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DOES THE CORRELATION BETWEEN TECHNOLOGICAL INNOVATION AND NET OUTWARD INVESTMENT POSITION, REALLY EXIST?

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Abstract:
This study presents the relationship between technological innovation, as a pillar of competitiveness at a global level, and net outward investment position of a country. We analysed in a static manner two representative indicators, namely net outward investment per capita (NOI) and innovation (GCI_INOV), for 133 worldwide economies, in the year 2013. The results of the analyses performed, using the Linear, Logarithmic, Inverse, Quadratic and Cubic models, demonstrate that there is no significant correlation between NOI, as dependent variable, and GCI_INOV, as independent one. Thus, the highest coefficient of determination value was .139 (quadratic and cubic models), showing that only 13.9% of the variation in the net outward investment position is explained by innovation. So, the technological innovation does not faithfully reflect the stage of a country's investment development path.

Key words: Investment Development Path, net outward investment position, technological innovation, competitiveness, regression equation

JEL classification: F21, F23, O52

INTRODUCTION

The concept of the Investment Development Path (IDP) was launched by John Dunning (1993) based on the assumption that the level and structure of foreign direct investment received and generated by a country change alongside with its economic development. The level and structure of foreign direct investment received and generated by a country are indicated by net outward investment (NOI) position determined by the difference between outward FDI (OFDI) stock and inward FDI (IFDI) stock (Buckley and Castro, 1998). According to this theory, as a country is developing, a modification of the conditions offered to local and foreign firms takes place, with direct implications on the foreign direct investment inflows (Durán and Ubeda, 2001; Matei, 2004) which, in turn, influence the economic structure and its development, acting upon competition and upon the benefits of local firms (Dunning, 2006).

Thus, in the initial stages of IDP (stage one and stage two) the FDI outflows are unimportant and the NOI position is negative. These stages are the most specific to the least developed countries, in which the created production factors are insignificant and as such, the "ownership advantages" of domestic companies are very poor. In stage three, local firms become more competitive based on "ownership advantages" generated by investments aimed at increasing the quality of labour, developing the infrastructure as well as investments in technology. In this stage, the NOI position is still negative even though foreign direct investment outflows may be higher than inward FDI flows. In stages four and five, domestic companies have the ability to sustain innovation in "the organizational, managerial and technological field" and therefore relocate abroad activities based on traditional factors. In these stages, specific to developed (stage 4) and the most developed economies (stage 5) the FDI inflows go mainly to economic sectors intensive in knowledge and high-technology. As FDI outflows become increasingly higher than inward FDI, the outward FDI stock surpasses the IFDI stock and the NOI position turns to positive. According with the theory, in stage five the positive values of net outward

investment position may alternate with negative ones (Dunning, 1992; Porter, 1992; Dunning and Narula, 1996; Matei, 2004; Narula and Dunning, 2010).

Subsequently, the results of some studies (WIR, 2006; Boudier, 2008; Narula and Guimón, 2010) have emphasized some discrepancies between theory and practice, illustrating the error of using only two indicators, respectively GDP/capita at PPP and NOI/capita, and comparing across countries. According to these, "a deeper qualitative assessment of the interactions between FDI and development" is needed. These researches must be focused on the quality of FDI received by a country, in terms of attracting the kind of foreign direct investment that "matches the country's development aspirations and strategies" and "contributes to enhancing domestic technological strengths and location-specific assets" (Narula and Guimón, 2010; Voica and Panait, 2014).

Therefore, in order to progress towards a higher level of development a country has to attract foreign direct investments, inclusively green investments (Andrei, Panait and Ene, 2014), that supports and stimulates the creation and development of competitive advantages based on innovation and knowledge. This statement is also sustained by an empirical study that underlined the relation between innovation and competitiveness, analysing representative data concerning the research and development expenditure, the innovation capabilities, and the level of competitiveness for European countries. The results showed that "the more advanced the country's national innovation system, the greater the likelihood of positive effects on the economy, in terms of competitiveness" (Ivan and Iacovoiu, 2009).

Consequently, the theories and empirical studies presented above highlight the existence of a close connection between innovative capabilities, competitive advantages and net outward investment position. Thus, in advanced stages of investment development path (stages 4 and 5) the high level of competitiveness is generated by knowledge and innovation, statement sustained also by the experience of the most developed countries.

Therefore, given the theories in the field, is there any reason to assume that a correlation between innovation, as a pillar of competitiveness, and net outward investment position, really exist? The main purpose of this study is to underline the correlation between innovative capabilities and net outward investment position, through the level of competitiveness.

DATA AND METHODOLOGY

In order to test the correlation between technological innovation and net outward investment position we analyse in a static manner specific indicators worldwide for the year 2013, respectively net outward investment per capita (NOI) and innovation (GCI_INOV) calculated by the World Economic Forum (WEF) as the twelfth pillar of competitiveness (Appendix).

The *Net outward investment per capita (NOI)* was computed according to the theory presented above (Buckley and Castro, 1998) through formula (1):

$$NOI = \frac{OFDIS - IFDIS}{TP} \quad (1)$$

OFDIS – outward FDI stock;
IFDIS – inward FDI stock;
TP – total population.

The *Innovation (GCI_INOV),* the twelfth pillar of competitiveness, focuses on technological innovation. The overall score is calculated based on seven parameters: (1) Capacity for innovation, (2) Quality of scientific research institutions, (3) Company spending on R&D, (4) University-industry collaboration in R&D, (5) Government procurement of advanced tech products, (6) Availability of scientists and engineers, and (7) PCT patents, applications/million population (Schwab, 2013).

We grouped the world countries (Appendix) depending on the level of GCI_INOV, considering three ranges. We associated values greater than 4.61 with a high level of innovation, values ranging between 3.30 and 4.60 correspond to a medium level of innovation, and values lower than 3.29 equals a low level of innovation (Table no.1).

Table no.1. GCI_INOV values and corresponding levels

GCI_INOV Values	GCI_INOV Levels
GCI_INOV ≥ 4.61	High
[3.30 – 4.60]	Medium
GCI_INOV ≤ 3.29	Low

Source: Authors' own elaboration.

The crosstabulation between GCI_INOV and NOI for the analysed countries is presented in the Table no.2.

Table no.2. GCI_INOV and NOI Crosstabulation

			NOI		Total
			Negative values	Positive values	
GCI_INOV	Low Level	Count	71	3	74
		% within GCI_INOV	95.9%	4.1%	100.0%
		% within NOI	64.0%	13.6%	55.6%
		% of Total	53.4%	2.3%	55.6%
	Medium Level	Count	37	4	41
		% within GCI_INOV	90.2%	9.8%	100.0%
		% within NOI	33.3%	18.2%	30.8%
		% of Total	27.8%	3.0%	30.8%
	High Level	Count	3	15	18
		% within GCI_INOV	16.7%	83.3%	100.0%
		% within NOI	2.7%	68.2%	13.5%
		% of Total	2.3%	11.3%	13.5%
Total		Count	111	22	133
		% within GCI_INOV	83.5%	16.5%	100.0%
		% within NOI	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Source: Authors' own calculation based on data in Appendix;

As we underlined above, 71 (95.9%) of the 74 states that recorded a low level of GCI_INOV registered negative values of NOI, while 15 (83.3%) of the 18 economies that recorded a high level of GCI_INOV were outward investors (positive values of NOI).

Beginning with the theoretical relationship between the analysed indicators, we considered the net outward investment per capita as depending variable and the innovation parameter (GCI_INOV) as independent one.

$$NOI = f(GCI\_INOV) \quad (2)$$

In order to highlight the regression equation which best describes the association between NOI and GCI_INOV, we used the IBM® SPSS® Statistics Version 21 software to create the plots, to graph the fitting line for different types of models, to compute the F and R square parameters, and to establish the regression equation.

By the reason of that NOI has negative values, the Compound, Power, S-curve, Growth, Exponential, and Logistic models are useless. As a consequence, only the Linear, Logarithmic, Inverse, Quadratic and Cubic models can be analyzed.

As regards the selecting of the best model that describes the association between NOI and GCI_INOV, the criteria were the value of significance probability and the value of coefficient of determination.

First of all, the value of significance probability must be lower than .05 (5%) to take into account the coefficient of determination value. Furthermore, the model which has the higher coefficient

of determination value is the one that better outline the type of relationship between NOI and GCI_INOV.

RESULTS AND DISCUSSIONS

a) The Linear Model

The fitting line for the linear model is shown in Figure no.1.

The values of F and R Square and of the parameters of the regression equation for the linear model are shown in Table no.3.

Table no.3. Values of F and R Square and of the parameters of the regression equation for the linear model

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.080	11.389	1	131	.001	-15583.790	4208.592

Source: Authors' own calculation based on data in Appendix

The coefficient of determination (R Square) in Table no.3 is .08 and the significance probability is 0.1%. Thus, about 8% of the variation in the NOI is explained by GCI_INOV. This is a low value which means that there are other important factors that determine the variation of NOI.

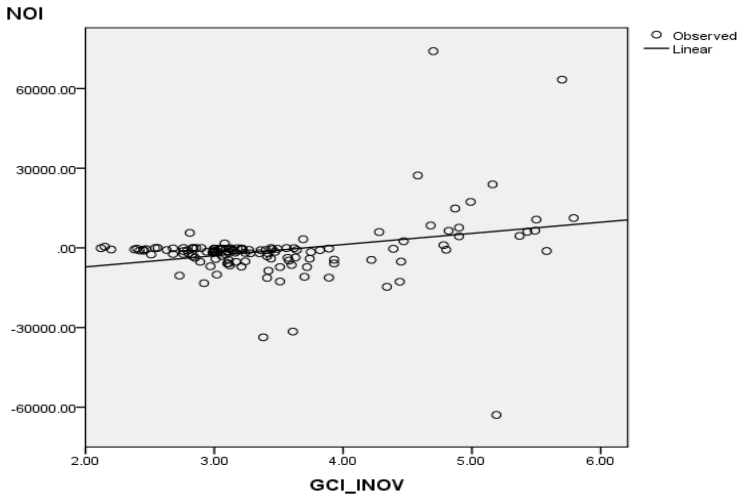

Figure no.1. The Linear Model

Source: Authors' own elaboration based on data in Appendix

b) The Logarithmic Model

Figure no.2 shows the position of the fitting line against the scatter of the data points.

Table no.4 displays the values of F and R Square and of the parameters of the regression equation for the logarithmic model.

Table no.4. Values of F and R Square and of the parameters of the regression equation for the logarithmic model

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Logarithmic	.062	8.647	1	131	.004	-17764.331	13774.398

Source: Author's own calculation based on data in Appendix

The coefficient of determination is .062 and the significance probability is 0.4%. Therefore, about 6.2% of the variation in the NOI is explained by GCI_INOV, which is a lower value than the one obtained in the linear model.

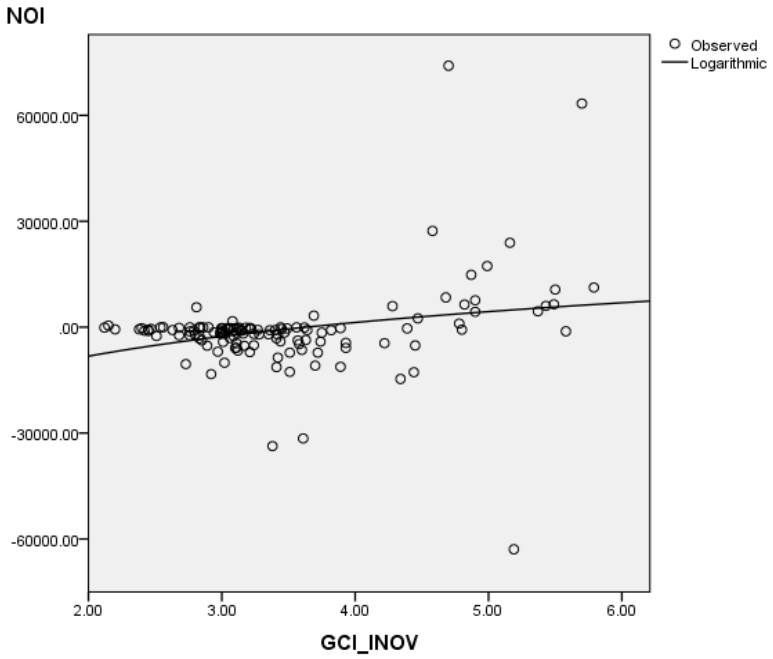

Figure no.2. The Logarithmic Model
Source: Authors' own elaboration based on data in Appendix

c) The Inverse Model

The position of the fitting line against the distribution of the data points is displayed in Figure no.5.

The values of F and R Square and of the parameters of the regression equation for the inverse model are shown in Table no.5.

Table no.5. Values of F and R Square and of the parameters of the regression equation for the inverse model

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Inverse	.044	6.038	1	131	.015	11316.198	-40624.732

Source: Authors' own calculation based on data in Appendix

The coefficient of determination is .044 and the significance probability is 1.5%. Therefore, about 4.4% of the variation in the NOI is explained by GCI_INOV, which is lower than the values obtained in the other two models (linear and logarithmic).

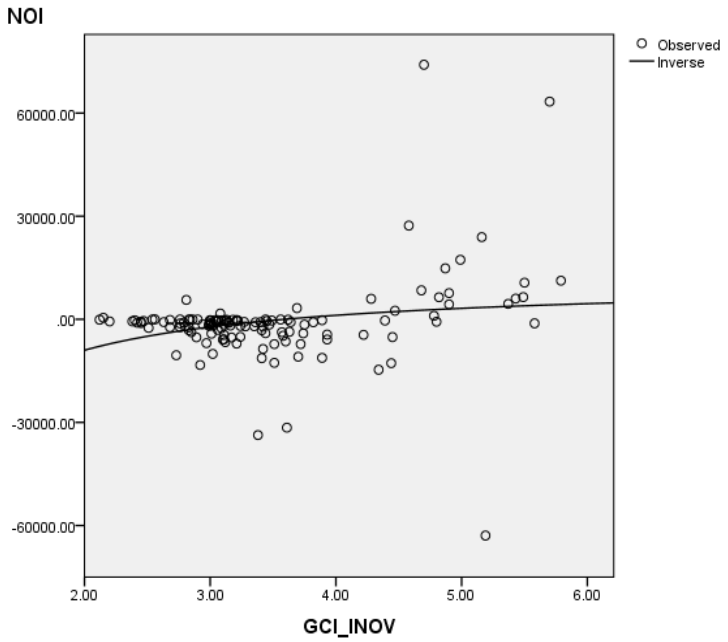

Figure no.3. The Inverse Model
Source: Authors' own elaboration based on data in Appendix

d) The Quadratic Model

Figure no.4 illustrates the position of the fitting line against the scatter of the data points.

Table no.6 shows the values of F and R Square and of the parameters of the regression equation for the quadratic model.

Table no.6. Values of F and R Square and of the parameters of the regression equation for the quadratic model

Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	Constant	b1	b2
Quadratic	.139	10.471	2	130	.000	38989.904	-25423.110	3791.367

Source: Authors' own calculation based on data in Appendix

The coefficient of determination is .139 and the significance probability is 0.0%. Therefore, about 13.9% of the variation in the NOI is explained by GCI_INOV, which is a higher value than the ones obtained in the previous models.

The quadratic regression equation is:

$NOI= 38989.904 - 25423.110(GCI\_INOV) + 3791.367(GCI\_INOV)^2$

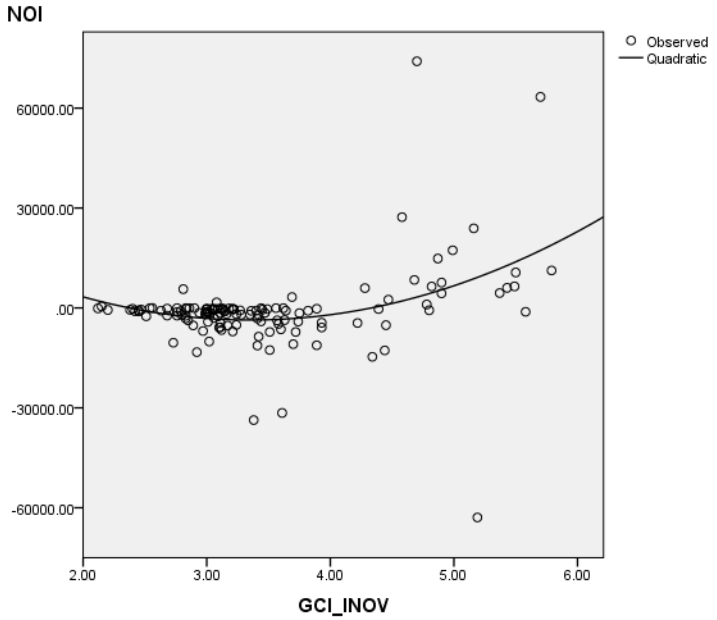

Figure no.4. The Quadratic Model
Source: Authors' own elaboration based on data in Appendix

e) The Cubic Model

The position of the fitting line against the distribution of the data points is shown in Figure no.5.

The values of F and R Square and of the parameters of the regression equation for the cubic model are displayed in Table no.7.

Table no.7. Values of F and R Square and of the parameters of the regression equation for the cubic model

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Cubic	.139	6.928	3	129	.000	42442.555	-28316.526	4569.916	-67.054

Source: Authors' own calculation based on data in Appendix

The coefficient of determination is .139 and the significance probability is 0.0%. Therefore, about 13.9% of the variation in the NOI is explained by GCI_INOV, which is the same value with the quadratic model.

The cubic regression equation is:

$NOI = 42442.555 - 28316.526(GCI\_INOV) + 4569.916(GCI\_INOV)^2 - 67.054(GCI\_INOV)^3$

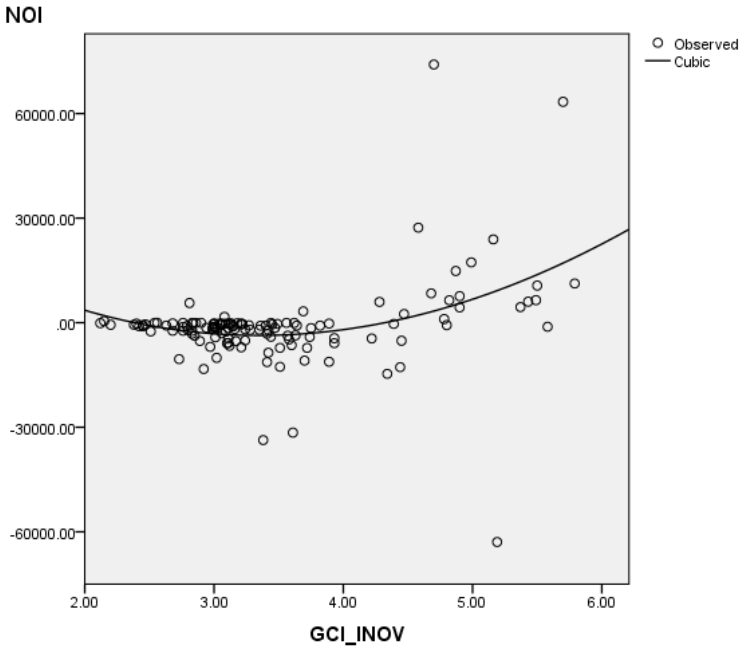

Figure no.5. The Cubic Model
Source: Authors' own elaboration based on data in Appendix

CONCLUSIONS

The correlation between technological innovation and net outward investment position, through the level of competitiveness was tested by analising two representative indicators, namely net outward investment per capita and innovation, for 133 worldwide economies, in the year 2013. The results of the analyses performed, using the Linear, Logarithmic, Inverse, Quadratic and Cubic models underline that there is no significant correlation between NOI, as dependent variable, and GCI_INOV, as independent one.

Thus, according to the analyses above, the linear, logarithmic, inverse, quadratic and cubic models have values of significance probability lower than .05 (5%), but the highest coefficient of determination value was .139, showing that only 13.9% of the variation in the net outward investment position is explained by innovation. Therefore, both quadratic and cubic models which have the same value for coefficient of determination (.139) better describe the association between NOI and GCI_INOV.

As a result, technological innovation, one of the main sources of competitiveness at the global level, does not faithfully reflect the stage of a country's investment development path. As some studies have emphasized, the turning points of a country's net outward investment position are determine by a diversity of factors (as for example natural resource endowments, economic and political structure, etc.) and the interaction between them.

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APPENDIX

No.	COUNTRY	NOI[1] (USD)	GCI_INOV[2] SCORE
1.	Finland	11244	5.79
2.	Switzerland	63358	5.70
3.	Israel	-1176	5.58
4.	Germany	10652	5.50
5.	Japan	6455	5.49
6.	Sweden	6033	5.43
7.	United States of America	4474	5.37

8.	Singapore	-62921	5.19
9.	Netherlands	23911	5.16
10.	Denmark	17313	4.99
11.	United Kingdom	4358	4.90
12.	Norway	7618	4.90
13.	Belgium	14833	4.87
14.	Austria	6432	4.82
15.	Qatar	-705	4.80
16.	Korea, Republic of	1029	4.78
17.	Luxembourg	74081	4.70
18.	France	8415	4.68
19.	Ireland	27273	4.58
20.	Canada	2487	4.47
21.	Australia	-5178	4.45
22.	Hong Kong	-12757	4.44
23.	Malaysia	-360	4.39
24.	New Zealand	-14667	4.34
25.	Iceland	5966	4.28
26.	United Arab Emirates	-4526	4.22
27.	Portugal	-4455	3.93
28.	Saudi Arabia	-5863	3.93
29.	Estonia	-11213	3.89
30.	China	-253	3.89
31.	Indonesia	-858	3.82
32.	Spain	-1560	3.75
33.	Costa Rica	-4101	3.74
34.	Panama	-7217	3.72
35.	Czech Republic	-10893	3.70
36.	Italy	3253	3.69
37.	South Africa	-817	3.64
38.	Slovenia	-3639	3.63
39.	India	-85	3.62
40.	Malta	-31532	3.61
41.	Chile	-6443	3.60
42.	Lithuania	-4796	3.58
43.	Oman	-3741	3.57
44.	Kenya	-69	3.56
45.	Hungary	-7219	3.51
46.	Barbados	-12667	3.51
47.	Sri Lanka	-355	3.49
48.	Turkey	-1504	3.47
49.	Azerbaijan	-504	3.45
50.	Jordan	-4047	3.44
51.	Rwanda	-71	3.44
52.	Montenegro	-8608	3.42
53.	Brazil	-2153	3.42
54.	Cyprus	-11300	3.41
55.	Guyana	-3181	3.41
56.	Ecuador	-832	3.40
57.	Brunei Darussalam	-33679	3.38
58.	Zambia	-871	3.36
59.	Mexico	-2005	3.35
60.	Bosnia and Herzegovina	-2055	3.28
61.	Ghana	-762	3.27
62.	Poland	-5115	3.24
63.	Thailand	-1893	3.24
64.	Gambia	-408	3.22
65.	Latvia	-7059	3.21
66.	Philippines	-197	3.21
67	Iran	-481	3.21
68.	Senegal	-162	3.18
69.	Bahrain	-5311	3.17
70.	Colombia	-1840	3.16
71.	Bolivia	-989	3.15
72.	Viet Nam	-911	3.14
73.	Russian Federation	-519	3.13
74.	Pakistan	-142	3.13
75.	Croatia	-6617	3.12
76.	Uruguay	-5840	3.11
77.	Mauritius	-1516	3.11
78.	Jamaica	-4549	3.11
79.	Cameroon	-248	3.11
80.	Kazakhstan	-5894	3.10
81.	Macedonia	-2574	3.09
82.	Madagascar	-283	3.09
83.	Greece	1687	3.08
84.	Tunisia	-3054	3.06
85.	Tanzania	-258	3.06
86.	Guatemala	-632	3.05
87.	Cambodia	-590	3.05
88.	Uganda	-235	3.04
89.	Ukraine	-1472	3.03
90.	Slovakia	-10081	3.02
91.	Namibia	-1846	3.02
92.	Romania	-4165	3.01
93.	El Salvador	-1297	3.01
94	Mali	-221	3.00
95.	Nicaragua	-1166	3.00
96.	Nigeria	-422	3.00
97.	Côte d'Ivoire	-396	3.00
98.	Argentina	-1888	2.99
99.	Armenia	-1766	2.99
100.	Botswana	-1281	2.99
101.	Bulgaria	-6934	2.97
102.	Morocco	-1446	2.94
103.	Trinidad and Tobago	-13298	2.92
104.	Malawi	-71	2.90
105.	Mongolia	-5253	2.89
106.	Burkina Faso	-68	2.86
107.	Serbia	-3731	2.85
108.	Benin	-117	2.84
109.	Dominican Republic	-2355	2.83
110.	Cabo Verde	-3158	2.83
111.	Swaziland	-61	2.83
112.	Kuwait	5639	2.81
113.	Albania	-2116	2.80
114.	Egypt	-956	2.79
115.	Peru	-2288	2.76
116.	Honduras	-1201	2.76
117.	Ethiopia	-64	2.76
118.	Lebanon	-10460	2.73
119.	Georgia	-2302	2.68
120.	Zimbabwe	-188	2.68
121.	Mozambique	-811	2.63
122.	Nepal	-18	2.56
123.	Bangladesh	-54	2.54
124.	Gabon	-2514	2.51
125	Lesotho	-499	2.47
126.	Paraguay	-684	2.45
127.	Venezuela	-1081	2.45
128.	Moldova, Republic of	-992	2.42
129.	Guinea	-269	2.40
130.	Algeria	-601	2.38
131.	Kyrgyzstan	-607	2.20
132.	Angola	448	2.15
133.	Yemen	-121	2.12

Source: 1) own calculations based on data available at UNCTAD, WIR 2014, p.209-214 (OFDI stock and IFDI stock) and World Bank, www.worldbank.org (total population); 2) Schwab, K. (2013), The Global Competitiveness Report 2013-2014: Full Data Edition, p.22.