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Is Innovation a Main Driver of The Economic Development?

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Abstract

Based on the theories and studies in the field, the purpose of this paper is to empirically verify the relationship between innovation performance and economic development. In this respect, the analyses made are based on the values of GDP/capita in current US$ and GII score worldwide for the year 2013. The empirical evidence presented shows that there is a strong relationship between innovation performance and economic development demonstrated by the fact that most of the countries with a GDP/capita higher than 15,000 US$ have high levels of GII score, while this index is generally lower for less developed and developing economies. The exceptions from this statement (this was the case for few of the analysed economies) prove that in certain conditions a country can achieve a higher level of economic development than another country that has more developed innovation capabilities.

Keywords: *innovation; performance; economic development; knowledge; productivity growth*

JEL Classification: *F63; O11; O30; O57*

Introduction

The importance of innovation as main driver of economic growth and development has been emphasized of many economists over time. Firstly, classical economists (Smith, 1776; List, 1841) underlined the link between science and technology development and productivity growth, recognizing the major role of domestic and imported technology as well as of capital investments in tangible and intangible assets. Later, Robert Solow (1957) was the first scholar who introduced innovation into a formal economic growth model, measuring the fraction of growth due to increase of investments in machinery and related equipment.

Other well-known economists developed sophisticated models focused on the relationship between human capital and economic growth. Lucas (1988) and Romer (1986, 1990) underlined the significant role of a highly skilled workforce (Lucas's model) as well as of investments in human capital and R&D (Romer's model) for long-term economic growth.

The new theory according to which investments in knowledge accumulation are more important for economic growth than physical capital investment has also been sustained by Grossman and Helpman (1991), Rebelo (1991), Aghion and Howitt (1992), and World Bank (1991). Therefore, innovation and knowledge have become the main determinants of growth, being placed in the centre of economic models.

According to J. Dunning (1992) and M. Porter (1992), innovative capabilities and R&D activities represent key factors for productivity growth and competitiveness increase, particularly in advanced stages of economic development when the high level of competitiveness is mainly based on innovation, knowledge and informational processes. Thus, intangible investments in education and training that contribute to the increase of knowledge stock as well as Research & Development (R&D) activities and innovation in the organizational, managerial and technological field are essential to driving productivity and competitiveness.

Based on this theory and the latest empirical research, Professor Xavier Sala-i-Martin (2004) developed a new model that groups the factors of economic growth into 12 pillars organized into three sub-indexes, respectively "basic requirements", "efficiency enhancers", and "innovation and sophistication factors" (WEF, 2014). The model gives different weights to each sub-index according to the significance of the factors for every stage of economic development. The weights for "innovation and sophistication factors" are presented in the table below (Table 1).

Table 1. Weights for "innovation and sophistication factors"

Stage 1 (Factor-driven)	Transition from stage 1 to stage 2	Stage 2 (Efficiency-driven)	Transition from stage 2 to stage 3	Stage 3 (Innovation-driven)
5%	5–10%	10%	10–30%	30%

Source: WEF, "The Global Competitiveness Report 2013-2014: Full Data Edition", Geneva, 2013, p.10

Thus, the "innovation and sophistication factors" are very important (weight of 30%) in stage 3 of economic development, respectively innovation-driven stage. Companies in the countries that have reached the innovation stage have to design and develop new and unique products in order to maintain their competitive advantage. Therefore, innovation and knowledge are critical, being the key factors for economic growth in the case of developed countries. Comparatively, companies in developing countries can compete on the basis of product quality and/or price, using the available technologies. Hence, the "innovation and sophistication factors" are less important (weight of 5-10%) in stages 1 and 2 of economic development characterized by the fact that productivity growth can be obtained based on scientific and technological transfer.

Consequently, the latest theories and empirical studies underline the importance of the own capabilities of innovation, as "the only self-sustaining driver of economic growth", for those countries that have reached the superior stage of economic development (Akçomak and Bas, 2008; Becker, 2009). This idea was also emphasized by the Organisation for Economic Co-Operation and Development (OECD) - "the innovative effort itself, including formal research and development, remains the *sine qua non* of growth".

Based on these theories and studies, the main purpose of this paper is to verify empirically the relationship between innovation performance and economic development.

Methodology

In line with economic theory and practice, the level of economic development was established according to the value of Gross Domestic Product per capita in current US$ (GDP/capita). The worldwide analysed countries have been grouped in four categories, as follows:

MDV – most developed countries (GDP/capita higher than 40,000 US$);
DV1 – high developed countries (GDP/capita between 15,000 US$ and 40,000 US$);
DV2 – medium developed countries (GDP/capita between 5,000 US$ and 14,999 US$);
DVG – developing countries (GDP/capita lower than 5,000 US$).

In order to underline the innovation performance of every analysed country we used the overall Global Innovation Index (GII) score which is calculated according to the following formula (Dutta and Lanvin, 2013):

$$GII = \frac{IISI + IOSI}{2} \quad (1)$$

in which:
IISI - Innovation Input Sub-Index (fig.no.1);
IOSI - Innovation Output Sub-Index (fig.no.2).

The Innovation Input Sub-Index is focused on "those elements of the national economy that enables innovative activities" (Dutta and Lanvin, 2013), as presented in Figure 1.

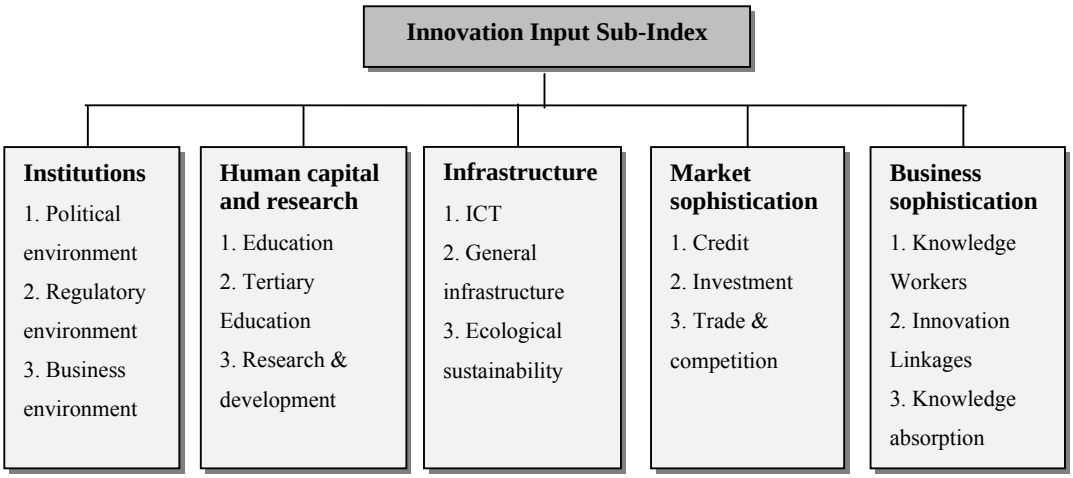

Fig. 1. The structure of Innovation Input Sub-Index

Source: Dutta, S. and Lanvin B., 2013. The Global Innovation Index 2013: The Local Dynamics of Innovation, p.6.

The Innovation Output Sub-Index takes into account the results of innovative activities (Dutta and Lanvin, 2013), as shown in Figure 2.

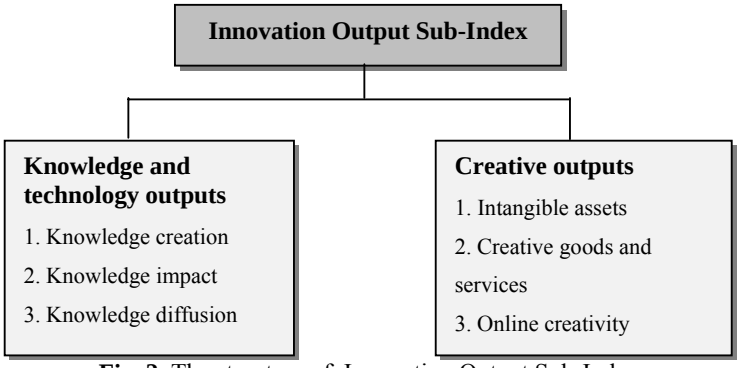

Fig. 2. The structure of Innovation Output Sub-Index

Source: Dutta, S. and Lanvin B., 2013, The Global Innovation Index 2013: The Local Dynamics of Innovation, p.6.

The analyses are based on the values of GDP/capita in current US$ and GII score worldwide for the year 2013, presented in Appendix.

Empirical Evidence

The values of GII score for the 22 countries that belong to the group MDV are presented in the table below (Table 2).

Table 2. GDP/capita – GII for MDV

Values of analyzed indicators	Number of countries	%
MDV - Total	**22**	**100**
GII > 50	19	86.36
40 < GII < 50	3	13.64

Source: Appendix, crt. no. 1-22

According to the data above, most of the MDV countries (86.36%) benefits from a very high level of innovation capabilities resulted in a value of GII score more than 50. Only 3 of the 22 most developed countries have a GII score lower than 50, namely Qatar (GII score is 41), Kuwait (the score is 40) and United Arab Emirates (41.9), as presented in Appendix. The fact that according to the level of GDP/capita these three countries are situated before other states that have a GII score higher than 60, as for example Sweden (61.4), United States of America (60.3), Netherlands (61.1) and United Kingdom (61.2) can be explained by the contribution of other production factors, as exploitation of natural resources (oil), at their economic growth.

As shown in the table below (Table 3) 17 of the 23 countries with GDP/capita between 15,000 US$ and 40,000 US$ (DV1), respectively 73.91%, have a GII score higher than 40.

Table 3. GDP/capita – GII for DV1

Values of analyzed indicators	Number of countries	%
DV1 - Total	**23**	**100**
GII > 40	17	73.91
30 < GII < 40	6	26.09

Source: Appendix, crt. no. 23-45

Like in the previous case there are some exceptions to the rule, as follows:

- Brunei Darussalam has a value of GDP/capita very close to the one shown by Japan and Hong Kong (around 38,000 US$) even though its GII score is much lower (35.5 to 52.2 or 59,4);
- Bahrain (24,689.10 US$) shows a value of GDP/capita higher than Slovenia (23,295.30 US$) and Malta (22,775.00 US$) while its GII score (36.1) is much lower than the one recorded in the two EU states (47.3 respectively 51.8). The same developments can be found in case of Greece and Oman (compared with Portugal, Czech Republic and Estonia) as well as Trinidad and Tobago compared to Slovakia and Uruguay compared to Latvia and Lithuania (Appendix).

The most of the countries with GDP/capita levels situated between 5,000 US$ and 14,999 US$ (DV2) have a GII score higher than 30, while only 16.67% presents a GII score ranging between 20 and 30 (Table 4).

As before, there are some states that do not fit into the general trend, respectively: Venezuela (with a GII score of 27.3) shows a higher GDP/capita value than Poland, Croatia and Hungary (with values of GII score over 40); Gabon (GII score is 28) has over 11,500 US$/capita as compared with Romania that shows a much lower level of GDP/capita (around 9,500 US$) even

though its GII score is much higher (40.3); Azerbaijan (with a GII score of 29) presents a value of GDP/capita (over 7,800 US$) higher than Bulgaria (around 7,500 US$) and China (around 6,800 US$) that have a GII score of 41.3 (Bulgaria) and 44.7 (China).

Table 4. GDP/capita – GII for DV2

Values of analyzed indicators	Number of countries	%
DV2 - Total	**36**	**100**
GII > 30	30	83.33
20 < GII < 30	6	16.67

Source: Appendix, crt. no. 46-81

As compared with developed countries, in the case of developing economies (DVG group) more than half of the analyzed states (35 out of 60, representing 58.33%) have a GII score lower than 30 (Table 5).

Table 5. GDP/capita – GII for DVG

Values of analyzed indicators	Number of countries	%
DVG - Total	**60**	**100**
GII > 30	25	41.67
19 < GII < 30	35	58.33

Source: Appendix, crt. no. 82-141

It has to be noticed the case of Republic of Moldova that shows a GII score of 40.9, which is much higher than the one registered by many of the DV2 countries and some of the DV1 economies, but its level of economic development is low (2,239.60 US$/capita). Also, the two countries that present the lowest GII score, respectively Sudan (19.8) and Yemen (19.3), have a much higher value of GDP/capita than states with a GII score situated around or over 30, as for example India (36.2), Kenya (30.3), Senegal (30.5), Tajikistan (30) and Uganda (31.2).

Conclusions

There is a strong relationship between innovation performance and economic development demonstrated by the fact that most of the countries with a GDP/capita higher than 15,000 US$ (MDV and DV1) show high levels of GII score, while this index is generally lower for less developed (DV2) and developing economies (DVG), as presented in the table below (Table 6).

Table 6. The relationship between GDP/capita and GII for worldwide countries (2013)

Group of countries	GDP/capita (US$)	GII (score)	%
MDV	> 40,000	51.9 – 66.6	86.36
DV1	15,000 – 40,000	40.6 – 59.4	73.91
DV2	5,000 – 14,999	31.1 – 46.9	83.33
DVG	< 5,000	19.3 - 30	58.33

Source: Appendix and data presented in tables' no. 2 to 5.

The exceptions from the above statement prove that in certain conditions (like the existence of reach natural resources or other production factors, strategic geographical position etc.) a

country can achieve a higher level of economic development than another country that has more developed innovation capabilities (this was the case for few of the analysed economies).

Therefore, the empirical evidence presented sustains once more the theory according to which the innovation and knowledge are key factors in the case of countries that have reached the superior stage of economic development, while in less advanced economies the economic growth is mainly based on imported technologies, because the own innovation capabilities are rather poor.

Given the above presented issues, we consider that the long-term strategy in less developed and developing countries has to be focused on those elements that enables innovative activities (as for example education, the development of infrastructure inclusive ITC, the regulation of business environment etc.) as an important step in development of the own innovation capabilities.

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Appendix

GDP/capita and GII score (2013)

Crt. No.	COUNTRY	GDP/capita[1] (current US$)	GII Score[2]
1	Luxembourg	110,664.80	56.6
2	Norway	100,898.40	55.6
3	*Qatar*	*93,714.10*	*41*
4	Switzerland	84,748.40	66.6
5	Australia	67,463.00	53.1
6	Sweden	60,380.90	61.4
7	Denmark	59,818.60	58.3
8	Singapore	55,182.50	59.4
9	United States of America	53,042.00	60.3
10	*Kuwait*	*52,197.30*	*40*
11	Canada	51,964.30	57.6
12	Netherlands	50,792.50	61.1
13	Austria	50,510.70	51.9
14	Ireland	50,478.40	57.9
15	Finland	49,150.60	59.5
16	Iceland	47,349.50	56.4
17	Belgium	46,929.60	52.5
18	Germany	46,251.40	55.8
19	*United Arab Emirates*	*43,048.90*	*41.9*
20	France	42,560.40	52.8
21	New Zealand	41,824.30	54.5
22	United Kingdom	41,781.10	61.2
23	Japan	38,633.70	52.2
24	*Brunei Darussalam*	*38,563.30*	*35.5*
25	Hong Kong (China)	38,123.50	59.4
26	Israel	36,050.70	56
27	Italy	35,685.60	47.8
28	Spain	29,882.10	49.4
29	Korea, Republic of	25,977.00	53.3
30	Saudi Arabia	25,961.80	41.2
31	Cyprus	25,249.00	49.3
32	*Bahrain*	*24,689.10*	*36.1*
33	Slovenia	23,295.30	47.3
34	Malta	22,775.00	51.8
35	*Greece*	*21,965.90*	*37.7*
36	*Oman*	*21,929.00*	*33.3*
37	Portugal	21,738.30	45.1
38	Czech Republic	19,858.30	48.4
39	Estonia	18,877.30	50.6
40	*Trinidad and Tobago*	*18,372.90*	*33.2*
41	Slovakia	18,049.20	42.2
42	*Uruguay*	*16,350.70*	*38.1*
43	Chile	15,732.30	40.6
44	Lithuania	15,529.70	41.4
45	Latvia	15,381.10	45.2
46	Barbados	14,917.10	40.5
47	Argentina	14,715.20	37.7
48	Russian Federation	14,611.70	37.2
49	*Venezuela, Bolivarian Republic of*	*14,414.80*	*27.3*
50	Poland	13,653.70	40.1
51	Kazakhstan	13,611.50	32.7
52	Croatia	13,597.90	41.9
53	Hungary	13,485.50	46.9
54	*Gabon*	*11,571.10*	*28*
55	Brazil	11,208.10	36.3
56	Panama	11,036.80	31.8
57	Turkey	10,971.70	36
58	Malaysia	10,538.10	46.9
59	Mexico	10,307.30	36.8
60	Costa Rica	10,184.60	41.5
61	Lebanon	9,928.00	35.5
62	Romania	9,490.80	40.3
63	Mauritius	9,477.80	38
64	Colombia	7,831.20	37.4
65	*Azerbaijan*	*7,811.60*	*29*
66	Belarus	7,575.50	34.6
67	Bulgaria	7,498.80	41.3
68	Botswana	7,315.00	31.1
69	Montenegro	7,106.90	41
70	South Africa	6,886.30	37.6
71	China	6,807.40	44.7
72	Peru	6,661.60	36
73	Serbia	6,353.80	37.9
74	Ecuador	6,002.90	32.8
75	Dominican Republic	5,879.00	33.3
76	*Angola*	*5,783.40*	*23.5*
77	Thailand	5,779.00	37.6
78	*Namibia*	*5,693.10*	*28.4*
79	*Algeria*	*5,360.70*	*23.1*
80	Jamaica	5,290.50	32.9
81	Jordan	5,213.40	37.3
82	Belize	4,893.90	30
83	TFYR of Macedonia	4,838.50	38.2
84	Iran, Islamic Republic of	4,763.30	27.3
85	Bosnia and Herzegovina	4,661.80	36.2
86	Albania	4,460.30	30.9
87	Fiji	4,375.40	30.5
88	Tunisia	4,316.70	35.8
89	Paraguay	4,264.70	30.3
90	Mongolia	4,056.40	35.8
91	Ukraine	3,900.50	35.8
92	El Salvador	3,826.10	31.3
93	Cabo Verde	3,767.10	29.7
94	Guyana	3,739.50	34.4
95	Georgia	3,596.90	35.6
96	Armenia	3,504.80	37.6
97	Guatemala	3,477.90	31.5
98	Indonesia	3,475.30	32
99	Egypt	3,314.50	28.5
100	Sri Lanka	3,279.90	30.4
101	Morocco	3,092.60	30.9

Crt. No.	COUNTRY	GDP/capita[1] (current US$)	GII Score[2]
102	Swaziland	3,034.20	29.6
103	Nigeria	3,005.50	26.6
104	Bolivia, Plurinational State of	2,867.60	30.5
105	Philippines	2,765.10	31.2
106	Honduras	2,290.80	28.8
107	Moldova, Republic of	2,239.60	40.9
108	Viet Nam	1,910.50	34.8
109	Uzbekistan	1,878.00	23.9
110	Ghana	1,858.20	30.6
111	Nicaragua	1,851.10	27.1
112	Zambia	1,844.80	26.8
113	Sudan	1,753.40	19.8
114	Côte d'Ivoire	1,528.90	23.4
115	India	1,497.50	36.2
116	Yemen	1,473.10	19.3
117	Cameroon	1,328.60	25.7
118	Pakistan	1,275.30	23.3
119	Kyrgyzstan	1,263.40	27
120	Kenya	1,245.50	30.3
121	Lesotho	1,125.60	26.3
122	Senegal	1,046.60	30.5
123	Tajikistan	1,036.60	30
124	Cambodia	1,006.80	28.1
125	Bangladesh	957.8	24.5
126	Zimbabwe	953.4	24
127	Tanzania, United Republic of	912.7	26.4
128	Benin	804.7	25.1
129	Burkina Faso	760.9	27
130	Mali	715.1	28.8
131	Nepal	694.1	25
132	Uganda	657.4	31.2
133	Rwanda	638.7	27.6
134	Togo	636.4	23
135	Mozambique	605	26.5
136	Guinea	523.1	25.7
137	Ethiopia	505	24.8
138	Gambia	488.6	26.4
139	Madagascar	463	22.9
140	Niger	415.4	24
141	Malawi	226.5	26.7

Source: 1) The World Bank, Data, http://data.worldbank.org/indicator/NY.GDP.PCAP.CD, on-line, [Accessed on March 12, 2016]; 2) Dutta, S. and Lanvin B. (2013), The Global Innovation Index 2013: The Local Dynamics of Innovation, p.10-11.