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Redefining the Croatian Economic Sentiment Indicator

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***Abstract*—**Based on Business and Consumer Survey (BCS) data, the European Commission (EC) regularly publishes the monthly Economic Sentiment Indicator (ESI) for each EU member state. ESI is conceptualized as a leading indicator, aimed ad tracking the overall economic activity. In calculating ESI, the EC employs arbitrarily chosen weights on 15 BCS response balances. This paper raises the predictive quality of ESI by applying nonlinear programming to find such weights that maximize the correlation coefficient of ESI and year-on-year GDP growth. The obtained results show that the highest weights are assigned to the response balances of industrial sector questions, followed by questions from the retail trade sector. This comes as no surprise since the existing literature shows that the industrial production is a plausible proxy for the overall Croatian economic activity and since Croatian GDP is largely influenced by the aggregate personal consumption.

***Keywords*—**Business and Consumer Survey, Economic Sentiment Indicator, Leading Indicator, Nonlinear Optimization with Constraints.

I. Introduction

ECONOMIC Sentiment Indicator (ESI) is a composite leading indicator aimed at expressing the overall economic climate in the national economy. It is now calculated and regularly published (at the monthly level) in all EU member states. ESI is calculated on the basis of Business and Consumer Survey (BCS) responses to 15 questions from the industrial sector, retail trade, construction, services and the consumer sector. Each of the 15 analysed response balances is weighted according to the relative share of its corresponding sector in the GDP of the observed country. Currently, on the EU level, the European Commission applies the following weights: industry (40%), services (30%), consumers (20%), construction (5%) and retail trade (5%), while individual questions in the same sector have equal weights. This kind of weighting scheme should obviously be permanently updated according to the observed changes in the structure of national economies. However, this is not the case. As a result of that, [9] reveals ESI's relatively bad performance in forecasting the industrial production in 15 old EU member states.

This paper aims to propose an alternation of the officially employed weighting scheme in order to obtain a novel ESI, characterized by somewhat different structure and perhaps better leading indicator qualities. With that in mind, the weights are chosen by maximizing the correlation coefficient between ESI and Croatian year-on-year GDP growth using nonlinear programming. The same procedure is repeated for one to twelve months lagging time between ESI and GDP. Namely, ESI is introduced as a leading indicator whose movements should proceed to the dynamics of GDP. Using this alternative weighting scheme much better predictive characteristics are obtained, resulting in considerably higher correlation coefficients for all observed lags.

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II. Literature Review

Although the BCS have significantly gained in significance over the last decades, empirical research on their predictive accuracy is still quite vague. Nevertheless, there are some papers on "leading" qualities of BCS composite indicators, mostly dealing with European countries. A brief literature review is given in Table I.

TABLE I
Literature Review

Study	Country	Estimation method	Obtained conclusions
Gayer [8]	Euro area	VAR model	ESI Granger-causes GDP growth by 4 quarters; Out of the analysed leading indicators, ESI adds the most to GDP.
Silgoner [11]	Euro area	VAR model; Panel OLS	All of the BCS indicators (expert the retail trade confidence indicator); Forecast for new member states (NMS) generate lower RMSE than those of old member countries (OMS).
Van Arle and Kappler [15]	Euro area and USA	VAR model	ESI shocks effectuate positively in retail trade and industry production; the effect on unemployment is negative.
Sorić, Škrabić and Čižmešija [13]	EU NMS and OMS	Panel; VAR model	BCS indicators precede actual economic movements by one year ahead; NMS and OMS BCS indicators are of the same quality.
Čižmešija and Sorić [6]	Croatia	VAR model	ESI precedes GDP by one year ahead and private consumption by two quarters ahead.

Just a glance at Table I reveals several intriguing inferences. First of all, literally all of the highlighted references examine the officially published Economic Sentiment Indicator (ESI) (both for the European countries and the USA). None of the mentioned papers make an effort to alter the weighting structure of ESI and in that way enhance its predictive characteristics. Namely, a uniform conclusion is brought about that ESI can explain future movements of the real economy for up to one year (four quarters) ahead. This is also founded in the sole formulation of BCS questions, which are aimed to express agents' opinion on the year-on-year changes in the economic system. Ultimately, it would be quite illusory to

expect that today's' shock in economic sentiment would significantly feed into the real economy in the medium or long run. The primary purpose of BCS analysis is strictly short run forecasting. This paper therefore does not aim to obtain a novel ESI indicator that would proceed to GDP by more than one year. On the contrary, the goal of this paper is to obtain new weights for the BCS balance of responses officially defined as ESI components [7]. To be more specific, the weights are chosen here in order to maximize the correlation coefficient of ESI and GDP growth for different lead times (up to 12 months ahead). The expected outcome is a more suitable, new ESI indicator, which should provide more timely information on the changes in the national economy and represent its (constantly changing) structure more realistically. Second, the vast majority of the aforementioned studies focus on the developed countries. As opposed to that, this paper relies on Croatian data. Since Croatia is recording a negative GDP growth rate for the 12th consecutive quarter in 2014 Q4, as such it is among the worst economic performers in the history of modern Europe. This highly necessitates a leading indicator which could provide timely information to the Croatian policy holders and give them more time to appropriately respond to any shock in the economic system.

III. Methodological Issues and Data Set

ESI is a composite indicator based on BCS survey results from five surveyed sectors: manufacturing industry, services, construction and retail trade, as well as for consumers. EU ESI is based on qualitative variables, but the similar composite OECD indicator includes qualitative and quantitative statistical series [10]. For all of these five sectors, individual confidence indicators are calculated as simple arithmetic averages of the (seasonally adjusted) balances (in percentage points) of answers to the selected questions in each individual survey. Variables included in the industrial confidence indicator are: production expectations, order books and stocks of finished products (the last with an inverted sign). Variables in the services confidence indicator are the business climate, recent and expected evolution of demand. The consumer confidence indicator includes four variables: the financial situation of households, the general economic situation, unemployment expectations (with an inverted sign) and savings, all over the next 12 months. The retail trade confidence indicator comprises the present and future business situation and stocks (the last with inverted sign). Lastly, the two variables included in the construction confidence indicator are order books and employment expectations. Detailed review of the ESI components and all other variables in BCS are presented in [7].

ESI is composed out of the 15 variables (x_j) included in five individual confidence indicators. Variables of stocks of finished products, unemployment expectations and stocks in retail trade are inversely correlated with the reference series (GDP). Therefore they are included in ESI calculation with the inverted sign.

In accordance with the Joint Harmonised EU programme of Business and Consumer Surveys, ESI components are weighted as follows: industry 0,4; services 0,3; consumers 0,2; construction 0,05 and retail trade 0,05 [7]. These weights are applied to the standardised individual variables components (y_j). The standardisation is conducted over a frozen sample to avoid monthly revisions of the index, as in (1) and in (2).

$$y_{j,t} = \frac{x_{j,t} - \bar{x}_j}{s_j};\ \forall j = 1,2,...,15;\ t = 1,2,...,n \tag{1}$$

$$\bar{x}_j = \frac{1}{T'}\sum_{t=1}^{T'} x_{j,t};\ s_j = \sqrt{\frac{1}{T'-1}\sum_{t=1}^{T'}\left(x_{j,t} - \bar{x}_j\right)^2}\ . \tag{2}$$

where T', is the number of observations in frozen sample (period). EC defines the frozen period for all EU member states as January 1990 - December 2013 (when applicable). For Croatia, consumer survey questions start with May 2005 and all other series with May 2008. Therefore in Croatia T'=116 for the consumer survey data and T'=80 for all other sectors.

According to EC methodological guidelines, all questions in the same sector have equal importance. Therefore the corresponding weights are calculated as a ratio of the sectoral weight and the number of questions making up the related confidence indicator. The weighted average z_t of individual standardized response balances is then calculated, as in (3).

$$z_t = \frac{\sum_{j=1}^{15} w_j \cdot y_{j,t}}{\left(\sum_{j=1}^{15} w_j\right)_t};\ t = 1,2,...,n \tag{3}$$

The weighted average z_t is then scaled to have a long-term mean of 100 and a standard deviation of 10, as in (4) and in (5).

$$ESI_t = \left(\frac{z_t - \bar{z}}{s_z}\right)\cdot 10 + 100;\ \ t = 1,2,...,n \tag{4}$$

$$\bar{z} = \frac{1}{T'}\sum_{t=1}^{T'} z_t,\ s_z = \sqrt{\frac{1}{T'-1}\sum_{t=1}^{T'}\left(z_t - \bar{z}\right)^2} \tag{5}$$

If the recorded value of ESI exceeds 100, the prevailing economic sentiment in the national economy is above average, and if ESI is less than 100, the economic sentiment is below average. With the assumption of approximated normality, for the standard deviation of 10, there are about 68% of the ESI values between 90 and 110 and about 95% of the ESI are between 80 and 120.

The sectoral weights used in ESI calculation are chosen according to two criteria: "representativeness" of the sector in question and tracking performance vis-à-vis a reference variable (e.g. GDP growth). Nevertheless, the weights are chosen completely arbitrarily. Therefore one may certainly

raise a question of whether is possible to obtain "new" weights that increase ESI's tracking performance (measured by the Pearson's correlation coefficient).

The corresponding optimization problem, as in (6) is defined as maximization of the correlation coefficient for prognostic horizons of up to 12 months $h \in \{0,1,2,...,12\}$. Since ESI is a nonlinear function of weights $w_1,...,w_{15}$, a nonlinear optimization with constraints (augmented Lagrangian algorithm) is used for obtaining optimal weights.

$$\max_{\substack{w_1,...,w_{15}\in[0,1] \\ w_1+...+w_{15}=1}} Corr\left(ESI_t(w_1,...,w_{15}), GDP_{t+h}\right) \quad (6)$$

The analysed dataset comprises Croatian GDP (quarterly) year-on-year growth rates and monthly BCS response balances. The source of GDP data is Eurostat, while the source of BCS data is the European Commission.

In order to obtain an adequate number of GDP observations, a temporal disaggregation procedure of Chow and Lin, as in [5] is applied here to estimate monthly GDP growth figures. Due to space restrictions, the Chow and Lin method is not thoroughly explained here. It suffices to say that it is commonly used for the purpose of increasing the number of observations (and consequentially the number of degrees of freedom) at hand (as in [1], [2] or [3]). Croatian industrial production and retail trade volume are used as additional regressors, both series, being obtained from Eurostat.

IV. Empirical Results

The obtained new ESI is graphically compared to the official one (ESI_EC) and the GDP growth rate in Fig. 1. ESI_EC and ESI diverge the most during the Great Crash of 2008 and 2009, while latter on the two series exhibit similar time dynamics. It will therefore be interesting to observe whether this newly proposed weighting scheme adds any value to ESI's predictive characteristics. The results obtained by applying model (6) are presented in Table II.

It is obvious from Table II that the variable Q4 of the industrial sector survey (related to the stock of finished products) has the largest weight for most lagging times. The second best individual component is the retail trade variable Q2 (again related to stock volume). Also, comparing the obtained correlation coefficients for the official and new ESI, it is striking by how much the new ESI dominates over the old one. For example, alternating the ESI weighting structure for the time lagging of 5 month raises the obtained correlation coefficient by as much as 32 times.

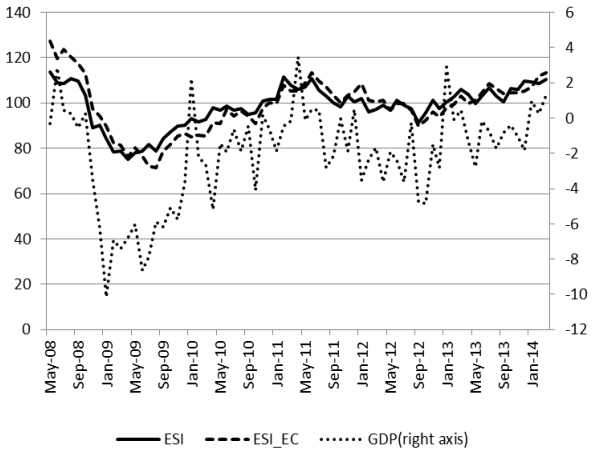

Fig. 1 Graphical presentation of the observed time series

TABLE II
Nonlinear Optimization Results

Variable/Lagging time	0	1	2	3	4	5	6	7	8	9	10	11	12
Industry Q2	0.01	0	0	0	0	0	0	0	0	0	0	0	0
Industry Q4	0.25	0.33	0.39	0.28	0.78	0.51	0.53	0.33	0.32	0.57	0.27	0.31	0.17
Industry Q5	0.43	0.34	0.44	0	0	0	0	0	0	0	0	0	0
Services Q1	0	0	0	0	0	0	0	0	0	0	0	0	0
Services Q2	0	0	0	0	0	0	0	0	0	0	0	0	0
Services Q3	0.21	0.23	0	0.30	0.02	0	0	0	0	0	0	0	0
Consumers Q2	0	0	0	0	0	0	0	0	0	0	0	0	0
Consumers Q4	0	0	0	0	0	0	0	0	0	0	0	0	0.02
Consumers Q7	0	0	0	0	0	0	0	0	0	0	0	0	0
Consumers Q11	0	0	0	0	0	0	0	0	0	0	0	0	.05
Building Q3	0	0	0	0	0	0	0	0	0	0	0	0	0
Building Q4	0	0	0	0	0	0	0	0	0	0	0	0	0
Retail Q1	0	0	0	0	0	0	0	0	0	0	0	0	0
Retail Q2	0.10	0.10	0.17	0.42	0.20	0.49	0.47	0.67	0.68	0.43	0.73	0.69	0.76
Retail Q4	0	0	0	0	0	0	0	0	0	0	0	0	0
$Corr(ESI_t, GDP_{t+h})$	0.81	0.78	0.74	0.66	0.60	0.64	0.60	0.55	0.47	0.36	0.40	0.30	0.34
$Corr(ESI\_EC_t, GDP_{t+h})$	0.71	0.64	0.49	0.33	0.17	0.02	-0.16	-0.20	-0.29	-0.36	-0.39	-0.45	-0.41

V. Conclusion

Several intriguing conclusions can be drawn from this research. Firstly, Croatian GDP can best be forecasted using data from industrial and retail trade BCS. Two opposite trends are observed here: the relative influence of industrial questions diminishes with the enhancement of lagging time, while the retail trade indicators gain in significance over time. Secondly, this in a way reflects the functioning mechanism of the Croatian economy and comes as no surprise. Namely, several previous studies have shown that the industrial production best describes Croatian GDP [4]. Also, the dominance of retail trade as a determinant of Croatian GDP is likewise intensely accentuated in the literature [12] and in all the paper cited there. Thirdly, what strikes as the most peculiar result is that the construction sector records zero weights for all lagging times. Considering the strong interdependency of the overall Croatian economy and the construction sector [14], this is a rather strange result (although it seems extremely robust). Perhaps this can be best explained by methodological flaws in conducting the surveys (small samples and low response rates, for details as presented in [13]).

To conclude, this paper has certainly opened a new niche of BCS research in Croatia. Several sectoral surveys have proven to be non-significant in predicting GDP growth and should be therefore be considered for revision or complete elimination from ESI calculation. Also, it is now obvious that some kind of novel, alternative weighting scheme is needed for ESI to be able to predict GDP more accurately.

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