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Confidence indicators analysis in the context of Romanian and European economy

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Abstract

The aim of this paper is to analyze the hypothesis according to which industrial confidence indicator is affected by the reference series from the economic sector represented by the industrial production index and at the same time bears the stamp of other national, European and world macroeconomic indicators. We analyse the correlation and causality between the industrial confidence indicator and macroeconomic indicators. For the identified factors, we elaborate models of multivariate classical and discrete regression that explain the formation of confidence in industry. Pursuant to the results obtained, the industrial confidence indicator of Romania is more strongly influenced by the reference series at EU (27) level, as compared to the series registered at national level.

Keywords: Logit model, causality tests, multicollinearity, confidence survey indicators, macroeconomic indicators;

1. Introduction

Business and consumer survey (BCS) offer important information for the short - term forecasting and economic researches. The data obtained from these surveys rely on managers' and consumers' perception in terms of the evolution of their environment and present the advantage of being available before the official statistic data.

In the specialized literature, there are numerous papers that mainly focus on the prognosis of fluctuations from the economic activity by means of confidence indicators. Thus, Brunco and Malgarini (2002) test the predictive capacity of confidence indicators for the reference series from industry, retail trade, constructions and consumption by using a dynamic factor model. The relationship between the industrial confidence indicator and the industrial production index have also been studied by P. Bengoechea and G.P. Quiros (2004), who proposed a new methodology for dating the business cycle in the euro area economy by means of industrial confidence indicator considered as a key variable in the identification of the current and future states of the euro area economy. Other important researches in this field have been carried out by J. Vanhaelen, L. Dresse (2000), P. Hüfner and M. Schröder (2002), J. Goggin (2008).

In this paper, we intend to analyse in reverse the relationship between the industrial confidence indicator and macroeconomic indicators, meaning that we intend to identify the influence that the economic climate has over the formation of confidence in industry. The economic climate at national, European or world level is represented by

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the following macroeconomic indicators: the industrial production index, the index of consumer prices, the unemployment rate, the official interest rate, and reference basket of crudes.

The identification of factors contributing to the formation of confidence indicator is made by correlation analysis and Granger-causality tests (Granger, 1969). The identified factors are used to elaborate some models of linear and Logit regression and that explain the formation of industrial confidence indicator.

The analysed data correspond to the interval January 2005 – November 2011 and they have been taken over from Eurostat, European Commission – DG ECFIN and OPEC sites. The choice of the starting moment of the analysed period is justified by ensuring the comparability of data in time, knowing that in 2005 they brought some modifications to the methodology on data collection and processing imposed by the harmonization process at the European Union level. Data processing is made using SPSS 17.0 software.

2. Methodology and date

2.1. Description of the data

Confidence indicators represent aggregated indicators calculated by the European Commission - DG ECFIN based on the data collected via Business and Consumer Surveys by the National Institutes of Statistics of Member States and of the candidate countries. The business and consumer surveys are carried out for the following sectors of economy: manufacturing industry, building, retail trade and services. Consumer surveys are conducted among consumers. The national institutes of statistics process the data representing the answers afferent to the questions from questionnaire under the form of conjunctural balances calculated as the difference between the share of answers estimating/appreciating positive and negative evolutions, respectively.

Discretization of industrial confidence indicator, necessary to apply Logit model, is made in relation with the significance of this indicator. Conjunctural balances on which confidence indicators are created indicate only the sense of changes from the economic activity, so that it may be useful to treat these variables as binary variables with variants: *stability – decrease*, for values of confidence lower or equal to 0 (code 0) and *increase*, for values of confidence higher than 0 (code 1).

In this paper, the industrial confidence indicator will be treated as a continuous numerical variable, symbolized by CII, in case of linear regression analysis, and as a binary variable, symbolized by CII_binary, in case of Logit model. The factors influencing the formation of the confidence indicator are macroeconomic indicators registered at the level of Romania, the EU (27) and at world level: industrial production index (IPI_RO and IPI_EU), consumer price index (IPC_RO and IPC_EU), unemployment rate (RS_RORO and RS_EU), official interest rate of Romania (RD_RO), and OPEC Reference Basket (OB).

2.2. Data analysis

The identification of the macroeconomic indicators contributing to the formation of CII shall be made using Pearson’s correlation coefficient and Granger and Toda Yamamoto causality tests.

The most common way to test the causal relationships between two variables is the Granger-causality proposed by Granger (1969). The Granger causality is limited by the assumptions on the exclusive dependency by respect to the observed variables, and on the linearity and stationarity of variables (Chirilă et. al. 2011).

To apply of the causality tests we folloe several steps: i) Formulation of the hypothesis according to which there is a long-run equilibrium relationship between variables; ii) Analysis of stationarity of considered variables by Augmented Dickey-Fuller test (ADF); iii) Testing the long-run equilibrium relationship based on the linear regression model between variables; iv) Analysis of stationarity of residuals of the regression model; v) Analysis of the Error Correction Model (ECM); vi) If, according to the results from the previous stages, variables are cointegrated, we shall apply Granger causality test. If variables are not cointegrated, we shall apply Toda-Yamamoto test which relaxes the stationarity and cointegration hypotheses imposed by Granger test.

The variables exhibiting significant correlations and that are Granger cause for the confidence indicator are considered as predictors in the regression models that are to be identified. We estimate the linear regression models for which the hypotheses of autocorrelation, homoscedasticity, normality of the residuals and multicollinearity of independent variables are verified (Maddala, 2001). Logit model have the advantage of less restrictive hypotheses and are preferred to other non-linear models, such as Probit model, since their results are more easily interpreted (Aldrich et. al., 1992, p.49).

Given the interconditioning between economic variables, the multicollinearity phenomenon is present in the econometric modeling (Jula, 2010, pp. 164-166). In this paper, the analysis of multicollinearity of independent variables is made with Tolerance and Variance Inflation Factor, and Collinearity Diagnostics, using SPSS software. To solve multicollinearity, we eliminated some independent variables from the analysis.

3. Results

The first step of analysis consists in identifying the correlations between CII and the macroeconomic indicators studied. We may notice that CII is not correlated to IPI_RO ($r = -0.088,\ prob = 0.428$) and RS_RO ($r = -0.049,\ prob = 0.662$), but it is significantly correlated to IPI_EU ($r = 0.854,\ prob = 0.000$), RS_EU ($r = -0.419,\ prob = 0.000)$), RD_RO ($r = -0.285,\ prob = 0.009$), IPC_RO ($r = -0.490,\ prob = 0.000$) and IPC_EU ($r = -0.461,\ prob = 0.000$).

Testing causality is made by following the stages indicated at section 2.2 of the paper. The analysis of stationarity made by Augmented Dickey-Fuller test shows that all variables under analysis are nonstationary, integrated of order one, denoted I(1). Engle-Granger cointegration test has significant results for the variables designating the industrial production index of EU (27) and unemployment rate of EU (27). These two variables are cointegrated with the industrial confidence indicator (table 1): there is a significant linear relation between CII and the independent variable considered (column 2), according to ADF test, residuals are stationary (column 3), and ECM model is significant (column 4). Results may be interpreted as follows: i) in the case of IPI_EU, 20.4% from the shock produced in the current month shall be corrected next month and be completely absorbed after 5 months; ii) in the case of RS_EU, 15% from the shock shall be attenuated next month and the whole shock shall be absorbed in about half a year. According to Granger causality test, both variables are Granger cause for CII (table 1, column 5).

Table 1. Results of Granger- Causality test between CII and macroeconomic indicators

Variables	Test long run equilibrium relationship	ADF test for residuals	ECM	Granger causality test
1	2	3	4	5
CII and IPI_EU	$CII_t = -111.842 + 1.071\ IPI\_EU_t$ (0.000) (0.000)	*t = -3.622* *prob = 0.000*	$\Delta CII_t = -0.204\, resid_{t-1} + 0.838\ \Delta IPI\_EU_t$ (0.002) (0.000)	$prob_{IPI\_EU/CII} =$ 0.0003
CII and RS_EU	$CII_t = 20.886 - 2.836\ RS\_EU_t$ (0.000) (0.000)	*t = -2.065* *prob = 0.038*	$\Delta CII_t = -0.150\, resid_{t-1} - 10.57\ \Delta RS\_EU_t$ (0.001) (0.000)	$prob_{RS\_EU/CII} =$ 0.0007

Note: The values under the regression coefficients represent the probability attached to the calculated value of the Student statistics.

For the macroeconomic indicators that are not cointegrated with CII, we apply Toda-Yamamoto causality test supposing the identification of the optimal length of the lag (*k*) for the VAR model and the application of Granger causality test for VAR model of order $p = d + k$, where d represents the maximum integration order of the two variables, in our case $d = 1$. Significant results indicating the cause factors for CII are given in table 2.

Table 2 Results of Toda-Yamamoto test between CII and macroeconomic indicators

Variable	Optimal lag length (*k*)	$p = d + k$	Wald test (probability)	Decision
CII and IPI_RO	5	*6*	prob = 0.012	H_0 **is rejected**
CII and RD_RO	1	2	prob = 0.001	H_0 **is rejected**

CII and RS_RO	1	*2*	prob = 0.029	H_0 **is rejected**
CII and OB	3	*4*	prob = 0.019	H_0 **is rejected**

Taking into account the results above and the fact that IPI_EU and RS_EU comprise the information supplied by IPI_RO and RS_RO, the following independent variables are considered in the identification of regression models: IPI_EU, RS_EU, RD_RO, OB.

We test collinearity of independent variables by estimating the linear regression model in relation with the dependent variable CII using SPSS software (table 3). The last two values of Condition Index are high, Eigenvalue has values tending to 0, and VIF values equal to 5.5996 and 5.515 are high for a weak model as Logit model. In conclusion, we accept the hypothesis of collinearity of the variables under analysis and we decide the elimination of RS_EU and RD_RO variables from the analysis.

Table 3 Results of Collinearity Analysis

	Collinearity Statistics		**Collinearity Diagnostics**		
Variables	**Tolerance**	**VIF**	**Dimension**	**Eigenvalue**	**Condition Index**
Constant			1	4.802	1.000
IPI_EU	0.181	5.515	2	.127	6.152
RS_EU	0.167	5.996	3	.059	8.988
RD_RO	0.345	2.896	4	.011	20.694
OB	0.794	1.260	5	.000	175.863

We estimate a multiple linear regression model depending on variables IPI_EU and OB. The coefficient of determination is statistically significant ($prob = 0.000$) and shows that 75% from the total variation of the dependent variable CII is explained by the specified regression model. The regression coefficients are statistically significant and the equation is:

$$CII = -114.416 + \underset{(0.000)}{1.130} IPI\_EU - \underset{(0.019)}{0.048} OB .$$

We verify the normality, autocorrelation and homoscedasticity hypotheses of regression errors. We apply Kolmogorov-Smirnov test and we obtain $prob = 0.584$, so errors are normally distributed for the significance level $\alpha = 5\%$. The hypothesis of autocorrelation error is verified by Durbin – Watson test, and we obtain $dw = 0.379$, with $d_L = 1.600$ and $d_U = 1.696$. In conditions of a significance level of 5%, we decide that regression errors are positively autocorrelated.

In conclusion, the multiple linear regression model may not be validated.

We estimate Logit model for CII_binary depending on IPI_EU and OB. The results obtained indicate a good adjustment of the dependent variable, the total percentage of all correct adjustments being 85.5%, with only 4 cases of false positive and 8 cases of false negative. The values of pseudo-R^2 indicators are satisfactory: Cox & Snell R Square = 0,486, Nagelkerke = 0.649. The regression coefficients are statistically significant, according to Wald test. (table 3).

Table 3 Coefficients of the Logit model

Predictors	β **(Coefficient)**	**Std. Error**	**Wald statistic**	**Prob.**	**Exp(** β **)**
IPI_EU	0.461	0.097	22.512	0.000	1.585
OB	-0.057	0.016	13.248	0.000	0.945
Constant	-42.795	9.434	20.576	0.000	0.000

The equation of Logit model is:

$p_i = P(Y_i = 1) = e^{Z_i} / (1 + e^{Z_i})$, $\ln[p_i / (1 - p_i)] = Z_i = -42.795 + 0.461 \cdot IPI\_EU - 0.057 \cdot OB$.

As we expected, in Logit model IPI_EU has the greatest importance in explaining the formation of CII_binary.

Conclusion

The literature offers numerous papers which study the use of confidence indicators in short-term forecasting and economic researches. In this paper, we applied the approach in reverse trying to identify the factors contributing to the formation of industrial confidence indicator of Romania.

The obtained results showed some discrepancies for Romania in relation with the hypotheses of the methodology of confidence indicators and the results of other papers previously published on this topic. Thus, contrary to expectations, the correlation tests showed that in Romania confidence in industry is not correlated to the reference series represented by the industrial production index or other important macroeconomic indicators, such as the unemployment rate or the index of consumer price. But the causality tests established that the industrial production, the official interest rate and the unemployment rate are Granger-causes for the confidence indicator. The most important contribution to the formation of the industrial confidence coefficient is brought by European and world macroeconomic indicators, some of them being even cointegrated with the confidence in industry in Romania: IPI_EU, RS_EU and OB.

Although the number of factors was higher, violation of the multicollinearity hypothesis limited the number of predictors from the regression models to only two: IPI_EU and OB.

Searching for a regression model that may explain the formation of the industrial confidence indicator highlighted the fact that the discrete regression models, though weaker than the classical regression models, and their results are more difficult to interpret, they have the advantage of some less restrictive hypotheses and, thus, they are easier to apply. The classical linear regression model built for IPI_EU and OB was not validated since it did not comply with the hypotheses of classical regression. The binary transformation of the industrial confidence coefficient allowed for the identification of a significant Logit model. According to the results of the correlation and causality tests, the estimated values of regression coefficients for Logit model showed that IPI_EU factor has the largest contribution in the explanation of confidence in industry.

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