Faculty of Economics, University of Niš, 18 October 2013

International Scientific Conference

THE GLOBAL ECONOMIC CRISIS AND THE FUTURE OF EUROPEAN INTEGRATION

THE ANALISYS OF THE DEPENDENCE OF TECHNOLOGICAL LEVEL OF COUNTRIES' INTERNATIONALIZATION ON THE DEGREE OF THEIR INTEGRATION TO THE GLOBAL ECONOMIC AREA

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Abstract: *The paper analyzes links between technological level of countries' internalization and the degree of their integration to the global economic area. The subject under analysis is the dependence of the parts of countries' hi-tech export, as an index that displays technological level of their internationalization, on the system of data that characterizes the level of countries' integration to the world market connections system.*

Key words: *Technological development, internationalisation, World economy.*

In today's world an innovative model of economic development has become popular. It implies that investment in human capital, research and working on the base of national innovative systems and international cooperation in science and technology sphere, supplies for countries an appropriate economic development on innovative basement and increase of international competitiveness. Innovation and research intensity of the product have become one of the main factors to determine its competitiveness and innovative type of economic development has become the basement of determining economic power of the country and its prospects on the world market.

Countries with powerful innovative potential have come to a number of absolute leaders by the degree of competitiveness because of the reaching the high level of labor productivity; ability to respond quickly to a change of market demand, update classification of commodities, to lower all costs; capability cardinally to change the economic structure.

The following scientists were working on the problem of the development of the process of nationalization in the world economy: J. Gelbrate, S. Highmer, Ch. Kindleberger, K. Akamatsu, M. Porter, J. Danning, D. Lukianenko, V. Beloshapka, Yu. Makogon, A. Rogach, T. Orehova, S. Yakubovskii etc. I. Shumpeter became the first economist who make tried to research the possibility of introduction of innovations, while P. Draker binded entrepreneurial to innovative activity. And P. Draker's conclusions have

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UDC 330.341.1

become the basis of the theory of innovative entrepreneurship.

The purpose of the work is to analyze relations between technological level of countries' internalization and the degree of their integration to the global economic area.

The subject under analysis is the dependence of the parts of countries' hi-tech export, as an index that displays technological level of their internationalization, on the system of data that characterizes the level of countries' integration to the world market connections system.

Let Y1 be a hi-tech export part, X1 – direct foreign investment, X2 – GDP per capita, X3- products and services export, X4 – product and services import, X5 – industrial product part in added value (% from GDP), X6 – agricultural product part in added value (% from GDP), X7 – services part in added value (% from GDP).

To analyze outgoing data it is necessary to calculate descriptive statistics for the considered variable. Results of the calculations are submitted into the table 1.

The results depict that the part of hi-tech export (Y1?) in analyzed sample changes from 4,68% to 33,17%. It may show the significant scatter of outgoing data. It would be logical to assume that there are certain differences for different groups of countries. Wherein the average hi-tech export part for analyzed countries is considered to be 18,32%. Median for variable Y1? takes the value of 18,16%, which approximately matches the average number. So, approximately for the half of the countries hi-tech export part takes value of less than 18,16% and for the other half – higher than 18,16%. Insignificant difference between the average number and the median may say about symmetry of the spreading. The same assumption confirms the value of asymmetry coefficient – 0,075, which is sufficiently close to 0.

Table 1. Descriptive Statistics of the Outgoing Data

	Y1?	X1?	X2?	X3?	X4?	X5?	X6?	X7?
Mean	18.32551	3.77E+11	13802.60	28.03118	27.36754	31.18134	8.341162	60.44891
Median	18.16547	1.42E+11	4856.583	24.32472	25.11785	27.67684	5.803780	63.58863
Maximum	33.17648	1.62E+12	40899.12	46.20360	40.09130	6.39891	23.86460	73.58175
Minimum	4.687509	4.37E+09	447.2155	14.01129	15.61032	4.94753	1.417475	39.63914
Std. Dev.	8.761449	4.31E+11	14031.60	9.230861	7.448562	7.284512	7.435778	12.02490
Skewness	0.075095	1.139376	0.505395	0.369462	0.315632	1.192560	0.702258	-0.479352
Kurtosis	2.164090	3.356531	1.629746	1.893715	1.760022	2.766289	2.044612	1.707101

It is also necessary to consider characteristics of spreading degree. The Standard deviation – 8,76% - takes value of 45% from the average number. This means that the sample has sufficiently large spreading, which, obviously, is caused by the different scales of analyzed groups. Quantitative characteristics of the skewness degree of spreading is the asymmetry coefficient, which, as mentioned above, takes value practically equal to zero (0,075). Behavior of the spreading in the area of modal number is considered by the excess coefficient (2,16), which is less than 3. Consequently, spreading has flatter top compared with normal spreading.

To verify the hypothesis about normal spreading of a sample (Y1?) we use statistics of Jarque-Bera. It is known, the statistics is based on verification of how excess and asymmetry differ from matching characteristics of normal spreading. Wherein statistics verifies the following hypotheses: zero hypothesis: mistakes have normal principle of spreading $\left(N\left(0,\sigma^2\right)\right)$; alternative hypothesis: spreading significantly differs from normal spreading. Statistical values are calculated with fromula

$$Jarque\text{-}Bera = \frac{N-k}{6}\left(S^2 + \frac{(K-3)^2}{4}\right),$$

where S – asymmetry, K – excess.

All calculated values are submitted into the table 2.

Comparing the calculated and critical values depicts that the whole spreading differs from a normal one. It is now necessary to build a model of the dependence of hi-tech export part on selected factors. As a method of evaluation we should choose the simple method of the least squares (table 3).

Table 2. Jarque-Bera Statistics Value for the Outgoing Data

statistics	Y1?	Y2?	X1?	X2?	X3?	X4?	X5?	X6?	X7?
Jarque-Bera	1.352441	5.027724	9.974680	5.436172	3.318517	3.630073	10.76891	5.410188	4.857564

Table 3

Dependent Variable: Y1?				
Method: Pooled Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3483.572	3194.373	1.090534	0.2787
X1?	9.87E-12	4.36E-12	2.262622	0.0263
X2?	0.000150	0.000170	0.882420	0.3801
X3?	0.821105	0.390807	2.101048	0.0387
X4?	-0.960717	0.415822	-2.310407	0.0234
X5?	-34.30930	31.88742	-1.075951	0.2851
X6?	-34.82189	31.94245	-1.090145	0.2788
X7?	-34.91127	31.94853	-1.092735	0.2777
R-squared	0.478959	Mean dependent var		13.46893
Adjusted R-squared	0.434480	S.D. dependent var		9.136664
S.E. of regression	6.870870	Sum squared resid		3871.126
F-statistic	10.76817	Prob(F-statistic)		0.000000

The values of Fisher's statistics depict that generally model is statistically meaningful with very high level of reliability (significantly higher than 95%). However, the moderate values of determination coefficients, as well as high values of Student's statistics indicate the necessity of model fitting. After deleting from model variable X2 and recalculating, we have the result, submitted in table 4.

Table 4

Dependent Variable: Y1?				
Method: Pooled Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4303.169	3052.283	1.409820	0.1623
X1?	1.26E-11	3.11E-12	4.037828	0.0001
X3?	0.806553	0.389938	2.068412	0.0417
X4?	-0.942186	0.414737	-2.271768	0.0257
X5?	-42.52456	30.45740	-1.396198	0.1564
X6?	-43.07211	30.50277	-1.412072	0.1517
X7?	-43.07693	30.53824	-1.410590	0.1521
R-squared	0.474011	Mean dependent var		13.46893
Adjusted R-squared	0.435988	S.D. dependent var		9.136664
S.E. of regression	6.861703	Sum squared resid		3907.886
F-statistic	12.46634	Prob(F-statistic)		0.000000

Y1 = 4303.169+ 1.256e-11*X1 + 0.806*X3 - 0.942*X4 - 42.524*X5 - 43.072*X6 - 43.077*X7.

Even though the model built is statistically meaningful, it is not perfect from the interpretation point of view, because it doesn't consider the difference between analyzed groups of countries.

We should now make an evaluation of models with fixed effects (table 5). Analyzes depicts that the best model appeared to be was halflogarithmical model in which, all factors are excepted, considered the dependence of hi-tech export part during the analyzed period on the same index during the last period (table 5).

The model is characterized by high determination coefficient (0,98 and 0,97), relatively low value of standard mistake (0,12). Significance of all included variables is on the trust level of 90%. Apart of that, the model sets the dependence of hi-tech export part on further lagged variables (with lag in one unit – one year): hi-tech export part and export.

EAP – Eastern Asia and Oceania
ECA – Europe and Central Asia
EUU – EU
OEC – countries with high level of income
LAC – Latin America and Caribs
MNA – Middle East and Northern Africa
SAS – Southern Africa
SSA – Africa below Sahara.

Table 5

Dependent Variable: LOG(Y1?)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y1?(-1)	0.021118	0.012199	1.731173	0.0875
X4?	0.010527	0.008752	1.202834	0.1028
X2?	-2.73E-05	7.46E-06	-3.664026	0.0005
X3?(-1)	0.010652	0.006274	1.697861	0.0937
X5?	0.941798	1.139286	0.826656	0.0111
X6?	0.973699	1.141801	0.852774	0.0965
X7?	0.980138	1.141174	0.858886	0.0931
Fixed Effects				
_EAP--C	-94.17434			
_ECA--C	-95.37160			
_EUU--C	-94.46240			
_OEC--C	-94.01304			
_LAC--C	-94.80047			
_MNA--C	-95.87112			
_SAS--C	-95.65111			
_SSA--C	-96.19927			
R-squared	0.980339	Mean dependent var		2.341353
Adjusted R-squared	0.975674	S.D. dependent var		0.779581
S.E. of regression	0.121589	Sum squared resid		0.872256
F-statistic	490.3181	Prob(F-statistic)		0.000000

Equation of the dependence built:

LOG(Y1_EAP) = -94.17434269 + 0.02111829279*Y1_EAP(-1) + 0.01052675175*X4_EAP - 2.731684942e-05*X2_EAP + 0.01065213108*X3_EAP(-1) + 0.9417976043*X5_EAP + 0.9736987944*X6_EAP + 0.9801383879*X7_EAP

LOG(Y1_ECA) = -95.37159633 + 0.02111829279*Y1_ECA(-1) + 0.01052675175*X4_ECA - 2.731684942e-05*X2_ECA + 0.01065213108*X3_ECA(-1) + 0.9417976043*X5_ECA + 0.9736987944*X6_ECA + 0.9801383879*X7_ECA

LOG(Y1_EUU) = -94.46239703 + 0.02111829279*Y1_EUU(-1) + 0.01052675175*X4_EUU - 2.731684942e-05*X2_EUU + 0.01065213108*X3_EUU(-1) + 0.9417976043*X5_EUU + 0.9736987944*X6_EUU + 0.9801383879*X7_EUU

LOG(Y1_OEC) = -94.01304263 + 0.02111829279*Y1_OEC(-1) + 0.01052675175*X4_OEC - 2.731684942e-05*X2_OEC + 0.01065213108*X3_OEC(-1) + 0.9417976043*X5_OEC + 0.9736987944*X6_OEC + 0.9801383879*X7_OEC

LOG(Y1_LAC) = -94.8004726 + 0.02111829279*Y1_LAC(-1) + 0.01052675175*X4_LAC - 2.731684942e-05*X2_LAC + 0.01065213108*X3_LAC(-1) + 0.9417976043*X5_LAC + 0.9736987944*X6_LAC + 0.9801383879*X7_LAC

LOG(Y1_MNA) = -95.87112139 + 0.02111829279*Y1_MNA(-1) + 0.01052675175*X4_MNA - 2.731684942e-05*X2_MNA + 0.01065213108*X3_MNA(-1) + 0.9417976043*X5_MNA + 0.9736987944*X6_MNA + 0.9801383879*X7_MNA

LOG(Y1_SAS) = -95.6511125 + 0.02111829279*Y1_SAS(-1) + 0.01052675175*X4_SAS - 2.731684942e-05*X2_SAS + 0.01065213108*X3_SAS(-1) + 0.9417976043*X5_SAS + 0.9736987944*X6_SAS + 0.9801383879*X7_SAS

LOG(Y1_SSA) = -96.19927367 + 0.02111829279*Y1_SSA(-1) + 0.01052675175*X4_SSA - 2.731684942e-05*X2_SSA + 0.01065213108*X3_SSA(-1) + 0.9417976043*X5_SSA + 0.9736987944*X6_SSA + 0.9801383879*X7_SSA

The average value of additive constants, which conclude effects, are typical for some certain groups of countries and deviation from it for each country is submitted to table 6.

Table 6

_EAP--C	-94,17434	-0,89358
_ECA--C	-95,37160	0,303681
_EUU--C	-94,46240	-0,60552
_OEC--C	-94,01304	-1,05488
_LAC--C	-94,80047	-0,26745
_MNA--C	-95,87112	0,803201
_SAS--C	-95,65111	0,583191
_SSA--C	-96,19927	1,131351

1) According to the calculations, the biggest deviation (in the side of increase for 1,13 units) matches SSA, the lowest (in the side of decrease for 0,89 units) – EAP. So, the difference between SSA and EAP is 2,02 units.

Since models are halflogarithmical, they could be used for modeling effects of saturation on the level of speed growth. Coefficients, considering variables, are coefficients of elasticity. They depict number of percent that modeled index will change on, if variable grows by 1 unit. For example, the increase in the hi-tech export part during the last period will cause to its growth for the next year for 2,11%.

We should consider relations between the certain groups of countries. Only the most adequate models are depicted, which were obtained as a result of partition and comparing different alternative forms of connection of statistically meaningful factors.

1) ECA

The highest value of pair correlation coefficient between modeled index and proper factors – 0,94 matches export (X3) – connection positive and Services (X7) – connection negative. The least effect causes index Insustry (X5) – correlation coefficient is 0,38. But it makes sense to add all the data to the first model. Results submitted to table 7.

Table 7

Dependent Variable: LOG(Y1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2	-5.46E-15	2.76E-15	-1.980113	0.0950
X3	1.57E-06	2.28E-07	6.883633	0.0005
X4	0.000115	3.63E-05	3.164545	0.0195
X6	-0.000295	0.000176	-1.675565	0.1448
X7	-0.000342	9.62E-05	-3.556772	0.0120
C	7.614108	0.006830	1114.860	0.0000
R-squared	0.995475	Mean dependent var		7.603148
Adjusted R-squared	0.991704	S.D. dependent var		0.001799
S.E. of regression	0.000164	F-statistic		263.9931
Sum squared resid	1.61E-07	Prob(F-statistic)		0.000001
Durbin-Watson stat	2.393130			

Equation:

LOG(Y1) = -5.461e-15*X2 + 1.569e-06*X3 + 0.0001*X4 - 0.0003*X6 - 0.00034*X7 + 7.6141

The increase in import by 1 c.u. causes the incease in high technology export (HTE) by 0,01%, as well as the increase of X6 and X7 by 1 c.u. causes the decrease in high technology export by 0,03%. The increase in GDP per capita causes the decrease in HTE part as well.

2) Results depicted for other groups are similar.

ECA

Model calculations

Dependent Variable: Y1				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X3	0.326292	0.253792	1.285668	0.2345
X5	-0.958484	0.222780	-4.302385	0.0026
X6	0.720458	0.287434	2.506516	0.0366
C	22.10463	7.040369	3.139698	0.0138
R-squared	0.853311	Mean dependent var		8.083916
Adjusted R-squared	0.798302	S.D. dependent var		1.804885
S.E. of regression	0.810588	F-statistic		15.51233
Sum squared resid	5.256427	Prob(F-statistic)		0.001070
Durbin-Watson stat	2.505352			

Equation:

Y1 = 0.3262921915*X3 - 0.9584841492*X5 + 0.7204581529*X6 + 22.10463366

The model is linear, so coefficients show how HTE part changes. If X3 and X6 increase by 1 c.u., HTE part increases by 0,32 and 0,76 respectively. Growth of X5 by 1 c.u. causes the decrease in HTE part by 0,95.

3) EUU

Model calculations

Dependent Variable: LOG(Y1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.404053	0.663276	5.132185	0.0009
X2	-2.98E-05	6.39E-06	-4.661855	0.0016
X5	0.030590	0.029082	1.051859	0.3236
X6	-0.299342	0.165824	-1.805180	0.1087
R-squared	0.902732	Mean dependent var		2.855445
Adjusted R-squared	0.866256	S.D. dependent var		0.146508
S.E. of regression	0.053579	F-statistic		24.74899
Sum squared resid	0.022966	Prob(F-statistic)		0.000212
Durbin-Watson stat	1.600095			

Equation:

LOG(Y1) = 3.404052924 - 2.978168413e-05*X2 + 0.03058984947*X5 - 0.2993421242*X6

Model is halflogarythmical. X2 increases by 1 c.u., HTE decreases by 0,003%. X5 increases by 1 c.u. that causes the increase in HTE level by 3%. If X6 increases by 1 c.u., HTE decreases by 30%.

4) OEC

Model calculations

Dependent Variable: Y1				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2	-0.000510	7.41E-05	-6.879443	0.0001
X3	-1.968128	0.922670	-2.133080	0.0655
X4	1.950250	0.750950	2.597045	0.0318
C	35.91755	4.257853	8.435603	0.0000
R-squared	0.949806	Mean dependent var		20.36588
Adjusted R-squared	0.930983	S.D. dependent var		2.813684
S.E. of regression	0.739183	F-statistic		50.46071
Sum squared resid	4.371131	Prob(F-statistic)		0.000015
Durbin-Watson stat	1.961102			

Equation: Y1 = -0.0005099956009*X2 - 1.968128445*X3 + 1.95025008*X4 + 35.91755271

If X2 and X3 increase by 1 c.u., HTE decreases respectively by 0,0005 and 1,97 units. X4 increas by 1 c.u., it could be expected for HTE to increase by 1,95 units in average.

5) LAC

Model calculations

Dependent Variable: LOG(Y1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1(-1)	-4.15E-13	4.79E-13	-0.867749	0.4252
X2	-5.16E-05	8.19E-06	-6.299787	0.0015
X3(-1)	-0.024006	0.004691	-5.117713	0.0037
X4	-0.022439	0.011798	-1.901915	0.1156
X6	-0.082969	0.020460	-4.055156	0.0098
C	4.399562	0.294343	14.94707	0.0000
R-squared	0.983956	Mean dependent var		2.551660
Adjusted R-squared	0.967912	S.D. dependent var		0.145077
S.E. of regression	0.025988	F-statistic		61.32814
Sum squared resid	0.003377	Prob(F-statistic)		0.000174
Durbin-Watson stat	2.176313			

Equation:

LOG(Y1) = -4.152374186e-13*X1(-1) - 5.15917641e-05*X2 - 0.02400588584*X3(-1) - 0.02243901966*X4 - 0.08296892415*X6 + 4.399562477

If GDP increases by 1 c.u., HTE decreases by 0,005%, considering other factors are equal. If export in the last period and import in the current period increase by 1 c.u., that causes HTE decrease by 2,3% and 1,8% respectively in the current period.

6) SAS

Model calculations

Dependent Variable: LOG(Y1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2	0.000296	0.000179	1.653374	0.0493
X3	-0.138279	0.045619	-3.031188	0.0231
X4	0.081533	0.025270	3.226502	0.0180
X5	-0.072068	0.041248	-1.747181	0.0312
X6	-0.063884	0.026454	-2.414868	0.0522
C	5.440327	1.384754	3.928731	0.0077
R-squared	0.922319	Mean dependent var		1.697134

Adjusted R-squared	0.857586	S.D. dependent var	0.173273
S.E. of regression	0.065389	F-statistic	14.24787
Sum squared resid	0.025655	Prob(F-statistic)	0.002812
Durbin-Watson stat	2.322587		

Equation:

LOG(Y1) = 0.0002961780746*X2 - 0.1382788982*X3 + 0.08153307076*X4 - 0.07206761588*X5 - 0.06388402556*X6 + 5.440327172

Increase in GPD and import by 1 c.u., considering other factors are equal, causes the increase in HTE by 0,02% and 8,15% respectively. If X3, X5, X6 increse by 1 c.u., HTE decrease by 13,8%, 7,2% and 6,3% respectively.

Concluding all above, for different groups of countries models are built. It was done on the purpose of distinguishing the most meaningful factors, which affect the hi-tech export part.

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ANALIZA ZAVISNOSTI TEHNOLOŠKOG NIVOA INTERNACIONALIZACIJE DRŽAVE OD STEPENA INTEGRISANOSTI U GLOBALNU EKONOMIJU

Rezime: *U radu se analizira veza između tehnološke komponente internacionalizovanosti država i stepena njene integrisanosti u globalnu ekonomiju. Analizira se zavisnost dela izvoza iz oblasti visokih tehnologija, kao indeks koji izražava tehnološku komponentu internacionalizovanosti nacionalne ekonomije, u odnosu na date karakteristike koje ukazuju na stepen integrisanosti u sistem svetske ekonomiije.*

Ključne reči: *Tehnološka razvijenost, internacionalizovanost, svetska ekonomija.*