

# The Role of Business Survey Measures in Forecasting Croatian Industrial Production

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**Abstract**—While the European Union (EU) harmonized methodology is a benchmark of worldwide used business survey (BS) methodology, the choice of variables that are components of the confidence indicators, as the leading indicators, is not strictly determined and unique. Therefore, the aim of this paper is to investigate and to quantify the relationship between all business survey variables in manufacturing industry and industrial production as a reference macroeconomic series in Croatia. The assumption is that there are variables in the business survey, that are not components of Industrial Confidence Indicator (ICI) and which can accurately (and sometimes better than ICI) predict changes in Croatian industrial production. Empirical analyses are conducted using quarterly data of BS variables in manufacturing industry and Croatian industrial production over the period from the first quarter 2005 to the first quarter 2013. Research results confirmed the assumption: three BS variables which is not components of ICI (*competitive position, demand and liquidity*) are the best leading indicator then ICI, in forecasting changes in Croatian industrial production instantaneously, with one, two or three quarter ahead.

**Keywords**—Balance, Business Survey, Confidence Indicators, Industrial Production, Forecasting.

## I. INTRODUCTION

**B**USINESS surveys (BS) are relatively new area of monitoring and forecasting changes in the economy. These are primarily qualitative researches that provide simple and up to date information available prior to official statistical data. Empirical evidence proves that they have a relatively high degree of confidence in forecasting, especially in forecasting the direction of changes in the reference series of macroeconomic variables.

In the scientific and technical literature forecasting models are usually based on quantitative data and numerical indicators, while the indicators derived from qualitative research are not so common. On the other hand, information provided by BS is mostly qualitative. Using appropriate numerical methods, qualitative assessments and expectations of managers are translated into numerical indicators that are commonly used, not only as leading indicators, but also as coincidence indicators. However, it is important to note that the results of BS are available much earlier than the official

statistical data are published. This applies especially to the GDP data that are published quarterly with a delay of more than a month.

In order to summarize managers' subjective assessment of economic variables, various indicators can be calculated with the continuous revision of the calculation. These indicators can be used to predict changes in macroeconomic variables. Confidence indicators effectively predict changes in the macroeconomic reference series (at national and regional level) up to six months in advance, as in [7]. There have been many research results, studies and papers on this subject, as in [3] and [6]. However, they show that in the recession period (after 2008), harmonized officially used indicators do not have good predictions properties. Therefore, it is necessary to revise these indicators or consider new ones in order to accurately predict changes in the macroeconomic reference series one, two or three quarters ahead.

## II. CROATIAN BUSINESS SURVEY IN THE MANUFACTURING INDUSTRY

Business surveys in Croatia are conducted on a quarterly basis since 1995 in manufacturing industry, construction and retail trade, and since 2008 in the services. They are carried out in order to obtain information from the manager's assessment of the current business situation and their future plans and expectations. Surveys are conducted using the harmonized EU methodology that is adjusted for specific characteristics of Croatian economy. Surveys are financed by the Croatian Chamber of Commerce and carried out by the Research Centre of the economic journal *Privredni vjesnik*, which regularly publishes the research results.

## III. BUSINESS SURVEY MEASURES AND INDICATORS

Variables that are business survey measures are expressed as a difference (balance) between the weighted percentages of the positive (*good*) and negative (*bad*) responses of the firms to the questions.

Questions in the business survey in manufacturing industry are of a qualitative nature with three reply options: positive (*increase, more than sufficient, etc.*), equal (*remain unchanged, sufficient, etc.*) and negative (*decrease, not sufficient, etc.*). For each answer option (positive, equal or negative) relative frequencies are calculating. The common way of presenting business survey data is the balance. If P, E and M denote percentages of respondents' chosen options: *positive, equal* and *negative*, respectively, with the sum equals 100 for each variable, the balance is defined as a difference between P and M (the difference between the percentages of

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respondent's positive and negative replies). In line with the Harmonized European Business Survey methodology, weighted counting of answers is used in Croatian business survey. This means that the answers of each respondent are weighted with the coefficient in accordance with his firm turnover. Balance (B) is calculated for all questions (variables). Usually time series of balances are seasonally adjusted and then used in calculating the composite indicators.

Only three variables are used in calculating composite indicator in manufacturing industry, i.e. Industrial Confidence Indicator (ICI), namely: *order books*, *stock of finished products* (with inverted sign) and *production expectation*. Confidence indicator is produced to reflect perceptions and expectations at the individual sector level in a one-dimensional index, as in [5].

#### IV. METHODOLOGY AND DATA SET

According to research results in Croatia during the last 10 years, as in [1], [2], [8] and [9], Croatian Industrial confidence indicator correctly predicts changes in Croatian industrial production one or two quarters ahead in almost 60% of cases. However, the latest results are not so good. It is known that each variable in BS (such as assessments and expectations) can be a short-term forecasting indicator for the corresponding macroeconomic variable, as in [4]. In order to investigate the importance of the business survey measures and their forecasting properties, several econometric models are applied with the aim to reduce the risk of the false forecasts signals in Croatian macroeconomic variables trends. Therefore, business survey measures are expressed as seasonally adjusted balances for all variables in business survey.

The empirical analysis is performed using quarterly data covering the period from the first quarter 2005 to the first quarter 2013. The data sources were *Privredni vjesnik* (a business journal in Croatia) and the *Croatian National Bank*. Industrial production is expressed (in accordance with the EU methodology) as the growth rate of industrial production (y-o-y) and is seasonally adjusted as well.

#### V. EMPIRICAL RESULTS

The empirical analysis consists of two parts. The first part includes the correlation analysis which gives an insight into the relationship (the strength and direction) between industrial production, ICI and all business survey variables in manufacturing industry in Croatia. The second part presents the analysis of the several regression models and gives analytical expressions of the relationships between selected variables.

The variable RATE stands for Croatian growth rate of industrial production. Other abbreviations for business survey variables in manufacturing industry used in the study are:

A - Demand for the products as compared to the previous quarter,

B - Order book,

C - Stock of finished products,

D - Export order book,

E - Stock of raw materials and semi-products,

F - Assessment of the competitive position in the last quarter,

G - Assessment of the present situation,

H - Production expectations for the quarter ahead,

I - Export expectations for the quarter ahead,

J - Expected business position in the next six months,

K - Liquidity of the firm,

ICI - Industrial Confidence Indicator.

The results of the correlation analysis performed on the selected variables (instantaneously, with one quarter lead, with two quarters lead and with three quarters lead) are presented in Tables I and II.

TABLE I  
CORRELATION COEFFICIENTS BETWEEN RATE AND SELECTED BS VARIABLES,  
I

Variables	RATE	Variables	RATE
A	0,781299	A_1	0,797093
B	0,760755	B_1	0,786804
C	-0,08699	C_1	-0,25243
D	0,666012	D_1	0,71834
E	0,364159	E_1	0,192198
F	0,782445	F_1	0,779253
G	0,774097	G_1	0,725423
H	0,707358	H_1	0,703592
I	0,614576	I_1	0,709095
J	0,691286	J_1	0,784632
K	0,715496	K_1	0,750738
ICI	0,745862	ICI_1	0,772022

TABLE II  
CORRELATION COEFFICIENTS BETWEEN RATE AND SELECTED BS VARIABLES,  
II

Variables	RATE	Variables	RATE
A_2	0,751373	A_3	0,635345
B_2	0,723652	B_3	0,618324
C_2	-0,07992	C_3	0,015742
D_2	0,641338	D_3	0,545748
E_2	0,117688	E_3	-0,01034
F_2	0,740997	F_3	0,664555
G_2	0,635716	G_3	0,520613
H_2	0,651671	H_3	0,57187
I_2	0,695016	I_3	0,600193
J_2	0,698193	J_3	0,637955
K_2	0,709759	K_3	0,710398
ICI_2	0,699508	ICI_3	0,587741

The values of the correlation coefficients between variables indicate the importance of several variables. Apart from ICI, variables *Assessment of the competitive position* in the last quarter (abbreviation F), *Demand for the products compared to the previous quarter* (abbreviation A) and *Liquidity* (abbreviation K) prove to be highly correlated with the Croatian growth rate of industrial production (abbreviation RATE). Variable *Assessment of the competitive position in the last quarter* is determined with the survey question: Our competitive position on the domestic market in the last quarter is: (1) improved, (2) remained unchanged and (3) deteriorated.

The second important variable is *Demand for the products compared to the previous quarter* with the answers to the question: (1) increased, (2) - remained unchanged and (3) decreased. Variable *Liquidity* is derived from the following question: Liquidity of your firm is: (1) good, (2) with temporary problems, (3) bad.

The obtained results (Tables I and II) suggest that Croatian industrial production and *competitive position* (variable F) are highly positively correlated in the same period (i.e. instantaneously). The value of that correlation coefficient exceeds the value of correlation coefficient between ICI and RATE in the same period. Correlation (instantaneous) is evident from the graph of the corresponding series RATE, ICI and F (competitive position) presented in Fig. 1.

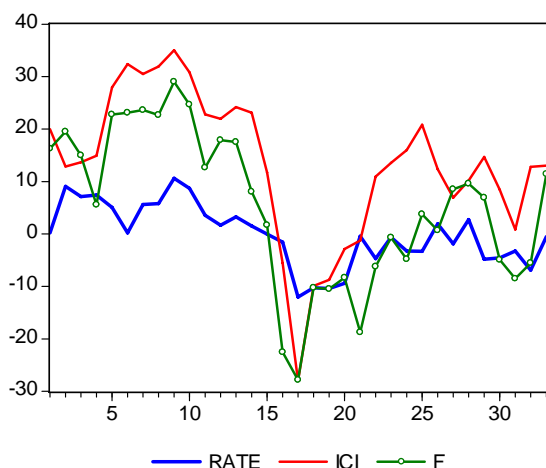


Fig. 1 Rate of change of Croatian industrial production, ICI and BS competitive position measure (instantaneous)

Analysis of the correlation between RATE and other analyzed variables with one and two quarters lead shows that RATE is more correlated with *demand* for the products with one and two quarters lead (A\_1 and A\_2) then with ICI variables with one and two quarters lead (ICI\_1 and ICI\_2). Correlation of RATE and variables with one quarter lead (A\_1 and ICI\_1) is detected in Fig. 2 and for RATE and variables with two quarters lead A\_2 and ICI\_2 from Fig. 3.

As for the three quarters lead of selected variables, RATE and *liquidity* with three quarters lead (K\_3) are the most correlated variables. The value of the coefficient is 0,710398 compared to the value of 0,587741 which is the correlation between RATE and ICI variable with three quarters lead (ICI\_3). Fig. 4 shows positive correlation between RATE and variables with three quarters lead K\_3 and ICI\_3.

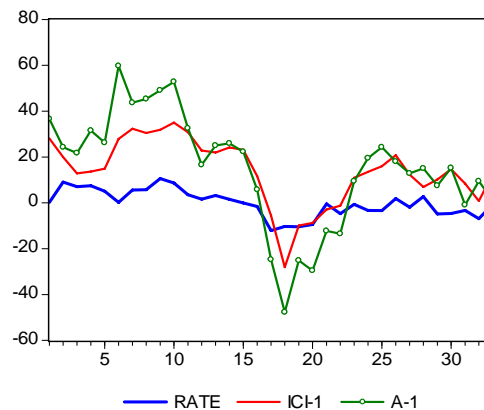


Fig. 2 Rate of change of industrial production, ICI and BS demand measure lagged one quarter ahead

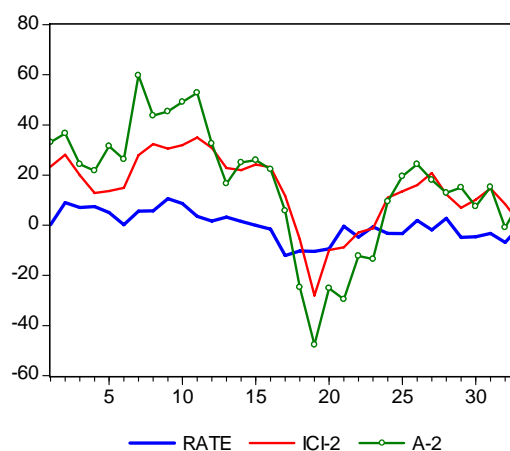


Fig. 3 Rate of change of industrial production, ICI and BS demand measure lagged two quarter ahead

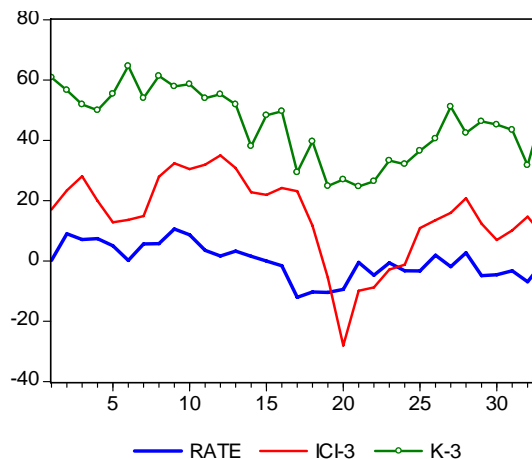


Fig. 4 Rate of change of industrial production, ICI and BS liquidity measure lagged three quarter ahead

The correlation and graph analysis suggest that Industrial Confidence Indicator (ICI) is highly correlated with industrial production instantaneously and with one, two and three

quarters lead. As a result, it can accurately predict changes in Croatian industrial production. However, there are variables that are not components of ICI and are more correlated with industrial production than ICI variable. The variables such as *competitive position*, the *demand* according to the previous quarter and *liquidity*, can better predict changes in Croatian industrial production.

In forecasting the direction of changes in industrial production instantaneously, the best predictor is *competitive position*, not ICI. For one and two quarters ahead, the best forecast variable is *demand* for the products (not ICI), while in forecasting changes in industrial production three quarters ahead, the best leading indicator is not ICI, but the variable *liquidity* which is a specific variable used only in Croatian Business survey.

In order to analyze and analytically express the relationship between selected variables and Croatian economy, various econometric models were considered. In each model, the depended variable was RATE (the rate of change of industrial production, y-o-y) and business survey variables (selected according to the correlation analysis results) were used as explanatory variables. Based on the results of performed analyses, the simple linear regression model proved to be the best in all cases. All estimated models were statistically correct and passed all model adequacy diagnostic tests.

Thus, the relationship between industrial production and *competitive position* is analytically expressed by the regression model (1):

$$RATE_t = \beta_0 + \beta_1 F_t + e_t \quad (1)$$

The estimation results and diagnostic statistics for the regression model (1) with the rate of change of industrial production and variable *competitive position* are presented in Table III.

TABLE III  
ESTIMATES OF THE REGRESSION MODELS FOR RATE AND DIAGNOSTIC STATISTICS (EXPLANATORY VARIABLE *F*)

	<i>F</i>
Constant	-1.735970
Coefficient	0.313115
Std. Error.Coeff	0.044757
t-Statistic	6.995878
Probability	6.995878
<i>DIAGNOSTIC</i>	
R-squared	0.612220
Adjusted R-squared	0.599711
S.E. of regression	3.718034
Sum squared resid.	428.5370
Log likelihood	-89.12882
Durbin-Watson stat.	1.764633
Mean dependent var.	-0.102271
S.D. dependent var.	5.876608
Akaike info criterion	5.522959
Schwarz criterion	5.613656
F-statistic	48.94231
Prob(F-statistic)	0.000000

The results from Table III show that instantaneous effects of competitive position (in the last quarter) on the Croatian growth rate of industrial production are statistically significant.

The obtained results can be interpreted as follows: Croatian managers' assessment of competitive position in the last quarter, have significant instantaneous impact on Croatian industrial production growth rate. It should be pointed out that it is a sign of a particular regression coefficient that is analyzed, not its value.

The best predictor of industrial production with one quarter lead is variable *demand for the products* (*A\_1*). Thus the following regression model is estimated:

$$RATE_t = \beta_0 + \beta_1 A_{-1}_t + e_t \quad (2)$$

The results of regression analysis and regression diagnostics for the model (2) with one quarter lead of variable *demand* are presented in Table IV.

TABLE IV  
ESTIMATES OF THE REGRESSION MODELS FOR RATE AND DIAGNOSTIC STATISTICS (EXPLANATORY VARIABLE *A\_1*)

	<i>A_1</i>
Constant	-2.979169
Coefficient	0.190439
Std. Error.Coeff	0.025912
t-Statistic	7.349459
Probability	0.0000
<i>DIAGNOSTIC</i>	
R-squared	0.635357
Adjusted R-squared	0.623594
S.E. of regression	3.605413
Sum squared resid.	402.9692
Log likelihood	-88.11379
Durbin-Watson stat.	1.826080
Mean dependent var.	-0.102271
S.D. dependent var.	5.876608
Akaike info criterion	5.461442
Schwarz criterion	5.552139
F-statistic	54.01454
Prob(F-statistic)	0.000000

The results of the similar regression model (3) with two quarters lead of variable *demand* (*A\_2*) are presented in Table V.

$$RATE_t = \beta_0 + \beta_1 A_{-2}_t + e_t \quad (3)$$

The results (Tables IV and V) confirm that the variable *demand for the products* is a significant variable in predicting changes in industrial production one and two quarters ahead. Positive sign of regression coefficient means that positive changes in managers' assessments of demand for the products have positive impact on changes in Croatian industrial production with one or two quarters lead.

TABLE V  
ESTIMATES OF THE REGRESSION MODELS FOR RATE AND DIAGNOSTIC  
STATISTICS (EXPLANATORY VARIABLE A\_2)

	A_2
Constant	-2.982029
Coefficient	0.179089
Std. Error.Coeff	0.028249
t-Statistic	6.339762
Probability	0.0000
<i>DIAGNOSTIC</i>	
R-squared	0.564561
Adjusted R-squared	0.550515
S.E. of regression	3.939892
Sum squared resid.	481.2052
Log likelihood	-91.04144
Durbin-Watson stat.	1.457308
Mean dependent var.	-0.102271
S.D. dependent var.	5.876608
Akaike info criterion	5.638875
Schwarz criterion	5.729573
F-statistic	40.19258
Prob(F-statistic)	0.000000

Since variable *liquidity* accurately predicts changes in industrial production three quarters ahead, the regression model with variable *liquidity* ( $K_3$ ) as an explanatory variable is estimated:

$$RATE_t = \beta_0 + \beta_1 K_{-3}_t + e_t \quad (4)$$

The results of regression analyses and regression diagnostics for the model (4) are presented in Table VI.

TABLE VI  
ESTIMATES OF THE REGRESSION MODELS FOR RATE AND DIAGNOSTIC  
STATISTICS (EXPLANATORY VARIABLE K\_3)

	K_3
Constant	-16.28047
Coefficient	0.357460
Std. Error.Coeff	0.063605
t-Statistic	5.619962
Probability	0.0000
<i>DIAGNOSTIC</i>	
R-squared	0.504665
Adjusted R-squared	0.488687
S.E. of regression	4.202136
Sum squared resid.	547.3964
Log likelihood	-93.16796
Durbin-Watson stat.	1.424248
Mean dependent var.	-0.102271
S.D. dependent var.	5.876608
Akaike info criterion	5.767755
Schwarz criterion	5.858452
F-statistic	31.58397
Prob(F-statistic)	0.000004

The estimation results (Table VI) confirm that the variable *liquidity* is statistically significant and the sign of regression coefficient is positive which means that the influence of *liquidity* has a positive impact on industrial production. Thus,

managers' assessments of *liquidity* are signals in predicting changes in industrial production three quarters ahead.

## VI. CONCLUSIONS

The aim of this paper was to investigate the possibility of improving short time forecasts for industrial production in Croatia using business survey measures, which are not the components of Industrial Confidence Indicator (ICI), commonly employed leading indicator in Business survey analyses.

The results of correlation and regression analyses presented in the paper showed that ICI is highly correlated with industrial production instantaneously and with one, two and three quarters lead. It means that ICI can accurately predict changes in Croatian industrial production. However, the same research results showed that ICI as a composite business survey indicator is not the best indicator in forecasting changes in Croatian industrial production for the different time lags.

There are variables that are not components of ICI and that are more correlated with industrial production than ICI. The variables such as *competitive position*, *demand*, and *liquidity* (as a numerical expression of managers' assessment) can better predict changes in Croatian industrial production.

In forecasting the direction of changes in industrial production instantaneously, the best predictor is *competitive position*, not ICI. For one and two quarters ahead, the best forecast variable is *demand* for the products, while in forecasting changes in industrial production three quarters ahead, the best leading indicator is not ICI, but the variable *liquidity* which is a specific variable used only in Croatian Business survey.

Finally, it is important to point out that managers' subjectivity, which is included in BS is one of the reasons that BS indicators and other measures are primarily used to forecast the direction of changes in referent economic series, not to forecast the value of changes. Consequently, it is of interest to track the direction of changes in variables and in the reference series, namely industrial production.

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