent macroeconomic series, not their absolute values.

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