A composite leading indicator for a small transition economy: the case of Croatia

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Abstract

This paper provides an overview of application of a modified NBER "leading indicators approach" in Croatia since the mid 1990s.

Shortness of time series, which has proven to be the biggest obstacle in applying the original NBER method, was overcome by a modification of a methodological step in the scoring procedure.

Key Words: Leading indicators approach, the CROLEI index, the NBER method, bivariate Granger causality test, the scoring method.

JEL Classification: C, E

1. Introduction

CROatian Leading Economic Indicator[1] (CROLEI) is a composite prognostic index with the main purpose to predict and explain fluctuations in the Croatian economy (Ahec-Sonje et al., 1996)[2]. The base for the construction of the index is a serially tested and treated set of reliable leading indicators that are matching economy's cyclical movements with a significant lead time. That implies that leading indicators "turn" (or have turning points in series) few months before the real turn in the economic activity occurs. NBER leading indicators approach became the focal point of research interest in Croatia in the beginning of 1990s primarily due to the fact that, at that time, conditions for constructing a sophisticated econometric forecasting model, were not satisfied. The main obstacle was found in the shortness of time series that were a consequence of setting up a new official statistical database in the midst of economic transition. This problem would also prove to be an obstacle for applying the original NBER "barometric" method in the very beginning of its application in Croatia.

The research based on the "barometric" method in Croatia resulted in the development of a prognostic system of leading indicators[3]. Today the system is used for calculating a prognostic expression of overall economic activity. Apart from having the quality of providing information about the future movements of the economy, the system is also a source of other useful information, in particular, about the "hidden" relationships in the economy. That quality of the system can be accredited to a set of auxiliary methodological steps and analysis that are inherent to the system. For those reasons, the method is widely used in highly developed economies, where many economic agents use its results as a basis for business decision making.

The methodological guidelines have no recommendations on what to do with the method when it is being applied in the time of significant economic changes, such as those that took place in Croatia. The Croatian economy underwent many significant economic and political changes (including the Homeland war) when the NBER method was applied for the first time, in 1994. The application of the leading indicators approach relies on the original NBER method, but has also been modified to account for the weaknesses in the statistical base. In this paper, we try to explain how the method can be applied in a transition economy and summarize the results that several methodological interventions i.e. revisions, produced.

The paper consists of three major parts. The main idea behind the first part of the paper is to briefly explain the NBER methodology, with causes of modifications and interventions in the method when it started being applied in Croatia. Then follows an informative outline of the last revision of the CROLEI index from 2004 with the purpose to update the prognostic system and improve the index's prognostic power. The last part of the paper analyses the movement of the CROLEI index and its prognostic strength with respect to the previous revisions and offers several conclusions.

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[1] The index has continuously been published on monthly basis in the Ministry of Finance's Statistical Bulletin since the end of 1995.

[2] Cerovac (2005) developed an alternative system of leading indicators for Croatia. Jagric (2001) and Jagric, Borsic and Stasek (2003) built a system of leading indicators for Slovenia, also based on the NBER method with elements of Stock-Watson approach.

[3] The impulse to create such a system in Croatia came from researches' enthusiasm and not as a result of economic policy makers or business community's needs. The benefits of using information for economic agents could reflect in an increased efficiency of the overall economic system or in lessened intensity of market disturbances. The range of users of information provided by CROLEI index is still confined to a narrower circle of employees in the public sector. Still, despite the relatively uninterested stand of economic audience CROLEI system has managed to affirm its value with its longevity.

2. The "barometric" method and the development of economic forecasting in Croatia in hindsight

The first impulse for constructing a system of leading indicators came to researchers at the NBER from the Head of American treasury, Henry Morgenthau, Jr. in 1937[4], when a panic about an onset of a new severe recession began as a consequence of recollection of difficult time during the Great Depression. Since then, the USA and many other countries (including all members of OECD) have researched and published cyclical indicators which are used as a source of information of an economy's wellbeing by all economic agents. This short-term forecasting has received a lot of attention mainly because of countries' bitter experience related to business cycles. In many countries this type of research has a status of a project continuously supported and funded by the Government. It is due to the fact that Governments are aware of the need to constantly watch for market signals. Authors believe that the widespread use of the NBER method can be accounted to the simplicity in its use and to the simplicity of its interpretation. According to the method, the prognostic index should be composed of indicators that can be leading, lagging or coincident in relation to the reference series. In reality, the index measures "averaged" behavior of a group consisting of time series that represent different activities and sectors of an economy[5]. The movement of time series should match the turning points in reference series, but with a certain time lag.

The first problem that the Croatian researchers had to deal with was finding time series that were statistically reliable and, at the same time, had a cyclical pattern. After that, researchers began to build a database for latter methodological steps. In 2004, the database consisted of 104 series.

The composite index – the CROLEI simulates economic activity with a shorter or longer lead-time, depending on the prognostic strength of its components – the chosen leads. The criteria that components must necessarily meet are that series have to represent different areas of economic activity, their pattern must be cyclical, and they have to exert certain prognostic characteristics i.e. prognostic power. Due to the wide encompassment of the components, the prognostic index is less dominated by irregular movements than are its components. The original method ensures that only series that are easily available, regularly updated and released, and those that have not been a subject of a methodological revision in the official statistics, enter the composite index.

[4] The first composite indices were constructed by Moore and Shiskin back in 1958.

[5] Niemira i Klein (1994); Zarnowitz i Boschan (1975); BEA/US Department of Commerce (1977); Moore i Shiskin (1967).

3. Revisions of the CROLEI system

Researchers who founded the CROLEI system were aware that the system would have to be adjusted methodologically and statistically every few years, not only because the NBER method requires that, but because of constraints that a transitional environment carries. Even in stable economies, testing and revision of the method are performed every few years and they represent standardized procedures. Recommendation holds that the system should be revised every two years, if possible, and its result should be an improved system that has been refreshed with new indicators of higher prognostic quality.

Revision is necessary on two accounts. The first one is statistical, and the second economic. With each new monthly observation added, a time series becomes longer and therefore raises the quality of its analysis. Methodology in use for keeping time series periodically gets altered in that some existing series are dismissed and new ones are created which simultaneously cripples and enriches the CROLEI database. These alterations have at times been so frequent that the continuity and the purpose of various economic analyses have sometimes been discouraged by it[6]. If the request for statistical continuity is respected, then every modification in the official statistics that reflects itself in the CROLEI database, calls for a revision of the CROLEI system. The economic reasoning of the revision is related to transitional characteristics of the Croatian economy. In the last 15 years the economy has been going through many legal and institutional changes, which continue because of adjustments necessary for the country to join the EU. As long as the process of adjustment of the domestic economic conditions to the functioning of highly developed market economies, more frequent are changes in the intensity of influence of economic variables on total economic activity.

3.1. The CROLEI database

The search for leading indicators begins with the setting up of a statistical base of economic series released by the official statistics and other official institutions[7]. The basic request of the methodology is that series in the CROLEI database are as long as possible, and that their time range overlaps. Additional request for running the database is to keep detailed methodological remarks and explanations because they provide the necessary information about the series that will later be used, when applying the method. It is desirable that series in the database are readily available on a certain date in the month, with no delays in their release. In 1994, when the method was applied for the first time, the CROLEI database consisted of 98 time series, and in the last methodological revision in 2004, the number of series was 104. Series in the CROLEI database are covering almost all areas of the Croatian economy and they are on monthly basis starting from January 1995.

[6] This problem will become even more pronounced in the light of integration with the EU because of statistical adjustments that Croatia will have to make.

[7] Financial agency-FINA, Ministry of finance of the Republic of Croatia, Employment office and Croatian National Bank.

Table 1. The CROLEI database in 2004

Economic Area	Number of series	Examples of series
1. Industry	39	volume index of total industrial production, volume index of production by activities and by industries
2. Employment and wages	3	number of employed, net wages, gross wages
3. Unemployment	7	number of newly registered seeking employment, the number of unemployed, number of person seeking employment for the first time, employed with the help of the Employment Bureau, etc.
4. Construction and tourism	5	value of net orders in construction, number of tourist nights etc.
5. Trade	2	value of retail trade, index of real retail trade
6. Foreign trade	22	export and import of goods by industry
7. State budget	29	total revenues, capital revenues, revenues from income tax, etc.
8. Non-financial transactions	1	unconsolidated revenues from the national, regional and local budgets
9. Monetary statistics	29	primary money, M1, M4, total cash, total deposits
10. Prices	12	retail price index – goods and services, industrial products price index, etc.

Source: Bacic et al., 2004

Analysis and decomposition of series follow after preparing the database. Given the fact that every series exerts a certain degree of seasonality and irregularity, decomposition is needed to separate the seasonal component from the trend-cycle and the irregular component. Seasonal adjustment of time series[8] is necessary for application of the "scoring" method.

3.2. Industrial production – the aggregate that is being forecasted

In constructing the CROLEI system, a dilemma about choosing a macroeconomic aggregate that reflects the movement of the economy in the best possible way, lies ahead. It is a difficult task because the best suitable aggregate available – gross domestic product (GDP) – is in most countries released on an annual or on quarterly basis. GDP cannot be a useful aggregate because the NBER method gives short-term forecast based on monthly changes in the components. Therefore, the aggregate or so-called "reference series" should be sought

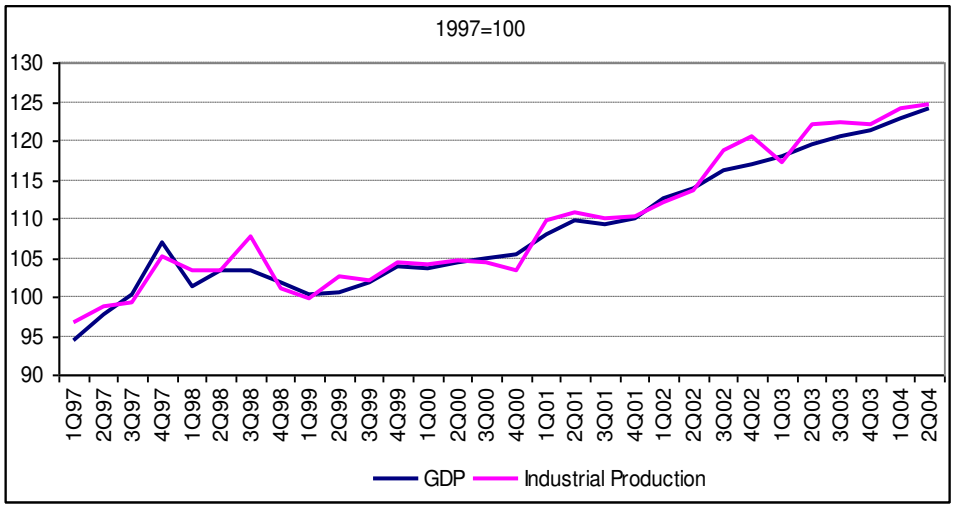
[8] Carried out using X11ARIMA2000 program, which provides all the necessary information about the quality of the original data (Statistics Canada).

elsewhere and most researchers[9] decide that it should be the volume of industrial production. More specifically, "turns" in a business cycle are being forecasted. "Turns" can be defined as the beginning of long-term change in the direction of movements of a series.

This choice of the industrial production a reference series has proven correct as the industrial cycle in Croatia nearly completely overlaps with the GDP cycle. Croatian researchers have confirmed this many times by comparing the movement of GDP and industrial production, discovering many similarities in the movement of those series. On a practical note, industrial production is released monthly, which suits the setup of the prognostic system ideally because of the monthly use of the index. It is because of these characteristics that industrial production is used as a reference series in many other countries. In the Croatian case, industrial production has one shortcoming and that is that the industrial sector participates in the total value added with about 28 percent[10]. In other words, the series only approximates the dynamics of the entire economic activity.

Figures 1 and 2 illustrate that total industrial production still remains the optimal choice for reference series. Despite the fact that the industrial production index does not reflect the dynamic of activity for the whole economy, it has continuously been confirmed that the cycles of industrial production overlap with the cyclical pattern of GDP in the Croatian economy. Trend-cycles of both series appear coincident that justifies using industrial production as reference series. Also, the turning points in cycles do not differ significantly for both industrial production and GDP. It is important to take into account that industrial production, as well as none of its components, is not used in the calculation of the index in any way.

Figure 1. Seasonally adjusted values of GDP and industrial production

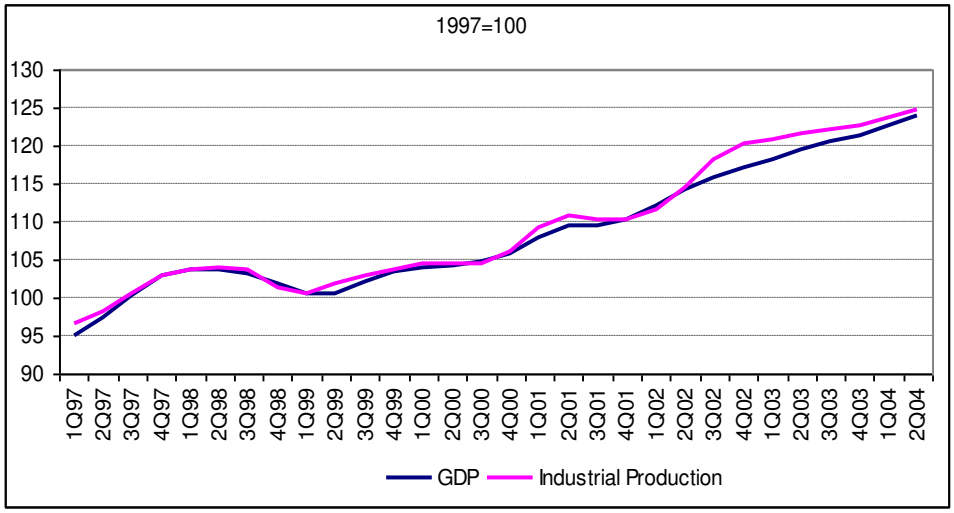


Source for original data: Croatian Statistical Bureau.

[9] See, for example "OECD Composite leading indicators: a tool for short-term analysis", OECD, 28-jun-2001, http://www.oecd.org.

[10] The average share of gross value added (mining and quarrying; manufacturing; electricity, gas and water supply) in total value added according to the quarterly estimates of GDP in constant prices (source: Croatian Statistical Bureau).

Figure 2. Seasonally adjusted values of GDP and industrial production



Source for original data: Croatian Statistical Bureau.

3.3. Evaluating the quality of time series with the "scoring" method

The essence of the scoring procedure is evaluation and analysis of filtered series from the database. Scoring is a methodological step towards evaluation of the role and quality of economic variables as possible "signal" indicators of economic fluctuations. The goal is to establish whether series can be used for analytical and prognostic purposes, which also means that it is possible to interpret their current values easily. Series that are being scored are adjusted for inflation and are seasonally adjusted. The original scoring procedure helps reveal the conformity of possible leads to the reference series at troughs and peaks in cycles in order to establish if the potential indicator lead the reference series persistently. Although this method has been in use in Croatia for 13 years, time range of certain series in 2004 was under 10 years which was not a long enough range to apply all of the original scoring criteria. Therefore, the criterion "conformity to the business cycle" was replaced by a parametric approach. That approach is the bi-variate Granger causality test, results of which are the only available objective measure of conformity of possible leads to reference series. The resulting adjusted scoring system of Croatian indicators is built on the following scores:

1. Score of economic significance;
2. Score of statistical adequacy;
3. Score of economic significance of the link;
4. Score of smoothness;
5. Score of currency of the statistics.

The procedure of scoring series in the database is limited to the series that conform to the pattern of the Croatian business cycle. Elimination of series that do not conform to the reference series movement is carried out on two levels.

The first level is the graphic comparison of industrial production series movement to the movement of all series in the base. On the second level, series are additionally eliminated by the results of Granger bi-variate causality tests. In the following section we provide a detailed description of the numbered criteria with the share of each criterion's score in the total score within brackets.

3.3.1. Economic significance (20%)

The key criterion when choosing indicators is economic significance. The chosen indicators from the vast database must represent key activities in the cyclical economic process. According to this criterion, the role of an indicator is seen through the importance of the economic process (that the indicator represents) in a wider economic activity. This criterion also brings most difficulties to researchers because an objective and a quantitative procedure for scoring economic significance does not exist in the literature. That is the reason why in this case researchers have to rely on their own judgments.

3.3.2. Statistical adequacy (20%)

Statistical adequacy of time series depends on the quality of statistical methods of collecting data. It is used to evaluate the quality of statistical sources and a series is scored according to:

- Coverage of process (population, sample)
- Reporting system (direct from respondents, administrative records, etc.)
- Revisions
- Description
- Duration
- Comparability of historical series

3.3.3. Economic significance of the link (30%)

The application of the original criteria "conformity to the business cycle" is not possible for Croatia because of rather short time series, unless the methodology was adjusted for this criterion. The original criteria involve estimating conformity probability, taking into account absence of cyclical turns, absence of lapses in conformity and amplitude (Moore, Shiskin, 1967, p. 23). Nevertheless, thanks to the fact that the NBER scoring procedure is only a framework that researchers may comply with entirely or to some extent, is favorable for the Croatian case. There is also an option that the NBER framework may be modified with recognized analytical methods which justifies the Croatian modification. Considering that Croatian time series are too short for scoring according to "the conformity with business cycles" – and that there are only a few turning points in the Croatian business cycle, researchers cannot confirm regularity in the movement of series, or follow cyclical patterns with certainty, etc. For that reason, the CROLEI scoring system is complemented with the results of Granger bi-variate causality test so that the research remains methodologically consistent. The NBER does not carry out this test in the search for prognostic indicators, but some authors do use it when they are evaluating prognostic strength of composite indices (Auerbach, 1982).

With the results of Granger causality tests, series are accordingly distributed into groups of indicators that are leads, lags or coincident in relation to the reference series. Additionally, this test is used to determine an indicator's lead-time. Series are first tested with an econometric autoregressive specification of industrial production. Then the model is expanded with an introduction of lagged independent variables i.e. lagged potential indicators (equation 1),

$$IND_t = A_0 D_t + \sum_{j=1}^{k} \alpha_j IND_{t-j} + \sum_{j=1}^{k} \beta_j LI_{t-j} + \varepsilon_j \qquad (1)$$

where A_0D_t represents the deterministic part of the equation (the constant), $\sum_{j=1}^{k} \alpha_j IND_{t-j}$ is the autoregressive specification of industrial production to its own lagged values, and $\sum_{j=1}^{k} \beta_j LI_{t-j}$ is a regression of referent series to lagged values of a potential leading indicator. Model specification begins with lagged values of IND[11] and the potential LI[12] at time (t-1), and is gradually expanded with adding of lagged values of IND and LI at time (t-2), (t-3),…,(t-12). Testing of parameters and the whole regression specification is completed with the F-test (Auerbach, 1982; Charemza, Deadman, 1992). Statistical value for testing the null hypothesis ($ß_1 = \ldots = ß_k = 0$) is F distributed with (m, T-k) degrees of freedom and is compared against a table value under level of significance (5%).

For example, if all parameters $ß_j$ (j=1,…,k) in a regression specification with lagged values of IND and LI equal 0, then the LI under observation does not Granger cause IND. If the null hypothesis is rejected on the basis of F statistics under level of significance of 5%, then LI does Granger cause reference series, IND. More specifically, if a null hypothesis that LI Granger causes IND at (t-1)..(t-8) with autoregressive specification included, is rejected, and then LI Granger causes IND at (t-8).

The test results have a significant share in the scoring procedure and in the choice of leading indicators. It is because leads with their lead time are revealed, as well as the strength of the relationship between reference series and the lead.

Economic significance of the link is measured with the adjusted coefficient of determination R^{2*}. This pattern of scoring will hold only for series that have been accepted by measures of seasonality and that have been seasonally adjusted. Those series have an irregular component that is not dominant and monthly changes in seasonally adjusted values are useful for making conclusions about the series' tendencies. Series with a dominant irregular component appear a significant analytical problem. Although the program X11ARIMA2000 used for seasonally adjusting series provides estimates of each series' trend-cycle, series with a dominant irregular component are not suitable for forecasting economic activity on the basis of the NBER method. Once that those series have been seasonally adjusted and the irregular component removed, then completely smoothened series with their tendencies of movement are obtained, but this is not acceptable because of the monthly aspect of forecasting.

[11] Industrial production.
[12] Leading indicator.

3.3.4. Smoothness (20%)

Each series is a mix of trend-cycle, seasonal and irregular component, sometimes also with the component "number and type of working days". One of the more traditional approaches to estimating these components is the regression method. Its advantage is that it is simple and easy to understand, but its shortcoming is that it opens up the possibility of making a mistake when choosing the type polynomial and its degree with which the trend-cycle is described. The second traditional approach uses the moving average method. Non-seasonal component is estimated by a symmetric moving average operator, and the seasonal component is obtained as the difference between the original series and the estimated non-seasonal component. These estimations may be obtained with the use of an iterative method by repeating various moving averages.

The most widely used method of moving averages is the "II-X-11 method", a variant from the year 1968. However, this method, as all other traditional methods, ignores the fact that seasonal component has a stochastic character and is connected to other components. It is therefore better to use seasonal ARIMA models. Scoring procedure requires series to first be seasonally adjusted, and then analyzed and scored. Scoring uses measures provided by the program for seasonal adjustment of series. That type of information about each series, for example, is:

- ratio of averaged change in irregular and cyclical component in the observed period (I/C)
- number of months during which percentage change in cyclical component is greater than percentage change of irregular component (i.e. MCD-months for cyclical dominance);
- relative contribution of single components variances of percentage changes in one or more months' ranges within the observed period. In this way, it can be discerned what part of variance can be explained by irregular component, by trend-cycle or by seasonal component. Evaluating cyclical significance in the development of series' movement tendencies is carried out with the help of measure MCD considering that their monthly observations are available.

3.3.5. Currency of the statistics (10%)

According to this criterion, promptness of data and data availability is measured. Prognostic expressions significantly depend on how quickly are data collected, released and prepared for the analysis. Any major delay in data release may discredit forecasts.

3.4. Scores and the selection of the CROLEI index components

After series have been adjusted for inflation and seasonally adjusted, a graphic analysis is carried out, followed by the bi-variate Granger causality test. In the original NBER method, the graphic comparison of indicators' movement against the reference series' movement is the key technique for grouping indicators as lead, lag and coincident series. A wider list of indicators that are eligible leads according to the application of the graphic method and according to the results of Granger test are available in the appendix.

Throughout the revisions of CROLEI prognostic system in 1997, 1999 and 2004, 13 series have persistently shown to be good leads in the Croatian economy (Ahec-Sonje et al., 1997, 2000; Bacic et al., 2004). That confirms the economic significance of these series and that they

conform to reference series well, which in turn raises the credibility of the used prognostic method. In the wider list of indicators these series are:

- Employed with the help of the Croatian Employment Agency during a month
- Users of unemployment compensation
- Nominal net wage per employee
- Tourist nights, total
- Foreign tourist nights, total
- Retail trade, real
- Unconsolidated revenues of state, county and municipal budgets
- Broadest money M4
- Reserve money
- Money M1
- Money M1a
- Deposit Money Banks' Claims
- State budget expenditures, total

As in the case of the first two revisions, a wider list of indicators is a basis for further detailed analysis of each series' prognostic strength considering that a part of these series has a strong irregular component and a shorter lead time. The sense of logic together with the "scoring" criteria will ensure that such series get a worse total score which will make them a less serious candidate for the CROLEI index component.

The scoring method is applied on 25 potential leads following the numbered and explained criteria. In table 2 an example of how one series are scored is provided, while in table 3 series are ranked according to their score.

Table 2. An Example of how series are scored – S109 Reserve money

Criterion	Score
I. Economic significance (20%)	20
II. Statistical adequacy (20%)	20
III. Economic significance of the link (30%)	30
IV. Smoothness (20%)	(2)r16
V. Currency of the statistics (10%)	6
VI. Total score (I+II+III+IV+V)	92

R^2 at (t-5) = 0,90

Table 3. Leads ranking according to their total score

Series code	Indicator	Total Score
S136	Money market rate, daily	92
S112	Time and Sav. Deposits with Dep. Money Banks, in dom. currency	92
S109	Reserve money	92
S48	Employed with the help of the Croatian Employment Agency during a month	88
S123	Reserves on time and notice deposits	88
S43	Nominal net wage per employee	87
S58	Retail trade, real	87
S54	Tourist nights, total	84
S55	Foreign tourist nights, total	80
S51	Users of unemployment compensation	79
S95	Unconsolidated revenues of state, county and municipal budgets	75
S107	Broadest money M4	75
S116	Deposit Money Banks' Claims	75
S105	Money M1	71
S106	Money M1a	71
S113	Time and Sav. Deposits with Dep. Money Banks, in for. currency	71
S114	Time and Sav. Deposits with Dep. Money Banks, in for. currency – households	67
S92	Machinery and transport equipment import	66
S115	Time and Sav. Deposits with Dep. Money Banks, in for. currency – enterprises	63
S157	State budget expenditures, total	55
S165	Surplus/Deficit of the State budget	55
S164	Capital Expenditure	51
S76	Chemical products export	48
S155	Revenues from excise on imports of motor vehicles	48
S146	Revenues from Tax on goods and services	46

Source: Bacic et al., 2004

When the quality of series that have entered the new CROLEI index in 2004 is compared to the old index, from 1999, an improvement is visible, in particular in the statistical quality[13].

A narrower selection of leads is founded on 4 requirements:

- a non dominant, ignorable irregular component;
- high total score, with 70 points as a threshold for entering the index;

[13] In the year 2004, the first three ranked series scored 92 points (out of possible 100 points), while in 1997, first-ranked series 1999 scored 87 points. Improvement is evident for series at the end of the list, because in 2004 the worse ranked series scored 46 points, while in 1999 the worse-ranked series scored 44 points. This accomplishment is seen in the improvement of the total score of all series (table 6).

- long enough lead time, starting from t-4;
- priority is given to economic aggregates.

If all requirements are respected, then series in the index will represent economic aggregates, they will be smooth and they will have a longer lead time. Researchers must be careful that series that are representatives of the same economic activity, but on a different degree of aggregation[14], do not enter the index more than once. As a result of applying all of the scoring criteria, 11 components are selected to take part in the CROLEI index until the next revision of the system. The new series – components are provided in table 4.

Table 4. Components of CROLEI index from 2004

Series Code	Indicator	Lead time
S43	Nominal net wage per employee	(t-4)
S48	Employed with the help of the Croatian Employment Agency during a month	(t-4)
S54	Tourist nights, total	(t-9)
S58	Retail trade, real	(t-8)
S92	Machinery and transport equipment import	(t-8)
S95	Unconsolidated revenues of state, county and municipal budgets	(t-4)
S107	Broadest money M4	(t-4)
S109	Reserve money	(t-5)
S112	Time and Sav. Deposits with Dep. Money Banks, in dom. currency	(t-4)
S123	Reserves on time and notice deposits	(t-8)
S136	Money market rate, daily	(t-5)

Source: Bacic et al, 2004.

The next step towards constructing the prognostic expression, the CROLEI index, is calculating significance weights for each of the 11 indicators. These weights are essential for the process of aggregation of components into the index.

[14] For example, “tourist nights” and “foreign tourist nights”.

Table 5. Scores and significance weights of the CROLEI index components

Series	Lead time	Economic significance (20%)	Statistical adequacy (20%)	Smoothness (20%)	Currency of the statistics (10%)	Economic significance of the link (30%)	Total score (Si)	Weights (Wi)
S43	-4	100	95	60	60	100	87	1,04
S48	-4	100	100	40	100	100	88	1,05
S54	-9	100	100	40	60	100	84	1,00
S58	-8	100	95	60	60	100	87	1,04
S92	-8	80	85	0	60	90	66	0,79
S95	-4	100	100	0	100	100	75	0,89
S107	-4	100	100	100	60	30	75	0,89
S109	-5	100	100	80	60	100	92	1,07
S112	-4	80	100	100	60	100	92	1,10
S123	-8	80	100	80	60	100	88	1,05
S136	-5	100	100	80	60	100	92	1,10
TOTAL							926,0	11,00
Average	-5,7*						84,18	

Source: Bacic et al, 2004

* average lead time of the CROLEI index = $\sum((t-m)_i * Wi)/k$, where *m* is the number of months in the lead time, *i=1,2,...k* where *k* is the total number of series in the index (in our case k=10), and Wi is the weight of each indicator *i.*

The CROLEI index is constructed with the help of the standardized methodological framework developed in the NBER and BEA/US Department of Commerce. The calculation of the index is the only part that has not yet gone through significant changes. For years the weighting system has been used in its original form (Zarnowitz i Boschan, 1975; Gapinski, 1982; Shiskin, 1961). Prognostic index may be seen as a weighted average of individual indicators, and this definition only credits the method's simplicity of use. Although the index reflects the amplitude and the direction of each component, it also smoothes random oscillations of components. By being built of many components, the prognostic index minimizes the possibility of incorrect forecasts which may occur in the case a forecast based on a single-indicator.

3.5. Computation of the prognostic index

The final prognostic expression of the industrial activity movement is based on the computation of the CROLEI composite index. The index is computed by following the NBER/BEA instructions (BEA/USDC, 1977; Zarnowitz i Boschan, 1975; Gapinski, 1982; Shiskin, 1961) that consist of five methodological steps and those are:

- Computing symmetric (Shiskin's) percentage changes;
- Standardization of the amplitude;
- Weighting of the standardized changes;
- Standardization of R_t[15]
- Turning monthly changes into the index.

The prognostic expression may be seen as a weighted average of the chosen leads, and that definition only confirms the sheer simplicity of the described methodology. Although the composite index reflects the amplitude and the direction of changes in each component, it also has the ability to smooth their random oscillations. Due to this ability of the index, the possibility of giving wrong forecasts, which appears if only one indicator is used, is reduced.

In interpretation, a simple rule by Vaccara and Zarnowitz (1977) is followed: consecutive three falls/rises (first difference between current and the previous month) in the composite index value signals a recession/recovery of the total economic activity. The rule does help specify when the turn is really going to occur, and this was confirmed in the American example (Stekler, 1991). Stekler and Schepsman (1973) propose a 4 month fall (or rise) below/above the last lowest/highest point in the index to be considered as an interpretation criterion for turns. Nevertheless, it must be pointed out that the NBER method allows the index interpretation to be a matter of a researcher's subjective evaluation. The CROLEI index's lead time, calculated as an averaged lead time of all components as suggested by Zarnowitz and Boschan (1975), is used in the interpretation of monthly changes. An additional measure - the diffusion index complements the interpretation of the prognostic expression. It is expressed as the ratio of number of components that exert growth in the total number of the components. The ratio can fall into three possible ranges: a) within the 0 – 50 range in which case a recession lies head or a fall in the economic activity; b) within 50 – 75 range in which case a moderate growth in economic activity may be expected; and c) within 75 – 100 range in which an acceleration in the economic activity may be expected or an expansion. Again, the value of the diffusion index may

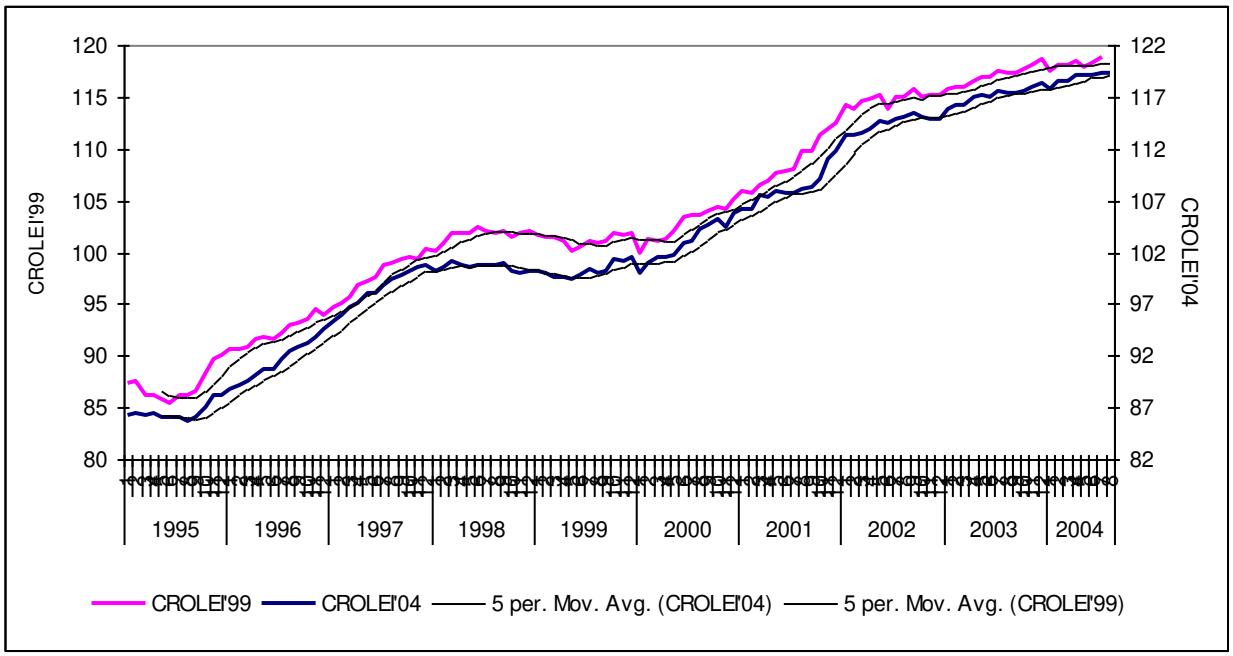
[15] A series that reflects averaged movement of components.

be seen in the context of "3 consecutive months in the same range" in order to interpret the index with more certainty.

4. Conclusions drawn from the revision of the CROLEI index in 2004

The last revision of the prognostic system in 2004 has resulted in the selection of 11 components and in a new combination of indicators that conform to the cyclical pattern of the Croatian economy. The new CROLEI index from 2004 has confirmed validity of the method that has been used so far, as well as the right selection of indicators. The new index appears more versatile in the choice of indicators since it covers almost all of the most important sectors in an economy. Perhaps it can also be argued that because of this versatility of components, the system has also become more reliable. That is seen in the highest score of an indictor, amounting to 92 points. In the previous revision, the highest grade amounted to 90, whereas in the last revision, more series with higher grades than ever before appeared. Also, the CROLEI database has altered on two accounts; some series that were a part of the database have ceased to be released, and some new series have started to be released since 1995, which enabled us to include them in the scoring process. An example of a series that has shown to be an excellent indicator is "money market rate". For the first time, in 2004 the index contains five series from the real sector. Nonetheless, the "old" CROLEI index has not lost its credibility because of the introduction of the new CROLEI index. That is evident from figure 3, where the old and the new index's movement appear almost simultaneous i.e. their cyclical pattern is very similar. Also, the new index contains few series that were already a part of the old index.

Figure 3. The CROLEI index '99 and the CROLEI index '04



Source: Ahec-Sonje et al, 1999; Bacic et al., 2004

Average lead time of the new CROLEI index is 5.7 months. Compared to the old index, the new lead time is shorter, which does not necessarily imply loss of prognostic strength or deterioration in the quality of the new index. Shortening of the lead time is a consequence of including more series with shorter lead time into the index. These series have, due to their high prognostic scores, contributed to the quality of the index.

Still, some issues remain to be solved and improved in the CROLEI prognostic system in the future. Our priority on the research agenda is to determine turns in a business cycle using a scientific method instead of subjective evaluation.

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6. Appendix

Table 6. A wider list of indicators

Series code	Indicators	Lead time
S20	Publishing, printing and reproduction of recorded media	(t-5) .. (t-6)
S24	Manufacture of other non-metallic mineral products	(t-8) .. (t-9)
S33	Manufacture of other transport equipment	(t-4) .. (t-5)
S43	Nominal net wage per employee	(t-4)
S48	Employed with the help of the Croatian Employment Agency during a month	(t-7) .. (t-11)
S51	Users of the unemployment compensation	(t-4) .. (t-6) and (t-11)
S54	Tourist nights, total	(t-6) and (t-8) .. (t-9)
S55	Foreign tourist nights, total	(t-6)

S58	Retail trade, real	(t-8) .. (t-9) and (t-11)
S67	Goods exports, total	(t-12)
S75	Animal and vegetable oils and fats export	(t-4), (t-8) .. (t-9)
S76	Chemical products export	(t-4)
S81	Goods imports, total	(t-4)
S87	Crude materials, except fuels import	(t-4) .. (t-8)
S88	Mineral fuels and lubricants import	(t-4) .. (t-8)
S90	Chemical products import	(t-4)
S92	Machinery and transport equipment import	(t-8)
S95	Unconsolidated revenues of state, county and municipal budgets	(t-4)
S105	Money M1	(t-4) and (t-12)
S106	Money M1a	(t-2)
S107	Broadest money M4	(t-4)
S109	Reserve money	(t-5) and (t-8)
S112	Time and Sav. Deposits with Dep. Money Banks, in dom. currency	(t-4) and (t-9)
S113	Time and Sav. Deposits with Dep. Money Banks, in for. currency	(t-4) .. (t-6)
S114	Time and Sav. Deposits with Dep. Money Banks, in for. currency – households	(t-4) .. (t-7)
S115	Time and Sav. Deposits with Dep. Money Banks, in for. currency – enterprises	(t-4) .. (t-7)
S116	Deposit Money Banks' Claims	(t-7) .. (t-9)
S123	Reserves on time and notice deposits	(t-6) and (t-8)
S136	Money market rate, daily	(t-5) and (t-7) .. (t-8)
S146	Revenues from Tax on goods and services	(t-5)
S155	Revenues from excise on imports of motor vehicles	(t-4) and (t-8) .. (t-9)
S157	State budget expenditures, total	(t-4)
S159	Expenditures on gross wages and salaries	(t-4) .. (t-5) and (t-8) .. (t-10)
S164	Capital Expenditure	(t-4) .. (t-7)
S165	Surplus/Deficit of the State budget	(t-5) .. (t-6) and (t-9) .. (t-10)

Source: Bacic et al., 2004