Turystyka i Rozwój Regionalny 2018, nr 9, 81–88

Journal of Tourism and Regional Development 2018, No. 9, 81–88

DOI 10.22630/TIRR.2018.9.9

ISSN 2353-9178 e-ISSN 2543-8859 ISBN 978-83-7583-812-1

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The determining role of health on the economic development of countries – case study in econometric analysis

Summary. Nowadays, the ultimate goal of all countries is to provide their citizens a higher quality of life and to build a prosperous society by carrying out the sustainable development. And these goals can be achieved only by investing in human capital. The method of investment in human capital goes through education services along with high-quality, reachable, inclusive and adequate health services. Development is not only an economic term. Development – in addition to economic growth (in addition to increase in per capita income) – includes improvement on economic, social, cultural and political form in a country. In this sense; health indicators such as maternal mortality rate, infant mortality rate and life expectancy at birth are being accepted to be the most primary criteria which determine the development level of countries. This study aims to reveal the role of health services on the development level of countries by making a comparative analysis between Turkey – which is a member of OECD and which presents in the league of developing countries – and selected developed OECD countries on indicators such as; infant mortality rate and GDP per capita.

Key words: development, health services, human capital, OECD countries

Introduction

Health expenditures of individuals and countries cannot be considered as consumption expenditures. Contrary, health expenditures should be considered as investment expenditures since purpose of these expenditures is to develop qualification of individuals.

In order to strengthen economic power of countries and to realize development of countries, human capital of countries should be enhanced alongside of real capital enhancement. Component of human capital comprise of health and education[1]. Enhance-

[1] M. Tunç: Kalkınmada İnsan Sermayesi: İç Getiri Oranı Yaklaşımı Ve Türkiye Uygulaması, Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 1998, 13(1), p. 83–106.

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ments in health of individuals also enhances added-value of their education thereby it improves qualification of human capital. Because of this reason Şimşir et al.[2] indicate that countries which want to improve their human capital should enhance their health indicators.

Purpose of this study, is to examine relationship between health and development empirically. In this context, infant mortality rate used as health status indicator and GDP used as development indicator in this study.

Empirical literature about relationship between health and development

Methods and results of studies which demonstrates the relationship between health and economic development is given at Table 1.

Table 1. Literature Review

Author (Year)	Independent Variables	Method	Results
Ak (2012)[a]	Health expenditure, Life expectancy at birth	Time series analysis	Long-run bilateral relationship was discovered
Bozkurt (2010)[b]	Life expectancy at birth	Time series analysis	Long-run bilateral relationship was discovered
Şimşir et al. (2015)	Health expenditure, Mortality rate	Time series analysis	Long-run bilateral relationship was discovered
Taban (2006)[c]	Life expectancy at birth	Time series analysis	Long-run bilateral relationship was discovered
Yardımcıoğlu (2012)[d]	Life expectancy at birth	Panel data analysis	Long-run causality relationship was discovered
Yumuşak and Yardımcıoğlu (2009)[e]	Health expenditure, Life expectancy at birth	Time series analysis	Long-run relationship from health expenditure to GDP per capita and from GDP per capita to life expectancy at birth were discovered

[a] Ak R.: The Relationship between Health Expenditures and Economic Growth: Turkish Case, International Journal of Business Management and Economic Research, 2012, 3(1), p. 404––409.

[b] Bozkurt H.: Eğitim, Sağlık ve İktisadi Büyüme Arasındaki İlişkiler, Türkiye İçin Bir Analiz, Bilgi Ekonomisi ve Yönetimi Dergisi, 2010, 5(1), p. 7–27.

[c] Taban S. : Türkiye'de Sağlık ve Ekonomik Büyüme Arasındaki Nedensellik İlişkisi, Sosyo Ekonomi 2006, 4(4), p. 31–46.

[d] Yardımcıoğlu F. : OECD Ülkelerinde Sağlık ve Ekonomik Büyüme İlişkisinin Ekonometrik Bir İncelemesi, Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi, 2012, 13(2), p. 27–47.

[e] Yumuşak İ.G., Yıldırım D.Ç.: Sağlik Harcamalari İktisadi Büyüme İlişkisi Üzerine Ekonometrik Bir İnceleme, Bilgi Ekonomisi ve Yönetimi Dergisi 2009, 4(1), p. 57–70.

[2] N.C. Şimşir, F. Çondur, Bölükbaş M., Alataş S.: Türkiye'de Sağlık ve Ekonomik Büyüme İlişkisi: ARDL Sınır Testi Yaklaşımı, Finans Politik & Ekonomik Yorumlar 2015, 52(604), p. 43–54.

As it seen at Table 1, literature review narrowed down in only studies which studied by Turkish academics. In all these studies which are stated in literature review, life expectancy at birth indicator was used to indicate health status. However, as we mentioned before, infant mortality rate indicator also can be used to indicate health status of populations that's why we used this indicator.

Data set, method and econometric model

In this study, GDP per capita and infant mortality rate data of 28 OECD countries including Turkey were examined. The study was a panel data analysis and examination period is 1960–2015. In order to ensure consistency, data were taken from World Bank data bank[3]. Explanation of data used in this study is given at Table 2.

Table 2. Explanation of Data

Variables	Definition	Observation Period	Data Source
lngdp	Logarithmic GDP Per Capita	1960–2015	WB
lnimr	Logarithmic Infant Mortality Rate	1960–2015	WB

Econometric models which are estimated in the study are given equations below.

Model-1: $lngdp_{it} = \alpha_{it} + \beta\, lnimr_{it} + u_{it}$

Model-2: $lnimr_{it} = \alpha_{it} + \beta\, lngdp_{it} + u_{it}$

Analyses and findings – cross-sectional dependence (CD) test

In panel data analyses, in order to get consistent results, cross-sectional dependence should be examined before the examination of long run relationship between variables[4]. Thus, CD was examined on the basis of both variables and model in the study.

CD Test on the basis of variables

CD test should be used on the basis of variables before unit root test in order to decide which kind of unit root test should be used. CD was examined for both two variables by using CDLM1 test which developed by Breusch-Pagan[5] and CDLM2 and CDLM3 tests which developed by Pesaran[6]. Results of CD test which were obtained by using Gaus 10 is given at Table 3.

CD test contains 3 kind of test statistics. Two of them, Breush Pagan LM (CD_{LM1}) and Peseran scaled LM (CD_{LM2}) tests is used when T > N; third test statistic, Peseran CD (CD_{LM3}) is used when N > T; fourth test statistic, Bias-adjusted CD test is used both

[3] World Bank Databank, 2015, retrieved from: http://databank.worldbank.org/data/reports.aspx? source=world-development-indicators (accessed: 28.05.2018).

[4] Küçükaksoy I., Akalın G.: Fisher Hipotezi'nin Panel Veri Analizi İle Test Edilmesi: OECD Ülkeleri Uygulaması, Hacettepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi 2017, 35(1), p. 19–40.

[5] T.S. Breusch and A.R. Pagan: The Lagrange Multiplier Test and Its Applications to Model Specification Tests in Econometrics, Review of Economic Studies 47, p. 239–53.

[6] M.H. Pesaran: General Diagnostic Tests for Cross Section Dependence in Panels, Cambridge Working Papers in Economics no. 0435, p. 1–42.

Table 3. Result of CD test for variables

	GDP		IMR	
Tests	t-statistics	Prob	t-statistics	Prob
CD_{LM1}	2253.059***	0.000	480.724***	0.000
CD_{LM2}	94.075***	0.000	11.618***	0.000
CD_{LM3}	–1.723***	0.042	–2.044***	0.020
Bias-adjusted CD test	18.079***	0.000	20.155***	0.000

*%10 Significant,**%5 Significant, ***%1 Significant.

T > N and N > T. In this test null hypothesis indicates that there is no CD between units. As it seen in Table 3, null hypothesis was rejected ($p < 0.05$) for both of two variables which means CD exists between units. In this case, since first generation unit root tests do not considerate CD we used one of second generation unit root tests which do considerate CD.

CD Test on the basis of model

Before co-integration test, CD test should be carried out to decide which kind of co-integration test should be used. The test result which was obtained from Gauss 10 econometric package program is given at Table 4.

Table 4. Result of CD Test for Model

Model-1: $lngdp_{it} = \alpha\, it + \beta\, lnimrit + u_{it}$		**Model-2: $lnimr_{it} = \alpha_{it} + \beta\, lngdp_{it} + u_{it}$**		
Tests	**t-statistics**	**Prob.**	**t-statistics**	**Prob.**
CD_{LM1}	10106.489***	0.000	10606.734***	0.000
CD_{LM2}	459.449***	0.000	482.723***	0.000
CD_{LM3}	99.922***	0.000	102.627***	0.000
Bias-adjusted CD test	25.262***	0.000	28.984***	0.000

Note: *%10 Significant,**%5 Significant, ***%1 Significant.

Null hypothesis of CD Model test indicates that there is no cross-sectional dependence for model. As it seen null hypothesis was rejected ($p < 0.05$) which means cross-sectional dependence existed for both of two model. In this case, one of second generation CD tests which considers cross-sectional dependence was used for panel

Panel unit root test

In order to avoid the problem of spurious regression, each variables should be attached into examination as their stable level[7]. Therefore, unit root test should be conducted to detect variables which are not stable and make them stable.

[7] N.C. Şimşir, F. Çondur, M. Bölükbaş, S. Alataş: Türkiye'de..., op.cit.

Stability of variables was examined by Cross Sectionally Augmented Dickey Fuller (CADF) test which was developed Peseran which one of the second generation unit root tests, since cross-sectonal dependence were detected for both of two variables (GDP&IMR) previous chapter.

CADF test generates CIPS statistics. In this test, calculated CIPS test statistic is compared with critical CIPS table value of Pesaran. If CIPS table value more than calculated CIPS value null hypothesis (H_0 = panel has unit root) is rejected. Calculated CIPS test statistics and critical values is given at Table 5.

Table 5. CADF Unit Root Test Results

	Düzey I(0)		Birinci Fark I(1)
	Panel CIPS istatistiði		Panel CIPS istatistiði
GDP	–2.470		–4.285***
IMR	–3.396***		–3.182***
CIPS Tablo Kritik Deðeri	–2.63*	–2.71**	–2.85***

*%10 Significant,**%5 Significant, ***%1 Significant. Test model was chosen as fixed&trend Critical values were taken from Table 2c article of Peseran for T = 56 ve N = 22[8].

As it seen at Table 5, GDP variable had unit root at level, and it stabled when it differenced I(1). As to GDP variable, it was stable at level I(0). In this case, variables were not stable at the same level.

Co-integration analysis

Durbin Hausman Co-integration test which was developed by Westerlund (2008)[9] was used in our study. There are two reason of using this test. First, this test considers Cross-sectional dependence for model. Second, this test can be used when variables are not stable at same level.

Durbin Hausman Co-integration test generates two kind of test statistics. First one, Durbin Hausman Group generates results for each units and second one, Durbin Hausman Panel generates result for whole of panel. Hypothesess of these test statistics given below.

Durbin Hausman Group;

H_0: There is no co-integration for panel.

H_1: Co-integration exists for some of units.

Durbin Hausman Panel;

H_0: There is no co-integration for panel.

H_1: Co-integration exists for panel.

[8] M.H. Peseran: A Sımple..., op.cit., p. 265–312.

[9] J. Westerlund: Panel Cointegration Tests of the Fisher Effect, Journal of Applied Econometrics 2008, 23, p. 193–223.

Table 6. Durbin Hausman Co-integration Test Results

Model-1: $lngdp_{it} = \alpha\ it + \beta\ lnimrit + u_{it}$			**Model-2: $lnimr_{it} = \alpha_{it} + \beta\ lngdp_{it} + u_{it}$**	
Test Statistic	t-statistic	Prob.	t-statistic	Prob.
Durbin-h Group Statistic	2.839***	0.002	2.803***	0.003
Durbin-h Panel Statistic	3.544***	0.000	1.891**	0.029

*%10 Significant,**%5 Significant, ***%1 Significant.

Durbin Hausman Test results which were generated by Gauss 10 econometric package program is given at Table 6.

Long-run relationship between health and economic development was examined by two different model. Effect of health on development was tested with first model, and effect of development on health was tested with second model.

As it seen at Table 6, both group and panel test statistics are significant and null hypothesis (there is no co-integration for panel) is rejected for both model-1 and model-2. As a result, there is a long run relationship between health and development for selected 20 countries.

Estimation of co-integration coefficients

Since long-run relationship were discovered between variables in previous chapter, co-integration coefficients were examined to detect the power of relationship in this section. Because there is a cross-sectional dependence for model, one of the second generation test, Common Correlated Effects Mean Group estimator (Panel CCEMG) which was developed by Peseran was used in this study. Panel CCEMG test results which were produced by Stata 12 econometric package program is given at Table 7.

Table 7. Panel CCEMG Test Results

Model-1: $lngdp_{it} = \alpha\ it + \beta\ lnimrit + u_{it}$			**Model-2: $lnimr_{it} = \alpha_{it} + \beta\ lngdp_{it} + u_{it}$**		
Independent Variable	Coeff	t-statistic	Independent Variable	Coeff	t-statistic
imr	–0.2765535	2.03**	GDP	–0.0951524	2.09**

*%10 Significant,**%5 Significant, ***%1 Significant.

According to results stated at Table 7, there is a inverse relationship between infant mortality and economic growth in the long term. When GDP per capita increases, Infant mortality rate decreases and vice versa. As it seen at Table 7, effect of health on economic development is more powerful than effect of economic development on health. 1 percentage improvement on health status of population (1 percentage decreasing

of IMR) augments GDP per capita 0.2 percentage in long term, while 1 percentage increasement on GDP per capita improves health status of population (reduces infant mortality rate) 0.09 percentage in long term.

Conclusion

In this study, long run relationship between health (infant mortality rate) and economic development (GDP per capita) data of 1960-2015 period was examined for 22 OECD countries including Turkey. During examination, firstly, logarithmic transformation of data was done to make them proper for analysis. At the second step of examination, cross-sectional dependence test was conducted for both model and each series to decide which kind of unit root test and co-integration test should be used. At the third step of examination, second generation CADF panel unit root test was conducted and as a result of this test it was discovered that IMR was stable at level I(0) and GDP was stable at firs difference I(1). At the fourth step of examination, Durbin Hausman Co-integration test which considers cross-sectional dependency between series and which can be used while y I(1) – x I(0) was conducted and as a result of this test we led to the conclusion that there is a long-run relationship between IMR and GDP.

At the last step of examination, in order to reveal relationship between health and economic development clearly, long-run co-integration coefficients were estimated by using Panel CCEMG estimator. As a result of this estimation, it was discovered that, 1% decreasing on imr increases 0.27% GDP per capita and 1% increasing on GDP per capita decreases 0.09% IMR.

To conclude, thesis of increasement of GDP per capita causes better health outcomes for population and improvement of health status of population causes economic development in long term was proved empirically.

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