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Effect of health on economic growth: A panel data study of developed and developing countries

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Abstract

In this paper , we investigate the effect of health, such as fertility rate, total (birth per woman), life expectancy at birth, total (years) and mortality rate, under-5(per 1000 live birth), as well as capital stock on the economic growth of 16 developed countries and 14 developing countries using Panel Unit Root and Panel Data Model for the period 1990-2010. In this investigation we have found that capital stock and life expectancy have a statistically significant positive effect on economic growth in both groups of countries. Mortality rate has a statistically significant negative effect on economic growth in both groups of countries. On the other hand fertility rate has a statistically significant positive effect on economic growth in developed countries while it has a statistically significant negative effect on economic growth in developing countries. Also the study results show that the fixed effects approach is more appropriate.

Keywords: Economic growth, Capital Stock, Fertility rate, Life expectancy at birth, Mortality rate, under-5

Introduction

Health is one of the important indicators of economic growth and human development which can affect production levels of one country through different channels. One of the important channels which have been mentioned in many studies is better performance of healthy laborers compared to others. Healthy workers can work more and better than others and they have more creative mind than others. In addition to this direct effect, health has some indirect effects on production. For example, improving health in human resources can be a motivation for continuing education and acquiring better skills; because improving health condition, on one hand, will increase attractiveness of investment in training and on the other hand, with increased learning ability, would motivate persons to continue their education and acquire more skills. Furthermore, improving health condition and its indicators which result in decreasing mortality rate and increasing life expectancy, would motivate persons to save. Following the increased saving in a society, physical capital will increase and it would affect, indirectly, economic growth and effectiveness of labor force.

Evidence shows that economic growth and health process are major issues in discussions on social development and public policy (e.g.Sen, 1998). Life expectancy at birth (LEB) is a major indicator of population health. Being a composite (inverse) index of all age-specific mortality rates, LEB is often used to compare health levels between nations or regions, or across time (e.g. Sen, 1981; Sen, 2001; Brady *et al.*, 2007; Kulkarni *et al.*, 2011; Riley, 2001)

Mushkin *et al* (1962) indicates human capital formation, with the help of health services, and education are based on the argument that people develop themselves when they invest in these assets and will earn a future return with them. Bryant (1969) indicates health and health services can improve or retard economic development and social and economic changes within a region.

Malenbaum (1970) used a step regression equation with macroeconomic data of 22 poor countries, using agricultural output as the independent variable, with several social, economic and health data as dependent variables. With this, he showed how the influence of

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health factors on output seems to be larger compared with other economic and social variables. As a conclusion, Malenbaum (1970) suggests health programs could change the happenings of the lives of the poor by taking their own decisions and to have the feeling to influence the events on their everyday activities, which often accept them as pre-ordered. Grossman *et al.*, (1972) and Bloom, David and Canning (2000) explain healthy individuals are more efficient at assimilating knowledge and, in consequence, obtain higher productivity levels. Preston (1976) examined cross-country data on life expectancy and national incomes for the approximate periods 1900, 1930, 1960 and discovered that the curves showed an upward shift over time. For a given income level, life expectancy was highest in 1960s. Moreover, per capita GDP above $600 (in 1963 prices) had little impact in raising the highest life expectancy (73 years) in the 1960s. While recognizing that shifts in the curves had multiple causes, Preston attributed approximately 15% of the gains in life expectancy to income growth, but was less optimistic about the role played by nutrition and literacy. In an early empirical review of the impact of health on economic development, Sorkin (1977) concluded that health, seen through reductions in mortality, had an important impact on economic growth during the early twentieth century. However, he comments increases in the health status of the population of developed nations will have little impact on economic growth, but the impact could be different for developing nations. For this matter, he points out several ways how health programs could have an impact on economic development on developing nations.

Barro (1996) performed a research with the subject of "Health and Economic Growth" by Cobb-Douglas production function. In this study the effect of life expectancy as a representative variable of health along with other variables such as the number of middle and high school students, the government consumption, terms of trade, democracy index and inflation rate investigated. This study showed the positive effect of representing variable of health on economic growth. Bloom *et al.*, (2001) conducted a research on The Effect of Health on Economic Growth with the Panel Data method and showed: public health status at its general level (it means healthy people in the society) is determinant of embodiment and positive benefiting of the potential workforce in community. Moreover accumulation of knowledge requires the use or application of living hours of healthy individuals which leads to the embodiment and objectification of knowledge in different people. These two positive effects of public health on economic performance are considered explicitly by Bloom and Canning.

Their main result from the study is that hygiene & health have a significant effect on economic growth; scilicet one year of increase in life expectancy at the society will cause four percentages of enhancements in national output. This is relatively a large effect that indicates cost increase for improving health may be acceptable through the influence on labor productivity.

Bhargava *et al.*, (2001) investigated effects of health on economic growth and showed that ASR (adult survival rate) has a positive effect on GDP growth rates in low-income countries. Gymah and Willson, (2004) investigated the effects of health human capital on the growth rate of per capita income in Sub-Saharan African and OECD countries. They found that 22% and 30% of the transition growth rate of per capita income in Sub-Saharan African and OECD countries respectively can be attributed to health. The structure of the relationship between health human capital and the growth rate of income in Sub-Saharan African countries was similar to the structure of the relationship in OECD countries. This implied that increased stocks of health human capital leads to higher steady state income. Narayan *et al* (2010) examined the relationship between health and economic growth: based on evidence from a panel of 5 Asian countries they found that in the long-run, while health, investment, exports, EDRD (the interaction term between education and R&D), and R&D have contributed positively to economic growth, imports have had a statistically significant negative effect while education has had an insignificant effect. They drew important policy implications from their findings. Renton *et al* (2012) Examined economic growth and decline in mortality in developing countries, and found in the poorest countries, social-economic change is likely to be a more important source of health improvement than technical progress. Technical progress, operating by increasing the size of the effect of a unit of GDP on health, is likely to benefit richer countries more than poorer countries, thereby increasing global health inequalities.

Few studies have been done on the health and economic growth. Most studies on human capital have focused on education as a measure of human capital, and less attention has been paid to health. While the quality of the workforce is spoken, the unique training, skills and experience are not, people's health should also be considered as a factor in the accumulation of human capital. The present

study may be considered as a complementary study to the previous studies on the relationship of health and economic growth. Our goal here is to continue studies and given the fact that effect of health on economic growth in various countries is different, we conducted the study in the form of two models for both developing and developed countries.

The aim of this study is to examine effect of health, such as capital stock, F(Fertility rate, total(birth per woman)), L(Life expectancy at birth , total (years)) and M(Mortality rate,under-5(per 1000 live birth)) on economic growth for 16 developed countries and 14 developing countries for the 1990-2010 by using panel data method.

The paper is organized as follows: Section 2 describes the data and methodology. Section 3 briefly describes the model used. Section 4 discusses the empirical results. Section5 provides the conclusions drawn from the in the study.

Materials and Methods

Data

We utilized annual data covering the period from 1990 to 2010 for 16 developed countries and 14 developing countries. The original data for the GDP per capita (constant 2000US$), capital stock, F (Fertility rate, total (birth per woman)), L (Life expectancy at birth, total (years)) and M (Mortality rate, under-5(per 1000 live birth)) were obtained from the World Development Indicators (WDI) of the World Bank database. The data for capital stock were obtained from the international monetary Fund (IMF) database. All variables are measured in natural logs. In the study, the classification of the countries, based on Human Development Index (HDI), is adopted from the UNDP website. According to the aforesaid criterion, 47 countries in the world have a very high human development which would be categorized as of developed countries. In this research, we investigate 16 out of these 47 countries. The investigated countries include: Argentina, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Japan, South Korea, Norway, Portugal, Spain, the Netherlands, and Sweden.

Moreover, based on the aforementioned criterion, 93 countries in the world have high and medium human development, which are classified as developing countries. In this research, we investigate 14 out of these 93 countries. The countries are the following: Columbia, Egypt, Iran, Thailand, Brazil, Philippines, Indonesia, Morocco, Bulgaria, China, India, Peru, South Africa, and Tunisia.

Materials and Methods

Using the econometric techniques with panel data approach has some advantages. These include panel data, the provision of suitable context for the development estimation methods and the theatrical results which help the researchers use cross-sectional time series to analyze issues which are not possible to be studied in either just cross- sectional or just time series (e.g. Baltagi, 2005).

Baltagi (1995) demonstrate that methods of panel data can bring into play the temporal- spatial variables. While time- series and cross-sectional studies did not have this ability. Therefore one advantage of panel data method is that estimations are unbiased and consistent. This model also provides more information, more variability, less collinearity, more degrees of freedom and more efficiency and can better represent adjustment (matching or correction) dynamics; cross-sectional distributions that seem to be relatively constant do not show multiple changes (multilateral dynamics); however, these changes are studied better by Panel Data methods. Panel data method has a better capability in identifying and measuring the effects that are not readily predictable in cross-sectional or specific time studies and this model allows more complex behavioral models be prepared and testes in comparison to cross-sectional or specific time series data.

Panel unit root tests

To study the stationary of variables we apply Levin, Lin and Chu (LLC) (e.g. Levin *et al.*, 2002). Im, Pesaran and Shin (IPS) (e.g. Im *et al.*, 2003), Fisher - Dickey Fuller (ADF) (Dickey *et al.*, 1979), and Fischer - Philips Perron (PP) (Phillips and Perron, 1988) that are mentioned by Madala and Wu (1999) (e.g. Maddala and Shaowen, 1999), and Choi (ADF). These four tests are from the most important unit root tests in panel data; although, different methods may present conflicting results. In all these tests the null hypothesis indicate that there is a unit root.

Model and theoretical framework

Our models are based on the regression such as suggested in (e.g.Bhargava *et al.*, 2001).

$$GROWTH_{it}=a_0+a_1LOGK_{it}+a_2LOGF_{it}+a_3LOGL_{it}+ + a_4LOGM_{it}+\varepsilon_{it}$$

Where "growth" represents log *GDP* per capita, K_{it} is the log Capital Stock, F_{it} is the log fertility rate, total (births per woman), L_{it} is the life expectancy at birth, total (years) and M_{it} is the mortality rate, under-5 (per 1000 live births), and $I = (1,2,..,N)$ represents the number of cross-section which are cross-section of the 30 countries in this study is, and $t = (1,2,..,T)$, represents the period of time which is the period examined in this study are 20 years for developed and developing countries.

Results

Results of panel unit root test

The results of the panel unit root tests are displayed in Tables *1* and *2*. Five test statistics are calculated for each variable (developed and developing countries). *(1)* The results for developed and developing countries show that most of the variables in both groups of countries are stationary in the level form, and the variable GDP after first- order differencing, would be stationary.

Table 1. Results of panel unit root test for developed countries

	Unit root test	LLC	Breitung	IPS	Fisher-ADF	Fisher-PP
Levels	GDP	1.69306	2.06766	0.89698	23.0595	7.96635
	K	-1.08349	-3.52858***	-2.95016***	56.4989***	43.2472*
	F	-10.2771***	0.67630	-4.13568***	163.930***	19.1293
	L	4.56437	1.84789	-1.32087*	53.0011**	43.9327*
	M	-5.25108***	2.24480	-6.92694***	130.270***	51.6338**
First difference	GDP	-9.93308***	-2.15167**	-8.57024***	126.656***	133.789***
	K	-13.3137***	-7.36940***	-12.4856***	187.392***	351.658***
	F	-5.59966***	-6.06258***	-11.3651***	173.217***	180.272***
	L	-3.88648***	-2.69173***	-20.5927***	346.764***	641.856***
	M	-2.78739***	-3.23765***	-3.33305***	66.3883***	60.5068***

*** denotes significance at the 1% level, ** denotes significance at the 5% level, *denotes significance at the 10% level.

Table 2. Results of panel unit root test for developing countries

	Unit root test	LLC	Breitung	IPS	Fisher-ADF	Fisher-PP
Levels	GDP	0.99275	3.01183	2.08684	17.1051	8.86750
	K	-1.69826**	-2.47615***	-1.55331*	36.6999	32.8648
	F	-9.36220***	3.76469	-5.46576***	326.694***	281.551***
	L	2.88179	8.68864	-0.48381	143.772***	78.2119***
	M	-3.98805***	-1.64935**	-3.36580***	79.3930***	47.9586**
First difference	GDP	-11.6367***	-5.86590***	-12.3359***	229.492***	223.382***
	K	-13.1385***	-6.38289***	-13.3496***	187.932***	286.597***
	F	-5.78994***	-0.22942	-5.33758***	169.374***	296.035***
	L	-8.03283***	3.28351	-12.7940***	272.120***	77.7671***
	M	77.7671***	-1.11300	-1.33119*	35.2191	37.9015

*** denotes significance at the 1% level,** denotes significance at the 5% level, *denotes significance at the 10% level.

Table 3 contains the regression result. We estimated the growth equation (Eq. (1) by various estimation methods: (a) pooled ordinary least squares (OLS), individual fixed effects for 30 countries (16 developed countries and 14 developing countries).

Next, we estimate the long-run elasticity's for the effects of capital stock, Fertility rate, and Life expectancy at birth and Mortality rate, under-5 on economic growth. To achieve this, as explained earlier, we use the OLS estimator. The results are reported in Table 3. The results can be summarized as follows. First, we find that, capital stock, Fertility rate and Life expectancy at birth have a statistically significant and positive impact on economic growth for the panel of 16 developed countries. A %1 increase in capital stock leads to at most 0.25% increase in economic growth, a %1 increase in fertility rate

leads to at most 0.04% increase in economic growth, a %1 increase in Life expectancy leads to at most 1% increase in economic growth and each %1 increase in Mortality rate, under-5 leads to at most 0.18% decrease in economic growth, also for developing countries the results show that, each %1 increase in capital stock leads to at most 0.08% increase in economic growth, a %1 increase in fertility rate leads to at most 0.13% decrease in economic growth, a %1 increase in Life expectancy leads to at most 1.43% increase in economic growth and a %1 increase in Mortality rate,under-5 leads to at most 0.40% decrease in economic growth.

Table 3. The health and economic growth for developed and developing countries

Developed countries	Long-run	Developing countries	Long-run
Log (k)	0.252713***	log (k)	0.086598
Log(f)	0.045441***	log (f)	-0.132649
Log (l)	1.000793***	log (l)	1.439824
Log (m)	-0.188048***	log (m)	-0.409568
R -squared	0.99	R-squared	0.99
Prob(F-statistic)	0.000000	prob (F-statistic)	0.000000
DW	1.99	DW	2.01

*** denotes significance at the 1% level.

Conclusion

The literature that examines the impact of health on economic growth is growing. Our aim was to contribute to this literature but from a different perspective. We examined this impact by using four variables, namely capital stock, F (Fertility rate, total (birth per woman)), L(Life expectancy at birth, total (years) and M(Mortality rate, under-5 (per 1000 live birth) with a panel data framework making use of recent developments in panel data econometric analysis, such as panel unit root. We were able to acquire the long-run impact of health indexes on economic growth for 16 developed countries and 14 developing countries for period 1990-2010.

We have found that there is a positive relationship between capital stock and life expectancy on economic growth. The effect of capital stock is much stronger in developed countries than in developing countries, while the effect of life expectancy is stronger in developing countries. As to the point that life expectancy has a positive effect on growth in developed and developing countries, it can be stated that healthcare and life quality improvement policies should be followed in order to increase life expectancy and investment increase policies (consumption decrease, economic security promotion, export growth, *etc.*) should be followed in order to increase growth in developed and developing countries. According to the results, the Mortality rate, under-5(per 1000 live birth) has a negative effect on economic growth in most of the developed and developing countries. As a matter of fact, it is an important point that the Mortality rate, under-5 (per 1000 live birth) is a reflection of the overall function of the socioeconomic system in the countries, which influences the literacy, education etc. status. Consequently, decrease of the death rate will be one of the factors influencing the economic growth. Since different studies have demonstrated that social stress, poverty, inequality, and injustice have negative effects on life expectancy and public health level both in children and in adults, it is strongly recommended that the governments pay special attention to decrease of social environment's anxiety and stress in order to increase life expectancy and decrease children death rate.

In this study we have found that fertility rate has a positive effect on economic growth in most of the developed countries while it has a statistically significant negative effect on economic growth of developing countries. Since population growth has stopped in most developed countries for many years, the population is on the verge of aging and the problems associated with this issue are of great importance. Therefore, the more the fertility rate is, the more it indicates emergence of a young population, which comprise a productive and entrepreneur population. Therefore, the relationship between growth and fertility rate has been evaluated as positive. In other words, the more population growth is, the more the young and productive population and the growth rate. This

situation is different from those of developing countries, since in these countries population growth rate is high, so limited part of population would be able to use economic facilities.

As a result, we suggest that population controlling policies, which controlled fertility rate, should be followed by developing countries and avoided by developed countries.

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