

# FORECASTING THE DIRECTION OF CHANGES IN CROATIA'S INDUSTRIAL PRODUCTION WITH ICI AND CROLEI

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## ABSTRACT

The Industrial Confidence Indicator (ICI) and the Croatian Leading Economic Indicator (CROLEI) can be used to forecast the direction of changes (Sosic, I. Cizmesija, M., 2003) in developments of the national economy, especially for the manufacturing industry.

ICI and CROLEI are two leading indicators calculated on different methodological grounds. In spite of the methodological differences, they are mutually correlated, and they are also correlated with the industrial production. This means that these indicators are two very important tools in the manufacturing activity prognostics. The Croatian experience has shown that ICI correctly predicts the direction of changes in the industrial production with a lead of one or two quarters (quarterly data) and CROLEI with a lead of about six months (monthly data). Some results of correlation analysis in Croatia confirm these conclusions<sup>3</sup>. A more refined and more reliable statistical analysis of forecasting results is restricted, since series of values of survey variables are short. Empirical modifications are conducted to make a comparison of the two indicators. Monthly values of CROLEI are expressed as quarterly data, in order to align it with ICI, which is based on quarterly surveys. Industrial production is expressed as percentage rate of the industrial production volume change (a rate of change in the current quarter over the same quarter in the previous year).

One could recently notice that the prognostic features of the mentioned indicators are no longer satisfying as in the first part of the observed period (1996 – 1999). It is necessary to conduct revisions of the mentioned indicators with the goal to improve the new prediction characteristics.

**KEY WORDS:** Business Survey, Industrial Confidence Indicator (ICI), Croatian Leading Economic Indicator (CROLEI), forecasting, regression analysis.

MSC:62P20

## RESUMEN

El indicador de confianza industrial (ICI) y el indicador económico principal croato (CROLEI) se pueden utilizar para pronosticar la dirección de los cambios (Sosic, I. Cizmesija, M., 2003) en desarrollos de la economía política, especialmente para la industria de fabricación.

ICI y CROLEI son dos indicadores principales calculados en diferentes fundamentos metodológicos. A pesar de las diferencias metodológicas, se correlacionan mutuamente, y también se correlacionan con la producción industrial. Esto significa que estos indicadores son dos medios muy importantes en los pronósticos de la actividad de fabricación. La experiencia en Croacia ha mostrado que ICI predice correctamente la dirección de cambios en la producción industrial con un avance de uno o dos trimestres (datos trimestrales) y CROLEI con un avance de aproximadamente seis meses (datos mensuales).

Algunos resultados del análisis de correlación en Croacia confirman estas conclusiones<sup>4</sup>. Un análisis estadístico más refinado y más confiable de los resultados del pronóstico es limitado, puesto que la serie de valores de variables de la encuesta es corta. Modificaciones empíricas se realizan para hacer una comparación de los dos indicadores. Los valores mensuales de CROLEI son expresados como datos trimestrales para poder compararlos con ICI que se basa en encuestas trimestrales. La producción industrial se expresa como tasa de porcentaje del cambio de volumen de la producción industrial (una tasa de cambio en el trimestre actual con respecto al mismo trimestre del año pasado).

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<sup>3</sup> Under the period 1996,I – 2007,III; quarterly data.

<sup>4</sup> En el período de I/1996 – III/2007; datos trimestrales

Se podría notar recientemente que las características pronósticas de los indicadores mencionados ya no son satisfactorias como fueron en la primera parte del período observado (1996 - 1999). Es necesario de realizar revisiones de los indicadores mencionados con el objetivo de mejorar las características de nuevos pronósticos.

## 1. INTRODUCTION

Empirical results and Croatian experience show that ICI and CROLEI, as two leading indicators, although based on different methodological grounds, have a similar prognostic power in forecasting the changes in industrial production as reference series. This paper shows by comparison the mentioned indicators and the industrial production throughout three periods: 1996 – 1999; 2000 – 2003 and 2004 – 2007. Based on an empirical research, a weakening of a correlation between the indicators and a reference series in each new observation period has been established. This means also a weakening of their prognostic power. Expert and science literature (Bacic, K., Vizek, M., 2006), Cerovac, S., 2005)) contains improvement suggestions for CROLEI and ICI for Croatia, but the suggestions still do not provide satisfying results. Based on an analysis which was conducted in this paper, the authors refer to a necessary review of both indicators as soon as possible.

## 2. BUSINESS SURVEY

Business surveys (Bahovec, V., Cizmesija, M., 2002) are a widely used means for observing, following, explaining and forecasting the changes in the business climate (in the manufacturing industry, in construction, in retail trade and in the services sector (financial sector)). This is a qualitative survey on the management level. Qualitative judgements and expectations are translated into quantitatively expressed indicators. One of the most commonly used representation of survey data is the “balance”. The balance is defined as a difference between the weighted percentages of positive and negative answers of firms on corresponding variables. The balance is calculated for all questions (variables). Time series of business survey results (balances) are often combined, producing a composite indicator and thus improving their information capacity.

Accuracy measures for most quantitative forecasts are based on forecasting errors. Business survey forecast variables are derived from qualitative questions, and the numerical operations thereon have a specific interpretation. The assessment of the forecasting performance is often based on the comparison of time series of survey variables and the corresponding official statistics data. Since there is a large variety of business survey information, it is useful for that purpose to select a composite indicator. One such indicator is the Industrial Confidence Indicator (*ICI*).

Business surveys in Croatia are conducted quarterly from 1995. They have been conducted in the manufacturing industry, in construction and in trade. Surveys are based on the harmonized European Union (EU) methodology. Surveys are financially supported by the Croatian Chamber of Economy and carried out by the Research Centre of the periodical “Privredni vjesnik”.

## 3. INDUSTRIAL CONFIDENCE INDICATOR (ICI)

The industrial confidence indicator (ICI) is a composite indicator of the business climate in a manufacturing industry (Matthes, H., [et. al] , 1997). ICI is a simple average of seasonally adjusted balances<sup>5</sup> of three variables: (1) order book, (2) production expectation and (3) stock of the finished products (negative sign).

$$ICI = \frac{B_{OB} + B_{PE} + (-B_{SFP})}{3} \quad (1)$$

whereas:

$B_{OB}$  - seasonally adjusted balances of the order book,

$B_{PE}$  - seasonally adjusted balances of the production expectation,

$B_{SFP}$  - seasonally adjusted balances of the stock of finished products.

<sup>5</sup> The seasonal adjustment method applied in Croatia is DAINITIES (Bahovec, V., Cizmesija, M., (2002), The European Commission used DAINITIES as well (Regling, K., Kröger, J., Darnaut, N., 2006, 2007).

Business survey results are available before the consideration of the corresponding statistic. In this paper we used data from the period I/1996 -III/2007 - quarterly data). Some empirical results (in Croatia and in EU) show a relatively strong correlation between ICI and the industrial production volume<sup>6</sup>, as published by the Statistical Bureau. With a lead of two quarters, ICI correctly predicts changes in the direction of the industrial production volume in round 66% cases (Cizmesija, M., 2008). This is useful in cyclical analyses and in decision-making. CROLEI has similar predictive characteristics.

#### 4. CROATIAN LEADING ECONOMIC INDICATOR (CROLEI)

CROLEI (Croatian Leading Economic Indicator) is calculated based on different methodological grounds than ICI. CROLEI<sup>7</sup> is a forecasting index that was developed in 1995 by the Institute of Economics, Zagreb and the Ministry of Finance in accordance with the renowned “barometric” methodology of the National Bureau of Economic Research in the United States. The index composed of leading indicators predicts industrial production as well as the overall economic activity in Croatia. In October 2004 CROLEI was revised.

CROLEI index is based on eleven leading indicators<sup>8</sup>: nominal net wage, registered persons employed, total tourist nights, real retail trade turnover, imports of machinery and transportation equipment, unconsolidated budget revenues, total liquid funds, total cash of participants in the payment system, time and savings deposits of commercial banks in domestic currency, foreign reserves of commercial banks and money market interest rate on other loans.

The barometric method involves five methodological steps (Bacic, K., Vizek, M., 2006: 325, 326):

1) Computing symmetric (Shiskin’s) percentage changes:

$$c_{it} = 200(X_{it} - X_{it-1}) / (X_{it} + X_{it-1}) \quad (2)$$

where  $X_{it}$  is value of the leading indicator in time t ( $X_{it-1}$  is value of the leading indicator in time t-1),  $c_{it}$  is its k symmetric monthly percentage changes ( $i=1,2,3,\dots,k$ , where k is total number of series entailing composite index;  $t=2,3,\dots,n$ ).

2) Standardization of the amplitude:

$$A_i = \sum_{t=2}^n |c_{it}| / (N - 1) \quad (3)$$

where  $A_i$  is the standardization factor (mean absolute percentage change) calculated for every leading indicator, N is the total number of monthly observations.

Symmetric monthly percentage changes (amplitude) for each component:

$$s_{it} = c_{it} / A_i \quad (4)$$

3) Weighting of the standardized changes (based on the best leading indicator scores)

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<sup>6</sup> The industrial production is calculated as a rate of change in the current quarter over the same quarter in the previous year, seasonally adjusted data; Central Bureau of Statistics, Republic of Croatia, Zagreb. (2008). *Volume Indices of Industrial Production; total and according to NKD 2002 Sections, Seasonally Adjusted Time Series and Trend Indices*; <http://www.dzs.hr>

<sup>7</sup> Bacic, K., Vizek, M. (2006). A brand new CROLEI – do we need a new forecasting index?. *Financial theory and Practice*, Vol. 30, No. 6. Zagreb, p. 312

<sup>8</sup> The Institute of Economics - Zagreb (2008). *Croatian Leading Indicator*. <http://www.eizg.hr/>

$$W_i = S_i / \sum_{i=1}^k (S_i / k) \quad (5)$$

where k is a number of composite index components.

$$R_t = \left( \sum_{i=1}^k S_{it} W_i \right) / \left( \sum_{i=1}^k W_i \right) \quad (6)$$

4) Standardisation using the standardisation factor of a group of leading indicators (F)

$$F = \left[ \left( \sum_{t=2}^n |R_t| \right) / (N - 1) \right] / \left[ \left( \sum_{t=2}^n |P_t| \right) / (N - 1) \right] \quad (7)$$

where  $P_t$  is obtained from same procedure as series  $R_t$ , just based on a group of leading indicators.

$$r_t = R_t / F \quad (8)$$

where  $r_t$  is adjusted weighted monthly changes in the group of leading indicators.

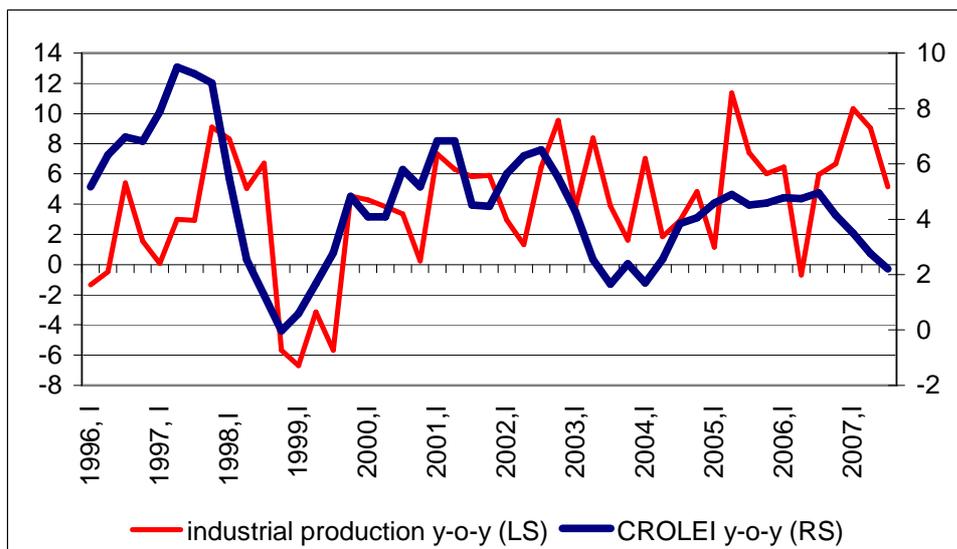
5) Expressing standardised average changes series in form of an index.

$$I_t = I_{t-1} \left[ (200 + r_t) / (200 - r_t) \right] \quad (9)$$

Where the starting value is usually set to 100.

During the period 1995-2004 the CROLEI system has successfully forecasted four turning points in the reference series of the industrial production.

#### 4.1 . CROLEI and ICI



**Figure 1 CROLEI and industrial production in Croatia, 1996, I – 2007, III**

The Croatian Leading Economic Indicator (CROLEI) and the Industrial Confidence Indicator (ICI) can be used to forecast developments of the national economy, especially of the manufacturing industry. The aim of this paper is to determine whether the ICI can predict the direction of changes in Croatia's industrial production

comparing ICI, CROLEI and the industrial production. This is important because ICI is a composite indicator derived from a qualitative survey and CROLEI is derived from a series in the national official statistics (not from qualitative surveys).

**Table 1 Coefficients of correlation between CROLEI in the period  $t$  and industrial production volume according to the number of leads (quarters) 1996, I – 2007, III**

Industrial production in period	Coefficient of Correlation, $r$
<b>t+2</b>	<b>0,486199</b>
t+1	0,434143
t+0	0,267011
t-1	-0,045528
t-2	-0,203240

During the observation period, one can notice that ICI and CROLEI have a similar trend, but during the period of 1996 - 1999 there was a sub period with the highest correlation coefficients among indicators and among industrial production, as well as among ICI and CROLEI during the remaining period until 2007. The period between 2000 and 2007 is an unstable period in the regional and national economy as a whole, as we can see in figure 1<sup>9</sup>.

**Table 2 Coefficients of correlation between CROLEI in period  $t$  and industrial production volume according to the number of leads (quarters) 1996, I – 2007, III**

Industrial production in period	CROLEI in period $t$		
	1996 - 1999	2000 – 2003	2004 - 2007
t+2	<b>0,717407</b>	<b>0,463934</b>	<b>0,314425</b>
t+1	0,695574	0,242775	<b>0,318018</b>
t+0	0,506876	0,127143	0,010373
t-1	0,091935	-0,372771	0,060457
t-2	-0,195946	-0,313686	0,272916

A coefficient of correlation ( $r$ ) with a negative sign does not have an economical interpretation.

#### 4.2 CROLEI and Industrial Production

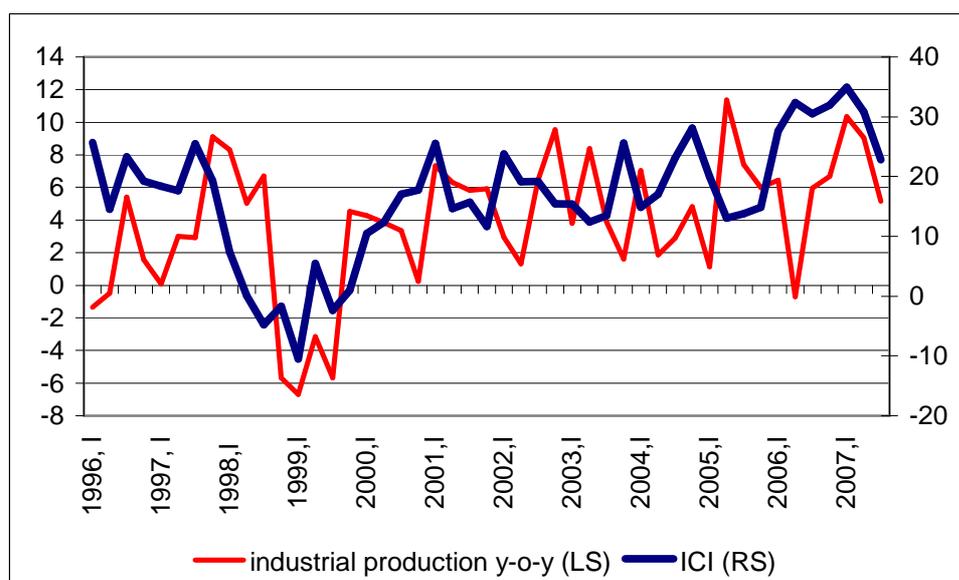
The highest  $r$  is for a lead of two quarters for all periods under observation. It means that CROLEI predicts changes in the industrial production (manufacturing industry) with a lead of two quarters. If we divide the whole period into three periods, we may realise that all correlation coefficients are highest for the period 1996 - 1999 (table 2). The same results are obtained for ICI and the industrial production (table 4).

#### 4.3 ICI and industrial production

The *ICI* quarterly series of the Croatian business survey is compared to the corresponding series of percentage rate of the industrial production volume change (manufacturing industry) as published by the Croatian Bureau of

<sup>9</sup> Industrial production is expressed as percentage rate of the industrial production volume change (a rate of change in the current quarter over the same quarter in the previous year, y-o-y). In Figure 1 and in Figure 2: LS - Left scale, RS - right scale).

**Figure 2 ICI and industrial production in Croatia, 1996, I – 2007, III**



Statistics [11]. The highest correlation coefficient 0.65 is for the *ICI* lead of the two quarters. Figure 2 shows the *ICI* time series and the percentage rate of the industrial production as published in the official statistics (rate of change percentage compared to the same period of the previous year)<sup>10</sup>.

**Table 3 Coefficients of correlation between ICI in the period  $t$  and industrial production volume according to the number of leads (quarters) 1996, I – 2007, III**

Industrial production in period	Coefficient of Correlation, $r$
<b>t+2</b>	<b>0,64301</b>
t+1	0,47407
t+0	0,33962
t-1	0,19796
t-2	0,07146

The highest  $r$  is for the two quarter lead. It means that *ICI* predicts changes in the industrial production with two quarters lead, as we can see for *CROLEI* and the industrial production.

With a lead of two quarters, *ICI* correctly predicts in round 66% cases changes in the direction of the industrial production volume. In table 4 we divide the whole period in three periods, and we may realise that all correlation coefficients are the highest for the period 1996 - 1999 (table 4) just as for *CROLEI* (table 2).

#### 4.4. *ICI* and *CROLEI*

Business surveys are qualitative surveys. The results can be used as indicators of the business sentiment and as a base for forecasting the manufacturing industry activity. It is important that the business survey results refer to the changes of variables, and our interest here is to track the direction of changes in a referent variable and in the industrial production as a whole.

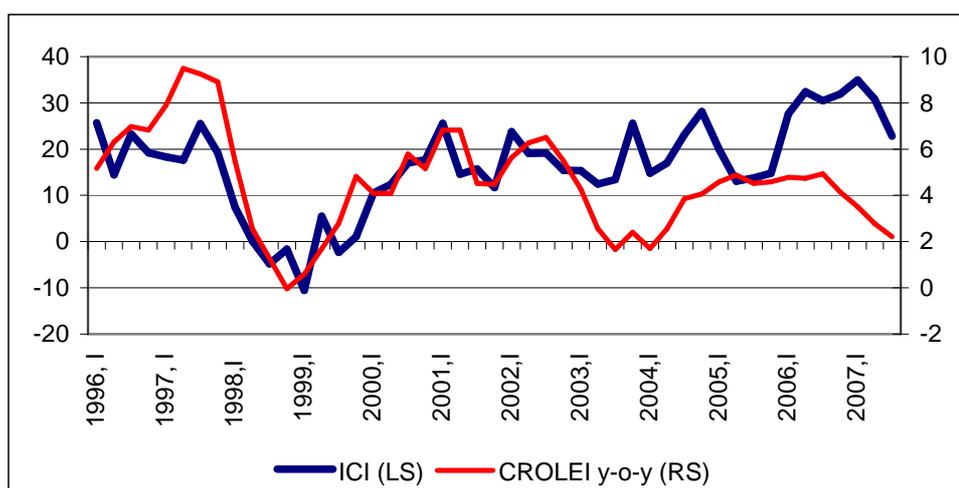
<sup>10</sup> The business survey data refer to the changes of a variable and it is important here to track the direction of change in a variable and in the industrial production. This is in accordance with the EU methodology; (Claveria, O., Pons, E., Ramos, R., 2005).

**Table 4 Coefficients of correlation between ICI in the period  $t$  and industrial production volume according to the number of leads (quarters) 1996, I – 2007, III**

Industrial production in period	ICI in period $t$		
	1996. -1999.	2000. – 2003.	2004. - 2007.
t+2	<b>0,648873</b>	<b>0,280195</b>	<b>0,490415</b>
t+1	0,432384	<b>0,286648</b>	0,125473
t+0	0,330996	-0,258178	-0,128681
t-1	0,056039	<b>-0,450133</b>	-0,096414
t-2	-0,33670	0,291056	-0,004393

ICI (and CROLEI) correctly predict the industrial production changes with a two quarter lead in around 60%. The best results were obtained for the period 1996 – 1999.

**Figure 3 ICI and CROLEI in Croatia, 1996, I – 2007, III**



As we have seen, the previous ICI and CROLEI have the highest coefficient of correlation with the industrial production for the lead of two quarters. This means that ICI and CROLEI have the highest correlation in the same period (Table 3). Like the correlations between the indicators and the industrial production for the tree parts of the period the highest coefficient of correlation between ICI and CROLEI is for the first period 1996 - 1999 ( $r=0,852950$ ), but for the period 2004 – 2007 the correlation coefficient amounts  $r= 0,112064$  (Table 6).

**Table 5 Coefficients of correlation between ICI in the period  $t$  and CROLEI in according to the number of leads (quarters) 1996, I – 2007, III**

CROLEI (y-o-y)	Coefficient of correlation
t+2	0,289477
t+1	0,430045
<b>t+0</b>	<b>0,472973</b>
t-1	0,368315
t-2	0,188371

**Table 6 Coefficients of correlation between ICI and CROLEI in according to the number of leads (quarters) 1996, I – 2007, III**

CROLEI (y-o-y)	ICI in period $t$		
	1996 -1999	2000 – 2003	2004 - 2007
t+2	0,7221724	0,154223	-0,56018
t+1	0,837268	0,593663	-0,24944
<b>t+0</b>	<b>0,852950</b>	<b>0,317096</b>	<b>0,112064</b>
t-1	0,815304	-0,17348	0,172667
t-2	0,562933	-0,48790	0,120615

## 5. CONCLUSION

The results of Croatian business surveys produce valuable forecast information on the direction of changes of the economic activity in the manufacturing industry, especially for the period from 1996 to 1999. In spite of the different methodological grounds of ICI and CROLEI, they are mutually highly correlated (in the same period), as well as with the industrial production (with the two quarter lead). Our interest in this paper was to track the industrial production changes direction as a referent series because ICI is derived from qualitative surveys based on judgments and expectations of economical units. Some results of the correlation analyses in Croatia, confirm these conclusions.

The period 1996 – 2007 was divided into three sub-periods. It was noticeable that ICI and CROLEI were mostly correlated with the industrial production as a reference series during the first sub-period (1996 – 1999). The correlation is becoming weaker in the next sub-period, whereas it is weakest in the third sub-period (2004 – 2007). They are mutually correlated in the same way as they are correlated with the industrial production. The correlation coefficients between the individual indicators and the industrial production are the highest during the two-quarter precedence of the indicators over the production. They are the highest during the period 1996 – 1999 and then they diminish. This is partly a consequence of the economic instability of the Croatian economy after 2000. One may also notice the need to revise the mentioned indicators, in order to improve their predictive characteristics. This is a very demanding task, because both indicators are calculated according to verified methodologies of international institutes.

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