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INTERDEPENDENCE BETWEEN THE STEEL CASTINGS AND MANUFACTURE OF MACHINES AND EQUIPMENT

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Starting from the fact that the metallurgical industry is the main supplier of raw material both for the equipment and machines industry, as well as for the car industry, this paper analyses, by means of the regression function, to what extent the quantity of casting of steel was influenced, on the one hand by the manufacture of machines and equipment, and on the other hand, by the manufacture of car body. Data subject to the study were related to the period January 2002 – June 2016 (174 months) and was conducted both at the level of the European Union, as well as at the level of the main countries manufacturing steel at its level, namely: Germany, Italy, France and Spain.

Key words: metallurgical industry, steel casting, manufacture, machines and equipment.

INTRODUCTION

Nowadays, steel is one of the most important materials in the world, almost everything around us being made of steel.

It is used for building roads, railways, buildings, bridges, pipes for gas, water and sanitation, but also for building fabrics, machines and not only [1]. According to the conducted studies, averagely, 900 kg of steel are used for building a vehicle and the total quantity annually used by the automobiles segment is of about 80 million tons of steel [2].

In this context, the research purpose is to establish the interdependence between the achieved quantity of cast steel and the manufacture of equipment and machines, but also cars bodies, trailers and semi-trailers, both for the main steel manufacturing countries within the European Union (EU), and for UE.

USED METHOD AND DATA BASIS

The conducted study aimed the period January 2002 – June 2016, and data subject to the research were taken from the data basis Eurostat [3], building influence patterns specific for the four analyzed countries (Germany, Italy, France and Spain), but also for EU [4], by means of the regression function [5]. The analysis includes, for each analyzed subject, a number of 174 observations, the used data being monthly taken and are expressed in value indices whose reference value is the year 2010 [3]. Data were processed using the software IBM SPSS [6].

The patterns' building has been started from the evolution of the indices concerning the quantity of cast steel (ICS), the machines and equipment manufacture indices (IME) and the car bodies manufacture (coachwork) for motor vehicles, trailers and semi-trailers (IBV), for each pattern the dependent variable being ICS and the independent variables (Vi): IME and IBV. Additionally, before building the pattern it has been verified if between the independent variables there is collinearity for each country separately and EU, reason for which it is calculated the factor of the variation inflation (VIF) for each of the two independent variables IME and IBV (Table 1).

Table 1 **Establishing VIF / 2002 – 2016* [2]**

Country	VIF	Country	VIF
Germany	2,086	France	4,172
Italy	4,209	Spain	3,964
EU	2,269		

Legend: 2016* - date for the first six months

The VIF value lower than 5 indicates that IME and IBV are not are not influencing each other, reason for which the two independent variables may be included together in the project. The genera form of the proposed pattern, from which the analysis starts, is the following:

$$ICS_i = \beta_0 + \beta_1 IME_i + \beta_2 IBV_i \quad (1)$$

where β_0, β_1, β_2 are the pattern coefficients, i – the value of the variables at the moment t.

TESTING THE VALIDITY OF PATTERNS INCLUDING THE VARIABLES ISC, IME AND IBV

For testing the validity of patterns, it will be calculated the value of the parameters and of the random variable and tested the statistical power, choosing a confidence level $\alpha = 0,05$. Thus, it will be calculated the statistical coefficients (Cs), represented by the simple correlation coefficient (R) and the coefficient of deter-

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mination (R^2) for the pattern related to each country, for calculating percentage with which IME and IBV influence ICS (Table 2). From the analysis of the data it result that R has, for each built pattern, a value of over 0,50, meaning that there is a strong relation between the dependent variable ICS and the independent IME and IBV. In case of Spain is good relation between the dependent variable because R is under 0,50.

Table 2 **Regression statistics / 2002 – 2016* [2]**

Cs	Value				
	Germany	Italy	France	Spain	EU
R	0,741	0,867	0,873	0,436	0,782
R^2	0,549	0,751	0,762	0,190	0,612

Legend: 2016* - date for the first six months

But, deeply analyzing the relation between these variables by means of the coefficient R^2, it may state that during the period January 2002 – June 2016 in EU 61,2 % of the quantity of cast steel was influenced by the manufacture of machines and equipment and by the manufacture of car bodies, trailers and semi-trailers. Among the analyzed countries the greatest influence was registered in France where the percentage was of 76,2 %, followed by Italy with 75,1 %, Germany with 54,9 % and Spain with 19,0 %. The value of the standard error calculated using the application IBM SPSS [6], for each of the built patterns is of 12,257 for the European Union, 11,177 for Germany, of 17,043 for France, of 15,287 at the level of Italy and of 23,402 for the Spain pattern. In order to test the patterns using the F test (F) the analysis based on the ANOVA table shall be used (Table 3).

Table 3 **Analysis using F test / 2002 – 2016* [2]**

Country	Fv	Country	Fv
Germany	103,981	France	273,396
Italy	258,064	Spain	20,064
EU	134,838		

Legend: 2016* - date for the first six months

Thus, from the analysis of the results obtained after using the F test, correlated with the possible critical value of F (Fcv) which is 3,0479 (value taken from the Table of F Function), it may be said that the Fcv is smaller than calculated value of F (Fv). It result that the null hypothesis is rejected in the favor of the alternative one for each country separately and for EU. Additionally, the proposed model may be tested (Table 4) by means of a student t test (t).

Table 4 **Analysis using t test / 2002 – 2016* [2]**

Vi	Value t				
	Germany	Italy	France	Spain	EU
IME	2,294	11,792	3,607	2,987	4,315
IBV	8,202	– 0,831	8,166	0,222	7,292

Legend: 2016* - date for the first six months

From the comparison of the calculated values (t) in the Table 4 for the t test with the critical values of this indicator is 1,6537 taken from the t distribution tables, it results that for EU the calculated values of the test area greater than the critical value, resulting that the pattern is different from the null value and, therefore, it may be used for establishing ICS knowing IME and IBV. The same may be noticed for Germany and France, but, in case of Italy and Spain one of the parameters of the independent variables has the value smaller than the critical value, resulting that the null hypothesis in their situation may not be accepted, but it shall notice that the parameter of the other indicator is greater and, therefore, the two patterns are different from the null value.

For verifying the hypothesis of errors independency it will be calculated the value of the Durbin-Watson variable (DW), date being presented in Table 5.

Table 5 **Analysis using DW / 2002 – 2016* [2]**

Country	DW	Country	DW
Germany	1,068	France	0,695
Italy	1,493	Spain	1,523
EU	1,138		

Legend: 2016* - date for the first six months

The obtained values shall be compared with the critical values DWlower = 1,72879 and DWupper = 1,77526 taken from the Durbin-Watson distribution table for n = 174 and k = 3. It may be noticed that the calculated value is lower than DWlower, resulting a positive autocorrelation of errors, and thus, the rejection of the null hypothesis.

After testing the patterns it results that they are statistically significant, so the quantity of cast steel is positively influenced both by the machines and equipment manufacture, as well as by the manufacture of cars bodies, trailers, semi-trailers, influence which is valid both at the level of EU, as well as at the level of the four analyzed countries.

BUILDING PATTERNS SHOWING THE INTERDEPENDENCE BETWEEN ICS, IME AND IBV

Based on the equation (1) it will be shown to what extent each indictor (IME and IBV) influences ICS. Thus, further (Table 6) it will be determined the value of the pattern coefficients (C) and the range from which they take values, using the software IBM SPSS [6].

Table 6 **Coefficients value / 2002 – 2016* [2]**

C	Germany	Italy	France	Spain	EU
β_0	38,995	– 6,379	–1,491	51,510	19,880
β_1	0,187	1,166	0,424	0,423	0,442
β_2	0,401	– 0,031	0,555	0,015	0,380

Legend: 2016* - date for the first six months

From the analysis of the previously calculated coefficients it results that both for EU and each country subject to the study, it may build econometric patterns. For Germany, the pattern has the following form:

$$ICS = 38,995 + 0,187\ IME + 0,401\ IBV \quad (2)$$

From the equation (2) it can be seen that when changing the IME by one unit, ICS shall be changed by 0,187 units, and when changing IBV by one unit, ICS shall be changed by 0,401 units. From the conducted calculations [6], the β_1 coefficient related to the IME variable takes values from the range [0,026; 0,348], and β_2 coefficient related to the IBV variable takes values from the range [0,304; 0,497]. For Italy, the pattern is:

$$ICS = -6,379 + 1,166\ IME - 0,031\ IBV \quad (3)$$

The equation (3) shows that when changing IME by one unit, ICS shall be changed by 1,166 units, and when changing IBV by one unit, ICS shall be changed by – 0,031 units. The β_1 coefficient related to the IME variable takes values from the range [0,971; 1,361], and the β_2 coefficient related to the IBV variable takes values from the range [– 0,104; 0,042], according to the calculations made by means of the used software [6]. For France, the built pattern is:

$$ICS = -1,491 + 0,424\ IME + 0,555\ IBV \quad (4)$$

The coefficients related to the equation (4) show that when changing IME by one unit, ICS shall be changed by 0,424 units, and when changing IBV by one unit, ICS shall be changed by 0,555 units. Following the conducted calculations [6], the possible values of the pattern coefficients belong to the range [0,192; 0,657] for β_1 and the range [0,421; 0,690] for β_2. The pattern built at the Spain level has the following form:

$$ICS = 51,510 + 0,423\ IME + 0,015\ IBV \quad (5)$$

In this situation when changing IME by one unit, ICS shall be changed by 0,423 units, and when changing the IBV by one unit, ICS shall be changed by 0,015 units. The pattern coefficient takes values from the ranges: [0,143; 0,702] for β_1 and [– 0,115; 0,145] for β_2 [6]. For EU, the built pattern is:

$$ICS = 19,880 + 0,442\ IME + 0,380\ IBV \quad (6)$$

This time when changing IME by one unit, ICS shall be changed by 0,442 units, and when changing the IBV by one unit, ICS shall be changed by 0,380 units. In this model the IME and IBV coefficients take values from the range [0,240; 0,644] for β_1, namely [0,277; 0,482] for β_2 [6]. As at least one of the terms is different from 0, it results that the pattern is different from the null value and therefore, it may be used for determining ICS, knowing the value of IME and IBV, both for the four countries subject to the study, as well as at the level of EU.

CONCLUSIONS

The coefficients value proves in the five cases that there is a strong and positive interdependence between the indices of the cast steel quantity and the indices of the machines and equipment manufacture, but also those of car bodies, trailers, semi-trailers manufacture. After testing the patterns proposed for Germany, Italy, France, Spain and EU, results that they are correct form the econometric point of view, but it shall mention that in reality, not only the requirement of cast steel for the industry of manufacturing machines and equipment, but also for the industry of manufacturing care bodies influences the quantity of cast steel, as there is other industries using the steel. Additionally, it must be taken into account that a part of the steel is designed to the export both to EU countries and to non-EU countries. The patterns made for the period January 2002 – June 2016 showed that in Germany, Italy and France over 50 % of the quantity of cast steel was influenced by the manufacture of machines and equipment and by the manufacture of car bodies, trailers and semi-trailers, while in Spain the influence was of only 19 %, and at the level of EU of 61,2 %. At the same time, it must be retained that the patterns are based on data existing a certain period and in a certain space, and the values they shall take in the future are uncertain.

BIBLIOGRAPHY

[1] http://www.worldsteel.org, Sustainable steel. At the core of a green economy.
[2] http://www.worldsteel.org/Steel-markets/ Automotive.html – Automotive.
[3] http://ec.europa.eu/eurostat/data/database.
[4] Paliu-Popa L., Impact of the economic and financial crisis on the evolving trend of crude steel consumption, Metalurgija 55 (2016) 2, 267-270.
[5] Seber G.A.F., Lee A.J., Linear Regression Analysis, Second Edition, John Wiley & Sons Publication, Canada, New Jersey, 2003, pp. 36.
[6] Arbuckle J.L.,IBM SPSS Amos 19 User's Guide, Amos Development Corporation, IBM Corporation, USA, Chicago, 2010, pp. 221-229.

Note: The responsible translator for English language is A.L. Florea, Craiova, Romania