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ANALYSIS MODELS OF ROMANIA'S FOREIGN TRADE

Abstract. *It is acknowledged that export is one of the most important factors that determine the outcomes and the evolution of any national economy. A developed economy will be characterized by the observable effectiveness of its foreign trade. Due to its importance, the foreign trade is a major focus for statistical analyses. These analyses, using different methods with various degrees of complexity, outline the existence and the characteristics of the connection between the main phenomenon and its influence factors.*

This paper presents some models able to support the statistical analysis of the foreign trade. The linear model is one of the most reliable instruments for a single factor approach. For analyses based on more than one influence factor, the multiple regression can be applied. The articles includes a case study, revealing the main evolutions of the foreign trade key indicators, and the influences induced by the most relevant internal factors.

Key words: *export, resources, import, economic growth, welfare, development.*

JEL Classification: C01, C10

1. General aspects

Exports are a source of economical convergence, and the countries with an average development level and expansive exports record faster economic growth than the countries weakly oriented towards exports.

In Romania, there must be a close relationship between economic growth, investments and exports, between the three variables a co-integration relationship is established, exports and investments have a major influence on the increase of GDP, especially on long-term.

Due to gradual transition from centralized economy to market economy, the influence of international competitiveness on exports has manifested itself gradually. Applied to various intervals, the Granger causality test suggests the existence of a trend for the competitively influence.

The statistical study and analysis of the relationships between social-

economical phenomenon are realized with elementary (simple) methods that verify the existence and the shape of the relation between the recorded characteristics but also with methods that measure the statistical dependence and use a more complex mathematical apparatus.

The regression model assumes the study of the connection between variables with the help of a regression function, which has as theoretical model the equation $y = f(x_1, x_2, ...x_n)$, and as statistical dependency model (due to the random character of the economical-social phenomenon and processes) it has the equation $y = f(x_1, x_2, ...x_n) + e$, where y - the dependant variable; x - the independent variable; e - represents a random error (a residual variable). Depending on the number of factors ($x_1, x_2, ...x_n$) which influence the (y) characteristic, there can be distinguished: uni-factorial or simple regression, if the function includes one factor, multi-factorial or multiple regression, if the function includes more factors.

Among the uni-factorial regression models, the best known and used is the linear model (the link between x and y is linear), with the following theoretical model: $y = a + bx + e$.

The average trend equation is: $Y = a + bx$ or $y_x = a + bx$; where a , b are the quotients that are to be calculated, and Y or y_x is "y adjusted on the trend of x ". The parameters a , b have content of average and they are estimated with the help of the least squares method, which assumes that the sum of the squares of deviations between the empirical (real) values y_i and the theoretical (adjusted) values Y_i to be minimum, that is $\sum (y_i - Y_i)^2$ = minim. If Y_i is substituted, the relationship becomes $\sum (y_i - a - bx_i)^2$ = minim.

By derivation on a , b and annulations of the partial derivatives, the following equation system results:

$$\begin{cases} na + b\sum x_i = \sum y_i \\ a\sum x_i + b\sum x_i = \sum x_i y_i \end{cases}$$

where "n" represents the number of observed units, that is, the number of pairs (x, y)

Depending on the sign of the regression quotient, it is possible to appreciate the type of link: in case of direct correlation, the quotient has a positive value, for the inverse correlation its value is negative; when $b = 0$ it is considered that the two variables (x and y) are independent. In the correlation chart, the "b" quotient indicates the slope of the line.

The exactness of the calculated parameters of the regression function is realized if $\sum y_i = \sum Y_i$.

Between the economical-social phenomenon, there are complex links that are characterized by the influence of a great number of factors (independent variables) on the resultant characteristic (the dependant variable) and is expressed with the help of the multiple regression equation: $Y = f(x_1, x_2, ...x_n) + e$; where $x_1, x_2, ...x_n$ represent the independent or factorial characteristics and "e" is a residual variable, with constant dispersion and null average.

The most used multi-factorial regression model is the linear model, whose expression is given by the relation: $Y = a_0 + a_1x_1 + a_2x_2 +, ..., +a_px_p$; where a_0 - the quotient which outlines the influence of factors not included in the model and considered of constant action; $a_i, i = 1,2,....., p$ - represent the multiple regression quotients and show the weight that influences each "x" characteristic on the resultant characteristic "y".

The parameters $a_0, a_1, a_2, ...a_p$ are calculated based on the least squares method.

The regression quotients a_i can have either positive sign, either a negative one, and they show the type of link (direct or inverse) between the factorial variable x_i and the resultant variable y.

The correlation model expresses the intensity of the statistic links between two or more variables which follow a normal repartition. The indicators used are the co-variance, the correlation quotient, and the correlation ratio.

2. The estimation of variables and the validation of the econometric model. Test of the regression model significance

The parameters of the multiple regression model at the level of general collectivity are determined as estimators, based on the data at the level of sample. To determine the estimators, the least squares method or the maximum likelihood method is used.

In the application of the testing process for the statistical significance of model parameters, the following steps are performed: "the null and alternative hypotheses are defined; the repartition on which the test is performed, is set; the value of the standard statistical test (statistic) for the measure to whose the quality of estimation is appreciated; the table value of the standard variable, corresponding to the established repartition is fixed; the calculated value of the statistic is compared to the table one. Depending on the report between these two measures, the null hypothesis (H_0) is accepted or rejected."

If data comes from small-size samples $(n < 30)$, we use the „t" test for the Student repartition, for which the table values were calculated.

The t test is calculated according to the formula:

$$t = \frac{b_k - \beta_k}{se(b_k)}$$

where: b_k - is the quotient obtained from regression (estimated); β_k - is the test value of the quotient; $se(b_k)$ - the standard error for quotient.

If the value of the test is greater than the critical value (value from the Student repartition table, for the relevance level considered and the relevance degrees $T-k$), then the null hypothesis is rejected and the quotient is considered significant.

The econometrical software examine, by the t test, for each quotient, the null hypothesis, that is: the effect recorded if that quotient would be zero.

The null hypothesis of the test is $b_k = \beta_k$

If the probability associated is inferior to the level of relevance at which the work is conducted (1%, 5%, or 10%) then the null hypothesis is rejected and the quotient is considered to be significant fro the statistical point of view.

Estimation of the interval for a regression parameter is made based on the formula:

$$P\left(-t_c \le \frac{b_k - \beta_k}{se(b_k)} \le t_c\right) = 1 - \alpha$$

where:

t_c is the critical value of t for $T-k$ degrees of liberty and is read from tables.

The previous relationship can be represented as such:

$$P\left(b_k - t_c \cdot se(b_k) \le \beta_k \le b_k + t_c \cdot se(b_k)\right) = 1 - \alpha$$

To validate the model in its whole, as specified, we use the ANOVA analysis and the Fisher (F) test.

These are used to replace the step-by-step testing of the significance for the parameters of the regression model with the singular testing of the model as a whole, simultaneously testing the homoskedasticity hypothesis from the least squares method.

The R^2 determination quotient is calculated based on the decomposition of total dispersion in dispersion of values observed, from theoretical ones, and the dispersion of theoretical values from the average.

The determination shows how much from the total dispersion is explained by the variation of chosen factors and is calculated as ratio between the deviations of calculated values and total deviation.

$$R^2 = \frac{SSR}{SST} = \frac{\sum(\hat{y}_t - \bar{y})^2}{\sum(y_t - \bar{y})^2} = 1 - \frac{SSE}{SST} = 1 - \frac{\sum e_t^2}{\sum(y_t - \bar{y})^2}$$

where:

SSE - is the sum of squares of regression errors, which is the non-explicated part

by factors of influence, but only by accidental factors.

Multi-co-linearity is identified by using the Klein criteria (from the correlation matrix, the greatest $r_{x/x_{ji}}$ is read, if $R_y^2 < r_{x/x_{ji}}$, and then there is co-linearity).

The independence hypothesis of the factorial variables (VIF) is also verified by the calculation of the VIF indicator; it shows in what measure the dispersion in the data sample is strengthen by the presence of multi-co-linearity. For VIF < 6, the hypothesis of factors independence is confirmed, multi-co-linearity does not affect estimations.

The occurrence of the heteroskedasticity phenomenon is due to measurement errors, sampling strategies or incorrect data transformation.

Identification of heteroskedasticity will be realized on graphical mode, or with the help of the White test.

In this case, $\chi^2_{\alpha,k}$ [1] is calculated, if $\chi^2_{\alpha,k} > LM3$ the model is homoskedastic, if $\chi^2_{\alpha,k} < LM$, the model is heteroskedastic.

Due to the specificity of the phenomenon studied during the analyzed period, a period of mass restructuring, long unemployment intervals, with high fluctuations in the number of registered unemployed people, the hypothesis that residuals are not correlated can be invalidated with great probability, because self-correlation of the endogenous variable can generate the self-correlation of results, in time.

Another cause of error self-correlation can be the negligence of other independent factors with significant influence on the dependent factor.

The most used test in econometrics for the linear regression, applied to verify the self-correlation of errors is the Durbin – Watson (DW)test.

$$d_{calc} = \frac{\sum_{t=2}^{T} (\varepsilon_t - \varepsilon_{t-1})^2}{\sum_t \varepsilon_t^2} = 2\left(1 - r_{\varepsilon_t, \varepsilon_{t-1}}\right)$$

This test calculates the variable „ d_{calc} ", which will be compared to its table values. The null hypothesis (H_0) in the case of DW test will mean, "there is no self-correlation of errors ".

The definition domain for the variable d is included between 0 and 4, limit significance values (d - inferior, d - superior) being calculated in the hypothesis of normal repartition, published in tables for various degrees of

[1] $\chi^2_{\alpha,k}$ is calculated for a defined α, k represents the number of parameters from the errors model; LM has table values; as seen in V.Voineagu, E.Țițan et al – "*Teorie şi practică econometrică*", Meteor Press Publishing House, 2007

significance; if d is close to 0 or 4, then the hypothesis is considered denied; if the values of d are around 2, the self-correlation can be considered absent.

The hypothesis according to which the error (ε_i) follows the normal repartition law is verified with the help of JB test. The test involves the pre-determination of the asymmetric quotient (s) (skewness) and of the plan (k) (kurtosis) for the repartition of errors.

The level of the indicator $JB = n\left[\left(s^2/6\right)+\left(\left(k^2-3\right)^2/24\right)\right]$ is achieved, for which a correspondent is sought (the closest value) in the table of the χ^2 repartition for $df = 2$.

The specification errors can have negative effects when we wish to realize an analysis or prognosis of the studied phenomenon.

These errors can be sought or removed by including more variables, even if irrelevant, because the test will show that is insignificant, instead of neglecting an important influence, in these situations we can apply the DW test or Ramsey's RESET test.

Econometric theory and practice offers us a set of tests to choose the optimum variant from more regression models.

The AIC (Akaike) criteria is the most widely used to choose, from "m" variants, the variant with the highest precision degree.

$$AIC\left(m\right) = \ln\left(S\varepsilon^2/n\left(m\right)\right)+\left(2k\left(\left(m\right)/n\left(m\right)\right)\right)$$

It will be chosen the variant for which AIC has the minimum value. Other tests used to choose the optimum variant are based on the calculation of F, or R^2. In the situation in which contradictory information is achieved by using previous tests, the *J* test is applied.

The multiple regression is sensitive to the co-linearity of independent (explicative) variables. This co-linearity induces an accentuate instability of the values for the parameters resulted from regression, following the foul conditioning of the observation matrix (determinant almost null, reason for which the inverse matrix raises calculation problems). The same phenomenon occurs also in the case when we have a small number of observations, compared to the number of estimated parameters. The immediate impact of co-linearity manifests through the fact that regression does not longer allows the individualization of the separate effect of each sector variable, but on groups of dependent variables. Also, co-linearity can be tested by trying a regression only between the independent factors and observing that some of them depend on the others.

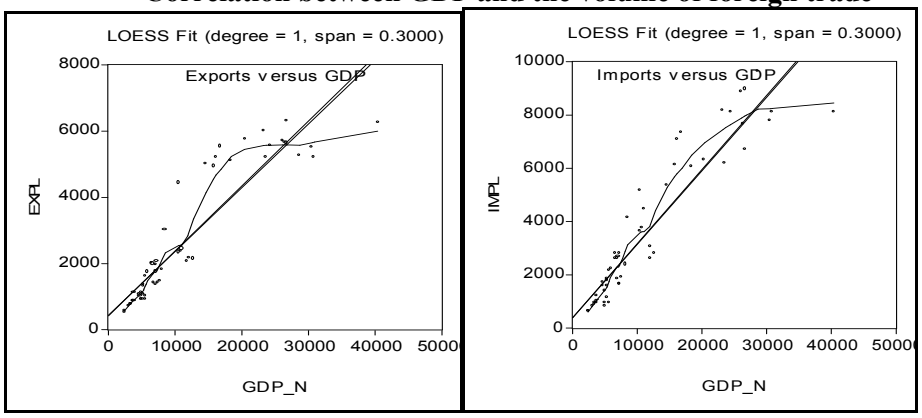
3. Structural models for the analysis of the foreign trade activity

The structure of imports and exports expresses the economic potential of a country and its development capacity. Meanwhile, a developed economy will have an effective regime of the foreign trade, which will stimulate the long-term growth for all economical activities. Due to this evident inter-dependency and to the reciprocal influence between foreign trade and economical development process,

commercial transactions must be analyzed through the optics of the most important economic factors that determine their evolution. The correlation between the volume of exports (respectively imports) and the economic activity, expressed by the level of GDP or by industrial production is evident. Exports and imports grow when a superior quantity of goods is produced in economy, external transactions are limited by the capacity of the economy to commercialize these goods abroad.

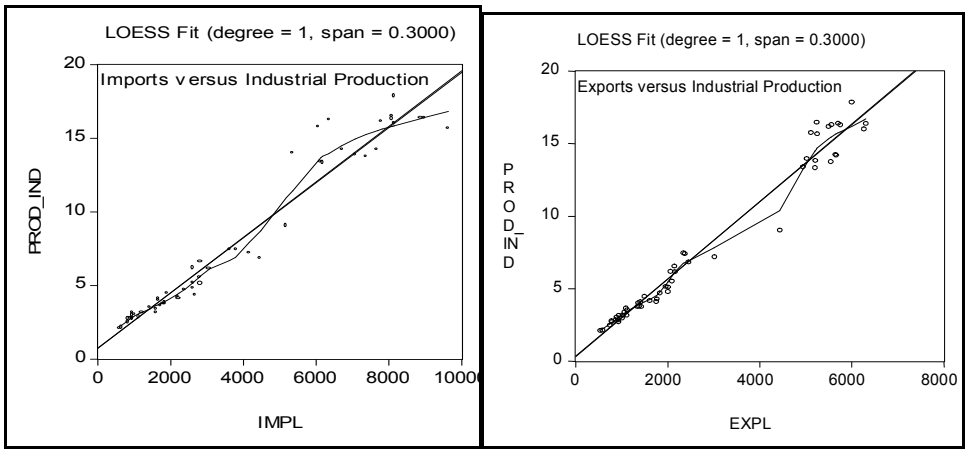
This limitation is less evident for industrial production, involving the fact that this activity sector holds a superior potential to the one effectively used.

Correlation between GDP and the volume of foreign trade



The influence of other factors on exports, respectively imports, is less evident and it must be determined with the help of econometrical techniques. The economic variables that explain the level and dynamics of exports (in lei) are the Exchange Rate(EXR), Value-Added Tax (VAT), Monetary Multiplication (MU), respectively the level of exports from previous period.

Correlation between industrial production and the volume of foreign trade



Estimated equation:

LOG(EXPORT) = C(1)+ C(2)*LOG(EXR(-1)) +C(3)*LOG(VAT) + C(4)*LOG(EXPORT(-1))+
+C(5)*LOG(MU(-1))

Quotients:

LOG(EXPORT) = -0.44436759+0.4917360017*LOG(EXR(-1))+0.1200115359*LOG(VAT)+
+0.376674015*LOG(EXPORT(-1)) + 0.456005701*LOG(MU(-1))

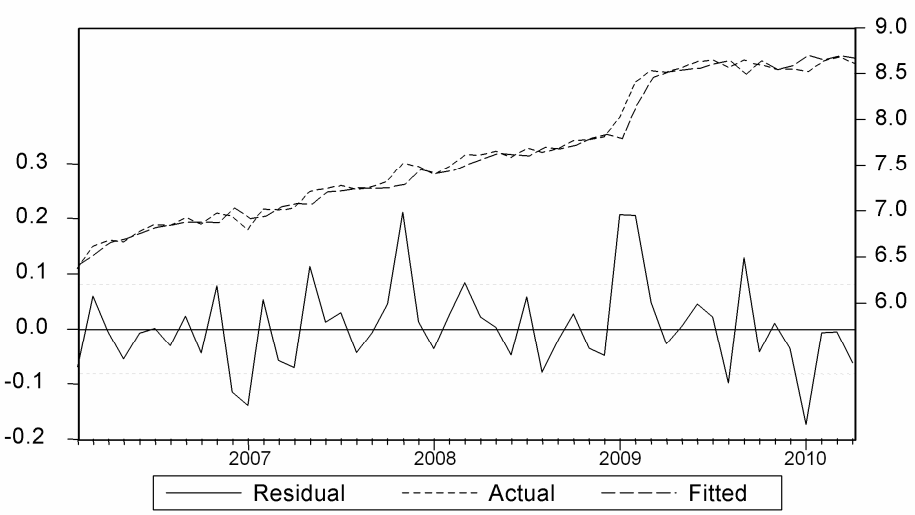
Results of regression for exports as dependant variable

Dependent Variable: LOG(EXPORT)				
Method: Least Squares				
Date: 08/09/2010 Time: 10:18				
Sample(adjusted): 2006:02 2010:04				
Included observations: 51 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.444368	0.235985	-1.883033	0.0660
LOG(EXR(-1))	0.491736	0.115139	4.270787	0.0001
LOG(VAT)	0.120012	0.060021	1.999495	0.0515
LOG(EXPORT(-1))	0.376674	0.130547	2.885352	0.0059
LOG(MU(-1))	0.456006	0.131617	3.464631	0.0012
R-squared	0.987864	Mean dependent var		7.623983
Adjusted R-squared	0.986809	S.D. dependent var		0.713181
S.E. of regresion	0.081911	Akaike info criterion		-2.073471
Sum squared resid	0.308634	Schwarz criterion		-1.884076
Log likelihood	57.87351	F-statistic		936.0978
Durbin-Watson stat	1.832327	Prob(F-statistic)		0.000000

The negative sign of the interception shows that the exports are not possible without the existence of a minimum level of economic activity (corresponding to the highest value of internal demand). The exchange ratio positively influences the volume of exports because the depreciation of the national currency is equivalent to a reduction of the price level related to internally produced goods. The value-added tax has also a positive effect on the quantity of goods exported, because the producers are exempted from this tax, and a raise of this rate induces a reorientation of production towards the foreign markets. The previous level of exports has a positive contribution on the present one through two

elements: the traditional character of the markets, respectively the development of export contacts over more periods. The money multiplication (MU) approximates the monetary policy of the National Bank. Its influence on exports is due to the inflation component of the indicator: a high inflation in economy is equivalent to a real depreciation of the currency, therefore a stimulation of exports.

Evolution of exports (concrete values, adjusted values, residual values)



The evolution of imports (expressed in Lei) is determined by the level of Foreign Currency Deposits/Reserves (FD), Nominal Industrial Production (YIN), Gross Average Wage (GAW), respectively Value-Added Tax.

The estimated equation:

LOG(IMPORT) = C(1)*LOG(FD(-1)) + C(2)*LOG(YIN(-1)) + C(3)*LOG(GAW(-1)) + C(4)*LOG(VAT(-1))

Quotients:

LOG(IMPORT) = 0.5991612362*LOG(FD(-1))+1.085233552*LOG(YIN(-1))+ +0.6051341664*LOG(GAW(-1))- 0.2370754615*LOG(VAT(-1))

The positive influence of Foreign Currency Reserves is evident, because this variable expresses often the number of period for which import can be ensured to economic agents. On the other hand, an increase of the volume of reserves induces a corresponding appreciation of the national currency, that is equivalent with a decrease in the price of imports. The industrial production contributes also to the volume of goods imported, because, as we saw, the Romanian economy is

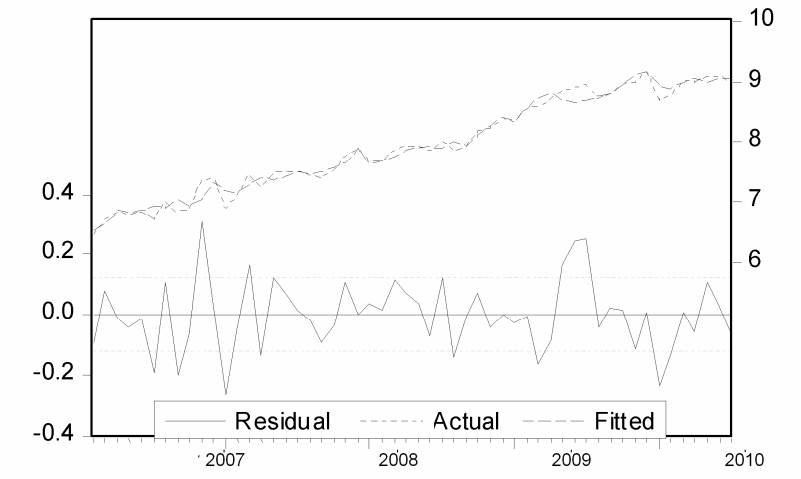
dependent on great measure on imports, especially raw materials: when the industrial activity develops, the enterprises need a superior quantity of inputs. The Industrial Production approximates thus the demand of internal producers, while the Average Wage, the equivalent of the available population income, expresses the consumer's demand for imports. The Value-Added Tax has a negative influence on the volume of imports because they are both exempted from the payment of this tax.

Results of import regression as dependant variable

Dependent Variable: LOG(IMPORT)				
Method: Least Squares				
Date: 08/09/2010 Time: 13:17				
Sample(adjusted): 2006:02 2010:07				
Included observations: 54 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(FD(-1))	0.599161	0.085176	7.034362	0.0000
LOG(YIN(-1))	1.085234	0.174888	6.205293	0.0000
LOG(GAW(-1))	0.605134	0.105198	5.752317	0.0000
LOG(VAT(-1))	-0.237075	0.099887	-2.373425	0.0215
R-squared	0.974513	Mean dependent var		7.946244
Adjusted R-squared	0.972984	S.D. dependent var		0.798165
S.E. of regression	0.131190	Akaike info criterion		-1.153153
Sum squared resid	0.860541	Schwarz criterion		-1.005821
Log likelihood	35.13513	F-statistic		637.2740
Durbin-Watson stat	1.914381	Prob(F-statistic)		0.000000

The Romanian foreign trade, despite its correlation with the Gross Domestic Product, depends in a non-significant manner on the economic activity, only the import is influenced by the industrial production. Both import and export depend on conjecture factors, such as VAT, Foreign Currency Reserves, or Monetary multiplication. The exchange rate and inflation elements have a major influence on foreign commercial transactions. Imports essentially depend on the level of the producers' demand (for inputs) and consumers' demand (for consumption goods), while exports are determined mainly by occasional factors.

Evolution of imports in Romania (actual values, fitted values, residual values)



This situation is determined by the insufficient adaptation of the economy to the competitiveness criteria, the only principles that can capitalize the comparative advantage on international markets. Meanwhile, the economic activities are insufficiently reshaped in terms of composition of exports, imports, efficiency, respectively the optimum of transaction orientation on global markets.

The analysis of the evolution and situation during the period 2006 – 2010 in the sphere of Romanian foreign trade led to a series of conclusions related to the effective potential of the economy within the international framework of commercial transactions.

The trading capacity was limited by a high level of inefficiency of economic activities, imports and exports recorded a stationary level, at which the value of imported goods surpassed significantly the total value of exports. The corresponding deficit has affected more and more the payments balance, due to the insufficiency of promotion policies for foreign investments and to the low level of credibility of the entire package of economic policies.

During the first decade of the transition, the foreign trade of Romania knew a complex adaptive process. It occurred the geographical re-orientation of the commercial exchanges, so the greatest part of them developed towards the advanced countries, inside which the European Union was the most important partner. Simultaneously, a new structure of traded goods was adopted, with the purpose of maximal capitalization of economy competitive advantages.

Even significantly re-oriented, especially after the adhesion of Romania to EU (transactions with the EU countries hold the greatest part in the total transactions of our country), Romania's foreign trade continued to be unstable,

insufficiently reshaped and much less competitive. Romania lost an appreciable part of its foreign markets, many of these being traditional partners during the socialist period. This situation was determined by the insufficient improvement of the foreign commercial regime and the reduced quality of products destined to exports.

4. Conclusions

During the transition period, the structure of goods traded reveals a high degree of substitution of imports: an important proportion of imports was represented by the goods that were also exported. In the late years, the import of technologies, even if it grew, it did not led however to an efficient reshape of industrial activities, the sector with the greatest contribution to the foreign trade. Subsequently, without a considerable improvement in efficiency, the development potential of the economy remained below the optimum level. Foreign trade did not contribute enough to the economic growth and, in the same time, economy was not capable to recover itself sufficiently to improve the commercial regime of foreign exchanges.

The economical factors that determine the dynamics of imports and exports were, in the greatest part, of conjectural nature. The fluctuations of the exchange ratio and the inflation have influenced in great manner the level of traded goods. The import had a relatively normal behavior form the economic viewpoint, as the demand of consumers and producers played an essential role in the quantity of goods acquired from foreign markets. Contrarily, exports were influenced by occasional factors (VAT, Monetary Multiplication), denoting the existence of an inadequate economical framework and therefore of some inconsistent policies for the stimulation of exports.

Depending on these characteristics, a significant improvement of the foreign trade capacity cannot be possible without sizable improvements of the structure of economic activities, with the emphasis being put on structural reforms.

The trade balance can be re-equilibrated only if the external loans are used in an efficient manner. The exchange rate policy must stimulate the exports, but this is possible only provided that appreciation or depreciation is integrally determined by the economical performance of the production sector.

The structure of imports must reflect in a greater measure the potential of the economy: a commercial regime oriented on resources is beneficial only if these resources are not passed to companies that generate losses or to less effective activities. The state must reduce and eliminate its intervention in economy by ensuring inputs at quasi-subsided prices, allowing for full competition between public and private operators, which will improve the overall competitiveness of our country on global markets.

Exports cannot be directly influenced by the state, but an effective set of measures destined to promote this activity would be considered as being highly necessary: granting special or small-interest loans, preferential exchange rate, tax

reductions and exemptions, fiscal facilities, etc.

Foreign direct investments represent a determinant factor for the improvement of foreign trade in Romania, which has a low level of this indicators, measured per capita. Without a significant inflow of foreign capital, the rhythm of economic development is reduced, negatively influencing the foreign trade capacity and, subsequently, the future developments possibilities of our country.

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