

The Level of the Country's Health Care as an Indicator of its Economic Development

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Abstract. The research paper deals with numerical evaluation of the impact of an economy's health care development on the economy's competitiveness globally. The research has been conducted with the help of econometrics and on the basis of data provided by credible organizations, such as the World Health Organization, the World Economic Forum and Bloomberg. The authors have constructed several regression models and have verified them for adequacy. The constructed models show that the efficiency of health care system has a significant impact on public health, and, in its turn, public health to a great extent shapes the economy's competitiveness. It is concluded that the level of a country's health care can be regarded as one of the most important indicators of economic development.

1. Introduction

Public health shall be a primary objective of the state policy of any country, irrespective of the level of its economic development. Public health has a significant impact on economy's competitiveness. "Healthier individuals have more physical and mental capabilities, are more productive and creative, and tend to invest more in education as life expectancy increases" [1]. Public health is shaped by a host of factors, with health care having a special place. "Health and health systems may increase or decrease economic production" and "improvements in health can enhance economic growth" [2].

The importance of the issue accounts for a substantial number of research papers, which analyze widely differing aspects of health care. As an example, we can give the research papers [3-9], which deal with governance in the health sector [3], organization and development of a country's palliative care [4], analyze "the link between income inequality and health" [5], financing of health care system [6], design of special indices to evaluate the performance of certain elements of health care system [7], analyze "patient organization participation in health policy decision making" [8] and public trust in health care systems [9], etc.

We believe that one of essential issues is numerical evaluation of how health care system development impacts an economy's competitiveness. The problem is solved with the help of econometrics and on the basis of data provided by credible organizations, such as the World Health Organization, the World Economic Forum and Bloomberg.

2. Global health care development: comparative study

The first rating of Health System Performance for 191 economies of the world was formed and released by the World Health Organization (WHO) in "The World Health Report 2000" [10].

According to the report, in 2000 France had a world lead in health system performance and Sierra Leone ranked the last. The above rating is not the only one. Presently, there are several benchmark surveys similar to it. Table 1 shows the top twenty economies of the world in 2018 by Bloomberg Health Care Efficiency among 56 economies. Hong Kong ranks the first there. Ten economies given in table 1 are also among the top twenty economies of the world by Health System Performance according to “The World Health Report 2000”. The Bloomberg Health Care Efficiency rating is based on official data provided by WHO, the UNO and the World Bank. The rating relies on three key indices: 1) life expectancy; 2) total health expenditure as a percentage of GDP; 3) per capita total health expenditure [11].

Table 1. The top twenty economies of the world in 2018 by Bloomberg Health Care Efficiency^a.

Rank	Economy	Rank	Economy	Rank	Economy	Rank	Economy
1	Hong Kong SAR	6	Israel	11	Norway ^b	16	Canada
2	Singapore ^b	7	Japan ^b	12	Switzerland ^b	16	France ^b
3	Spain ^b	8	Australia	13	Ireland ^b	18	Portugal ^b
4	Italy ^b	9	Taiwan	14	Greece ^b	19	Finland
5	S. Korea	10	U. A. E.	15	New Zealand	20	China

^a Source: formed by the authors based on [10-11].

^b Countries that are among the top 20 economies of the world by Health System Performance according to [10].

Table 2 gives the top twenty economies globally by Bloomberg 2019 Healthiest Country Index among 169 economies. Spain is regarded as the country with the healthiest population. “The index grades nations based on variables including life expectancy while imposing penalties on risks such as tobacco use and obesity. It also takes into consideration environmental factors including access to clean water and sanitation” [12]. Fourteen economies in table 2 are also among the top twenty economies in the world by Bloomberg 2018 Health Care Efficiency.

Table 2. The top twenty economies of the world by Bloomberg 2019 Healthiest Country Index^a.

Rank	Economy	Rank	Economy	Rank	Economy	Rank	Economy
1	Spain ^b	6	Sweden	11	Luxembourg	16	Canada ^b
2	Italy ^b	7	Australia ^b	12	France ^b	17	S. Korea ^b
3	Iceland	8	Singapore ^b	13	Austria	18	New Zealand ^b
4	Japan ^b	9	Norway ^b	14	Finland ^b	19	United Kingdom
5	Switzerland ^b	10	Israel ^b	15	Netherlands	20	Ireland ^b

^a Source: formed by the authors based on [12].

^b Countries that are also among the top 20 economies of the world by Bloomberg Health Care Efficiency 2018.

Table 3 shows the top twenty economies of the world in 2018 by health among 140 economies, according to the Global Competitiveness Report of the World Economic Forum (WEF) [1]. “Health” is one of 12 pillars of the Global Competitiveness Index 4.0 (GCI 4.0) calculated by WEF. According to the report, Hong Kong SAR, Japan, Singapore and Spain are the healthiest countries worldwide. The rating is based on only one criterion – healthy life expectancy. Twelve economies in table 3 are also among the top twenty economies of the world by Bloomberg 2018 Health Care Efficiency.

Table 3. The top twenty economies of the world in 2018 by Pillar 5 “Health” of GCI 4.0^a.

Rank	Economy	Rank	Economy	Rank	Economy	Rank	Economy
1	Hong Kong SAR ^b	6	Italy ^b	11	Israel ^b	16	Malta
1	Japan ^b	7	France ^b	12	Canada ^b	17	Sweden
1	Singapore ^b	8	Australia ^b	13	Costa Rica	18	New Zealand ^b
1	Spain ^b	9	Norway ^b	14	Luxembourg	19	Korea, Rep.
5	Switzerland ^b	10	Iceland	15	Austria	20	Netherlands

^a Source: formed by the authors based on [1].

^b Countries that are also among the top 20 economies of the world by Bloomberg Health Care Efficiency 2018.

Global Competitiveness Reports (starting with 2012-2013) [13-18] single out 16 most problematic factors for doing business: Tax rates, Inefficient government bureaucracy, Inflation, Corruption, etc.

Notably, in 2008-2011 the annual report dealt with 15 such factors [19-22]. From 2008 onwards, among these factors the annual research by WEF also lists “Poor public health” [19]. In 2017-2018 Poor public health on average ranked 14th globally among 16 most problematic factors for doing business; for 23.4 % economies it ranked 15th in order of importance, for 12.4 % economies it occupied 14th place, for 16.1 % economies – 13th place, for 4.4 % economies – 12th place, for 3.6 % economies – 11th place, for 2.9 % economies – 10th place, for 2.9 % economies – 9th place.

Table 4. The average rank of “Poor public health” as the most problematic factor for doing business in 2008-2018 (globally)^a.

Time period	2017-2018	2016-2017	2015-2016	2014-2015	2013-2014	2012-2013	2011-2012	2010-2011	2009-2010	2008-2009
The number of economies under study	137	138	140	144	148	144	142	139	133	134
The number of factors under study	16	16	16	16	16	16	15	15	15	15
Average rank of “Poor public health”	14.2	13.9	14.3	14.3	14.3	14.4	13.5	13.3	13.5	13.3

^aSource: calculated by the authors based on [13-22].

Table 4 gives the average rank of “Poor public health” as the most problematic factor for doing business for the period from 2008 to 2018. Table 4 shows that, according to experts, “Poor public health” globally holds not the last place among the group of factors under study by degree of impact on business performance.

3. Evaluation of how health care development impacts national competitiveness

It is interesting to evaluate how health care development impacts national competitiveness. We have made such an analysis for two time periods: 2000 and 2018. The research for 2000 is based on “The Global Competitiveness Report 2000” [23] (which contains data on competitiveness of 58 economies and assumes calculation of the Current Competitiveness Index) and “The World Health Report 2000” [10]. Table 5 gives data on ranking economies by the Current Competitiveness Index and Health System Performance for 56 economies only, as the two reports simultaneously cover precisely this number of economies. Note that in table 5 we have put 56 economies in order from 1 to 56 for each of the two criteria under study according to the data [10; 23].

Table 5. Ranking economies by the Current Competitiveness Index 2000 and Health System Performance 2000 (56 economies)^a.

Economy	CCI ^b (rank)	HSP ^c (rank)	Economy	CCI (rank)	HSP (rank)	Economy	CCI (rank)	HSP (rank)	Economy	CCI (rank)	HSP (rank)
Argentina	43	40	Ecuador	55	46	Japan	14	6	Singapore	9	3
Australia	10	22	Egypt	37	37	Jordan	33	42	Slovak Rep.	34	36
Austria	13	5	El Salvador	49	48	Korea, Rep.	25	33	South Africa	23	56
Belgium	12	15	Finland	1	21	Malaysia	28	30	Spain	21	4
Bolivia	56	50	France	15	1	Mauritius	36	43	Sweden	7	17
Brazil	29	49	Germany	3	18	Mexico	40	35	Switzerland	5	14
Bulgaria	53	45	Greece	31	9	Netherlands	4	11	Thailand	38	28
Canada	11	20	Hungary	30	38	New Zealand	18	27	Turkey	27	39
Chile	24	23	Iceland	16	10	Norway	19	7	UK	8	12
China	42	53	India	35	47	Peru	47	51	Ukraine	54	41
Colombia	46	16	Indonesia	45	44	Philippines	44	34	United States	2	26
Costa Rica	41	25	Ireland	20	13	Poland	39	31	Venezuela	52	32
Czech Republic	32	29	Israel	17	19	Portugal	26	8	Viet Nam	51	55
Denmark	6	24	Italy	22	2	Russia	50	52	Zimbabwe	48	54

^a Source: formed by the authors based on [10; 23].

^b Current Competitiveness Index.

^c Health System Performance.

Based on table 5, we have set up an equation of dependence, – interrelation between an economy’s position in the rating of Health System Performance and the economy’s position in the rating of Current Competitiveness Index, – equation (1). Equation (1) testifies to a rather strong impact of

Health System Performance on economy’s competitiveness in 2000. Notably, correlation coefficient between the indices under study equals 0.71, which shows a rather significant dependence.

$$y_1 = 0.7051 \cdot x_1 + 8.4039 , \tag{1}$$

where: x_1 – rank of an economy by Health System Performance in 2000 (among 56 economies); y_1 – rank of the economy by the Current Competitiveness Index in 2000 (among 56 economies).

The research for 2018 is based on “The Global Competitiveness Report 2018” (which contains data on global competitiveness of 140 economies and assumes calculation of GCI 4.0) and ranking of economies by Bloomberg 2018 Health Care Efficiency. For the first time ever, GCI 4.0 was presented to the public in [1]. GCI 4.0 covers 98 indices, 54 of which rely upon official statistics and 44 of which rely upon WEF’s Executive Opinion Survey [1]. GCI 4.0 consists of 12 pillars (enlarged components), with each of them having equal impact on the value of the index [1]. WEF’s report underlines that each economy has a potential to improve its global competitiveness and that these efforts are essential to “improve resilience to shocks” in the long term [1].

GCI 4.0 pillars are divided into four groups: Enabling Environment, Human Capital, Markets and Innovation Ecosystem. The report singles out a set of the most important factors to achieve economy’s competitiveness in the long term: “human capital, innovation, resilience and agility” [1]. Human Capital includes two pillars: Health and Skills. Health is the 5th Pillar of GCI 4.0 and is based on only one criterion – healthy life expectancy [1]. Notably, “...health is thought of as a state of complete physical, mental and social well-being, not merely the absence of disease or disabilities...” [1]. The report underscores that “...human capital is essential for generating prosperity and that any policy that adversely affects human factors’ potential will reduce economic growth in the long run” [1].

It is interesting to measure the impact of public health on economy’s competitiveness. Equation (2) shows linear dependence between an economy’s Health rank and GCI 4.0 rank in 2018:

$$y_2 = 0.8449 \cdot x_2 + 10.97 , \tag{2}$$

where: x_2 – rank of an economy by Pillar 5 “Health” of GCI 4.0 in 2018 (among 140 economies); y_2 – rank of the economy by GCI 4.0 in 2018 (among 140 economies).

The analysis of equation (2) shows that in 2018 improvement (deterioration) of a Health rank by 1, on average, correspondingly causes improvement (deterioration) of the global competitiveness of the economy by 0.8449. Note that correlation coefficient between the two indices under study equals 0.85 in 2018, which testifies to a rather strong dependence. Thus, we see that public health has a significant impact on economy’s competitiveness globally.

Table 6. Ranking economies by Bloomberg Health Care Efficiency and Health, 2018 (54 economies)^a.

Economy	BHCE ^b	Health	Economy	BHCE	Health	Economy	BHCE	Health	Economy	BHCE	Health	Economy	BHCE	Health
Algeria	32	43	Costa Rica	24	12	Iran	38	51	New Zealand	14	15	Spain	3	1
Australia	7	8	Czech Republic	29	31	Ireland	12	20	Norway	10	9	Sweden	21	14
Austria	31	13	Denmark	40	26	Israel	5	10	Peru	35	27	Switzerland	11	5
Azerbaijan	52	52	Dominican Rep.	48	41	Italy	4	6	Poland	23	36	Taiwan	8	22
Belgium	37	23	Ecuador	42	30	Japan	6	1	Portugal	17	19	Thailand	26	32
Brazil	49	48	Finland	18	18	Jordan	47	49	Romania	35	47	Turkey	25	35
Bulgaria	54	46	France	15	7	Kazakhstan	43	53	Russia	51	54	U.A.E.	9	50
Canada	15	11	Germany	44	21	Lebanon	22	29	Saudi Arabia	45	42	UK	34	24
Chile	30	25	Greece	13	17	Malaysia	28	40	Serbia	50	44	USA	52	34
China	19	33	Hong Kong	1	1	Mexico	19	37	Singapore	2	1	Venezuela	38	39
Colombia	46	28	Hungary	41	45	Netherlands	27	16	Slovak Rep.	33	38	X	X	X

^a Source: formed by the authors based on [1; 11].

^b Bloomberg Health Care Efficiency.

It is also interesting to measure how efficiency of health system influences public health. To make such an assessment, we have formed table 6 with ranking of economies by Bloomberg Health Care Efficiency and Health for 54 economies in 2018. The rating of Health was taken from [1]. Table 6 contains data on only 54 economies, as precisely this number is represented in both sources in terms of the two criteria under study. Note that we have put 54 economies in order from 1 to 54 for each of the two criteria under study.

Based on table 6, we have set up an equation of dependence, – interrelation between an economy’s position in the rating of Bloomberg Health Care Efficiency and the economy’s position in the rating of Health, – equation (3). Equation (3) testifies to a rather strong impact of Health Care Efficiency on public health. Notably, correlation coefficient between the indices under study equals 0.76, which shows a rather significant dependence.

$$y_3 = 0.7667 \cdot x_3 + 6.3748, \tag{3}$$

where: x_3 – rank of an economy by Bloomberg Health Care Efficiency in 2018 (among 54 economies); y_3 – rank of the economy by Health in 2018 (among 54 economies).

Let us verify the adequacy of the constructed models, i. e. the compliance of the constructed linear regressions with the results of observations. Let us introduce the following notation: n – the number of observations (in fact, the number of economies), k – the number of factors of the model, R^2 – determination coefficient of the constructed model. We shall verify adequacy by the use of an F-test, which consists of the following steps [24].

Step 1. To determine the real value $F_{\text{fact.}}$ of Fischer statistic by equation: $F_{\text{fact.}} = \frac{R^2}{1-R^2} \cdot \frac{n-k-1}{k}$.

Step 2. To set the value of significance level α . Let us assume that $\alpha = 0.05$, which means the following: upon examination of the corresponding statistical hypothesis, a possible error is in no more than $\alpha \cdot 100 = 0.05 \cdot 100 = 5$ % cases.

Step 3. To determine the table value $F_{\text{tabl.}}$ of Fischer statistic by equation: $F_{\text{tabl.}} = F_p(n_1; n_2)$, where $F_{\text{tabl.}} = F_p(n_1; n_2)$ is the table value of Fischer’s p -inverse distribution with n_1 and n_2 degrees of freedom, $p = 1 - \alpha$, $n_1 = k$, $n_2 = n - k - 1$. Provided that $\alpha = 0.05$ and all the constructed models are single-factor models, we have the following: $p = 1 - \alpha = 1 - 0.05 = 0.95$, $n_1 = k = 1$, $n_2 = n - k - 1 = n - 1 - 1 = n - 2$, $F_{\text{tabl.}} = F_p(n_1; n_2) = F_{0.95}(1; n - 2)$.

Step 4. To make a statistical decision according to the rule: if inequality $F_{\text{fact.}} < F_{\text{tabl.}}$ holds true, then for the set significance level α , i. e. with the risk of error in no more than $\alpha \cdot 100$ % cases, the constructed model shall be regarded as adequate; and if inequality $F_{\text{fact.}} > F_{\text{tabl.}}$ holds true, then for the set significance level α , i. e. with the risk of error in no more than $\alpha \cdot 100$ % cases, the constructed model shall be regarded as inadequate.

Table 7. The results of verification of the adequacy of the constructed models for significance level $\alpha = 0.05$ ^a.

#	Model	R^2	$F_{\text{fact.}}$	$n_2 = n - 2$	$F_{\text{tabl.}}$	Conclusion
1.	$y_1 = 0.7051 \cdot x_1 + 8.4039$	0.4972	53.3986	54	4.0195	adequate
2.	$y_2 = 0.8449 \cdot x_2 + 10.97$	0.7164	348.6008	138	3.9097	adequate
3.	$y_3 = 0.7667 \cdot x_3 + 6.3748$	0.5725	69.6374	52	4.0266	adequate

^aSource: calculated by the authors.

Table 7 gives the results of verification of the constructed models for adequacy. The results given in table 7 show that equations (1) to (3) are adequate and can be used for analysis.

4. Conclusions

The research results testify to a rather visible impact of health care system development on a country's competitiveness globally. The constructed models (regression equations) show that the efficiency of health care system has a significant impact on public health, and, in its turn, public health to a great extent shapes the economy's competitiveness. The constructed equations of dependence have been successfully verified for adequacy and can be used for analysis. Taking into account the values of determination coefficients R^2 for the equations, we cannot say that the set up equations completely describe the dependence under study. However, the set up equations provide us with rather useful information.

Based on the research results, we can conclude that the level of a country's health care can be regarded as one of the most important indicators of economic development.

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