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RESEARCH ARTICLE

Health and Economic Growth in Iran based on Spatial Econometrics Approach

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Abstract

In this paper, we have investigated the relationship between health and economic growth, for 28 provinces of Iran using spatial econometrics method. Also we have examined the provincial spatial spillover. First, we find that "health expenditure to GDP" has a negative effect and "number of hospital beds per capita" has a positive effect, and both are significant. Second, we find that there is no strong evidence of the existence of spatial spillover effects. The findings imply the improper allocation of resource in health sector.

Keywords: *Economic Growth, Health, Spatial spillover*.

Introduction

Development and growth have positive effects on people's lives; therefore, they are the top priority of policymakers and must identify the factors that affect them. In this regard, many variables have been identified that influence economic growth and among them, the health component and recently human capital variables have been used in numerous studies. Research in this field can be taken by: Narayan and Mishra [1] have studied relationship between health and economic growth; Li and Huang [2] argue that effects of the health and education on economic growth, Weil [3] has estimated effect of health on economic growth, Granados and Ionides [4] have discussed about reversal of the relation between economic growth and health progress in Sweden and Mayer [5] argue that long-term health impact on economic growth in Latin America.

Clearly, the comprehensive economic growth of every country needs to grow in all parts of the country; therefore, the study of factors affecting smaller areas (such as province, state, etc.) is unavoidable. To study it, for better evaluate the necessity of using spatial data can be quite noticeable. As Anselin [6] described the growth in the country, with emphasis on the effects of combined spillover and important elements and mentions "therefore the geographical dimension must be studied" [7].

When faced with spatial data and geographic conventional econometric methods failed to give results (due to spatial effects: spatial dependence and spatial heterogeneity). This problem is caused by ignoring the effects of neighborhood, and regional spillover between the variables. To avoid this problem, spatial econometrics should be used. Bai, Ma and Pan [8] have analyzed spatial structure of the provincial economic growth and the spatial spillover in China. Kuo and Yang [9] have assessed how and to what extent knowledge capital and technology spillover contribute to regional economic growth in China. Zhang and Kanbur [10] argue that some basic facts on the evolution of spatial inequalities in education and healthcare in China over the long run.

In this paper, we used data from the Iranian provinces over 9 years (2001-2009), to examine effects of components of health on economic growth using spatial econometric method and to answer the questions like to: "Is there significant spatial spillover between provinces in the specified time or not?" and "Is there significant effect of health components on economic growth in Iran or not?".

Theoretical Model

The theoretical framework of this paper follows the procedures of Li and Huang [2]; we consider the Solow model extended to include human capital in two forms -education and health- cross sectional case. The Cobb-Douglas production function with labor-augmenting technological progress, for time period t, is:

$$Y(t) = K(t)^{\alpha} E(t)^{\beta} H(t)^{\gamma} \big(A(t)L(t)\big)^{1-\alpha-\beta-\gamma}$$
$$\alpha, \beta, \gamma > 0, \gamma < 1, \alpha + \beta + \gamma <$$

where Y is output, K is physical capital, E is human capital of education, H is human capital of health, L is labor and A is the level of technology. The model assumes that $\alpha + \beta + \gamma < 1$, which implies that there is decreasing returns to all capital (If $\alpha + \beta + \gamma = 1$, then there are constant returns to scale in the reproducible factors. In this case, there is no steady state for this model). L and A grows are exogenously given at rates n and g:

$$L(t) = L(0)e^{nt} \quad (2)$$

$$A(t) = A(0)e^{gt} \quad (3)$$

The growth rate of the number of effective unit of labor,$A(t)L(t)$, is therefore $n + g$. The rates of savings, population growth and technological progress are constant and are exogenously given.

Definess_k,s_e, and$s_h$as the constant fractions of output that is invested in physical capital, education, and health. Define k, e and h as the stocks of physical capital, education, and health per effective unit of labor, respectively, i.e. k=$\frac{K}{AL}$,$e = \frac{E}{AL}$,$h = \frac{H}{AL}$. Similarly, define y as the level of output per effective unit of labor, i.e. $y = \frac{Y}{AL}$. Therefore the output y can be written as

$$y(t) = k(t)^{\alpha} e(t)^{\beta} h(t)^{\gamma} \quad (4)$$

The dynamics of $k, e,$ and h are given as the following:

$$\dot{k} = s_k y(t) - (n + g + \delta)k(t) \quad (5)$$
$$\dot{h} = s_h y(t) - (n + g + \delta)h(t) \quad (6)$$
$$\dot{e} = s_e y(t) - (n + g + \delta)e(t) \quad (7)$$

where δ is the rate of depreciation (assumed to be constant for all provinces). This implies that k, e, and h converge to their steady-state values k^*, e^* and$h^*$where

$$k^* = \left(\frac{s_k^{1-\beta-\gamma} s_e^{\beta} s_h^{\gamma}}{n+g+\delta}\right)^{\frac{1}{\theta}} \quad (8)$$

$$e^* = \left(\frac{s_k^{\alpha} s_e^{1-\alpha-\gamma} s_h^{\gamma}}{n+g+\delta}\right)^{\frac{1}{\theta}} \quad (9)$$

$$h^* = \left(\frac{s_k^{\alpha} s_e^{\beta} s_h^{1-\alpha-\beta}}{n+g+\delta}\right)^{\frac{1}{\theta}} \quad (10)$$

with $\theta = 1 - \alpha - \beta - \gamma$. Substituting Equations (3), (8), (9), and (10) into the production function (4) and taking logs, we obtain the implied steady-state per capita GDP: (1)

$$\ln y(t) = \ln A_0 + gt + \frac{\alpha}{\theta} \ln s_k + \frac{\beta}{\theta} \ln s_e + \frac{\gamma}{\theta} \ln s_h - \frac{1-\theta}{\theta} \ln(n + g + \delta) \quad (11)$$

where $y = \frac{Y}{L}$ is the per capita output.

Econometric Methodology

Spatial econometric studies of economic growth have not been widely used. Because it requires using formulated effects of place and space in the desired range and calculates the effects of the spillover on neighboring regions, respectively. So, spatial econometric method is more difficult than conventional methods. From the perspective of spatial econometrics, Anselin [6] said "a collection of techniques that deal with the peculiarities caused by space in the statistical analysis of regional science models". For contribute these spatial observations and regional in the model, first; due to the spatial effects (spatial dependence (or spatial autocorrelation) and spatial homoscedasticity) in the observations, OLS method to estimate the parameters of model is impossible (this is due to lack of correctly specification model). Second, the interpretation of the estimated parameters has been more complicated. The same token a brief definition of spatial effects is essential:

Spatial Dependence

Spatial dependence is relationship between what happens at one point in space and another point. It may be caused by two reasons. First, there is measurement error in different regions. The second reason is more fundamental and it is derived of different phenomena in spatial reaction.

Regarding to first reason, the aggregation data be collected. It could be there is no match between the phenomenon under study and observations. It will lead to spread between the borders. Therefore, the observation error in spatial unit i may be associated with the error in the j neighboring space.

Spatial Heterogeneity

"Spatial heterogeneity" refers to deviation of relationships between observations in space the geographical locations. Assuming a linear relationship is as follows:

$$\boldsymbol{Y}_i = \boldsymbol{X}_i \boldsymbol{\beta}_i + \boldsymbol{\varepsilon}_i \quad (12)$$

Whereas i, represents observations at i = 1,…,n points in space ; X_i represents a vector of explanatory variables and β_i parameters associated with set and Y_i the dependent variable in the observed or the location i. According to the above equation, distribution of sample observations for mean and variance were not constant.

To consider spatial effects in the regression model, two factors must be considered in parallel. First, space should be a factor in regression equations. Second, econometric regression models should be applied in spatial structure. In order to consider the space or place, two methods "contiguity" and "spatial expansion" are used (spatial expansion is related Casseti. in this paper, the same approach is used. More information is available at Lesage (1999) [11].

For structure sectional regression models in spatial econometrics, there are two main methods. In the first method, spatial autoregressive model (SAR), the spatial lag of the dependent variable appears in the right side of the equation. This model is presented as follows:

$$y_{it} = \rho W y_{it} + X_{it}\beta + \varepsilon_{it} \quad (13)$$

$$\varepsilon_{it} \sim N(0, \sigma^2 I_n)$$

Whereas i represents the geographical unit (that in this paper is provinces of Iran), y_{it} logarithm of per capita GDP for provinces of Iran, X_{it} the set of other control variables, β Coefficient, ρ Coefficient of "spatially lagged" dependent variable and also spatial dependence described in the observations of sample [12], W is the spatial weighted matrix which represent the spatial autoregressive process (Using latitude and longitude).

In the second method, spatial error model (SEM), regression equation has been spatial autocorrelation in the disturbance terms. This model is presented as follows:

$$y_{it} = X_{it}\beta + u_{it}$$

$$u_{it} = \lambda W u_{it} + \mu_{it} \quad (14)$$

$$\mu_{it} \sim N(0, \sigma^2 I_n)$$

Whereasy_{it},X_{it}, β, W interpret as before and λ is the spatial error coefficient (For more information about the other models and spatial econometric methods can refer Lesage [11] and Anselin [6].

Is there a Spatial Dependence Problem?

An intuitive and useful way to start analyzing spatial dependence is by looking at figure 1. In this figure, we have divided Iran map to its provinces and based on the average per capita GDP between 2001 to 2009 into three groups, low GDP (per capita GDP of below 15,000 Iranian Rials), middle GDP (per capita GDP between 15000 and 20000 Iranian Rials) and high GDP (per capita GDP of more than 20,000 Iranian Rials). Due to large differences in average per capita GDP in Tehran province with other provinces (about 6,689 Rials difference with the highest per capita GDP in other provinces) we have highlighted this province as a separated category from the others.

A quick look at the map can be seen provinces with high per capita GDPs are concentrated in around Tehran province and in the vicinity of the Persian Gulf (the oil region and place of importation to Iran and bordering with high per capita GDP countries). Also, provinces with lower per capita GDP have been focused in western and southeastern regions. It caused by two reasons. 1- Stay away from the capital, 2- and bordering with low per capita GDP countries. Also, Provinces with middle per capita GDP are located among the regions with high per capita GDP and low per capita GDP.

The map analysis has implies the relative dispersion of per capita GDPs in different regions of the cluster and also spatial relationship shows between per capita GDP in different regions of Iran, relatively. The next step is to test "existence of spatial dependence" using spatial econometric techniques, whether spatial dependence exists between the Iranian provinces or not?

Four major tests for spatial dependence specification are used as follows:

- Moran's I-statistic
- Likelihood ratio test
- Lagrange multiplier test
- Wald test

The most common test to assess the presence or absence of spatial dependence is Moran I-statistic.

Data

To estimate the growth equation we have used cross sectional data of 28 provinces of Iran and time series information over 9 years (2001-2009) that we've used average of these years in this research.

The data set includes some of usual variable used in growth regressions and variable as substitutes for health care expenditure. We have a GDP per-capita on the left side of equation but the effect of oil has been removed from GDP. This data has received from Central Bank of Iran and all of numbers are expressed in term of million rials. The macroeconomic variables included in the right hand side are:

- Population growth rate: We have extracted the data of this variable from Central Bank of Iran.
- Health expenditure to GDP: We have extracted these data from Central Bank of Iran. The data calculated from division of health care expenditure to GDP.
- Number of high school students: We have extracted the data from Statistical Yearbook of Iran. The data is the number of high school students for every thousand people in each province.
- Number of hospital beds: We extracted the data from Statistical Yearbook of Iran. The data is the number of hospital bed for every thousand people.

Result

According to the table 1, which has been described a summary of the estimation results, in both models predicted by the spatial models and OLS standard model, “health expenditure to GDP” and “number of hospital beds per capita” are significant. This is a significant impact per capita GDP on the health in Iran. Of course “health expenditure to GDP” significantly with negative sign and very large coefficient is wonderful. Also the “growth rate of population” is significant. The “number of high school students” on the level of per capita GDP is ineffective, that this result is not so surprising [13].

The second part of the table is devoted to examining the presence or absence of spatial dependence. According to the Moran’s I-statistics is observed that spatial spillovers between provincial health variables for Iran can’t be accepted (significant at the 5% level as determined and significant at the 10% level as boundary). As well as, the results for the three other statistics verify this.

Spatial spillovers effects studied according to the data and the statistics are very weak [14-15].

Conclusion

This paper uses spatial econometrics to estimate a standard growth model that includes between-provincial interdependence, in which a province’s economic growth depends on the growth of its neighbors. Therefore, the data has been used in 28 provinces during 2001-2009. According to theoretical foundation, health capital is expected to have positive impact on GDP growth. For this purpose, the two variables, “health expenditure to GDP” and “number of hospital beds per capita”, was used as a representative for health. The former has a unexpected negative effect and the latter has a positive effect, and both are significant. Based on tests of spatial spillover, there is no strong evidence of the existence of spatial spillover effects.The significant negative impact of health expenditure ratio on provincial growth may be attributed to lack of optimal allocation of resource in health sector in Iran. Thus, policymakers should make efforts to improve expenditure allocations toward more cost-effectiveness uses such as infrastructures and public health.

References

1. Narayan S, Narayan PK, Mishra S (2010) Investigating the relationship between health and economic growth: Empirical evidence from a panel of 5 Asian countries. J. Asian Economics 21(4):404-411.
2. Li Hongyi, Liang, Huang (2009) Health, education, and economic growth in China: Empirical findings and implications. China Economic Review.20(3):374-387.
3. Weil, David N (2007) Accounting for the Effect of Health on Economic Growth". The Quarterly Journal of Economics. Vol 122.No 3.pp 1265-1306.
4. Granados Jose A Tapia, Edward L Ionides (2008) The reversal of the relation between economic growth and health progress: Sweden in the 19th and 20th centuries. J. Health Economics. 27(3)544-563.
5. Mayer David (2001) The Long-Term Impact of Health on Economic Growth in Latin America. World Development. 29(6):1025-1033.
6. Anselin L (1988) Spatial Econometrics. Methods and Models. Dordrecht: Kluwer Academic.
7. Ramirez Maria Teresa, Ana Maria, Loboguerrero (2005) Spatial dependence and economic growth: Evidence from a panel of countries. Economic growth issues. L.A.Finley. pp 23-51.
8. Bai Chong-En, Hong Ma, Wenqing Pan (2012) Spatial spillover and regional economic growth

in China. China Economic Review, 23(4):982-990.

9. Kuo Chun-Chien, Chih-Hai Yang (2008) Knowledge capital and spillover on regional economic growth: Evidence from China". China Economic Review, 19(4):594-604.

10. Zhang Xiaobo, Ravi Kanbur (2005) Spatial inequality in education and health care in China. China Economic Review, 16.(2):189-204.

11. Lesage James P (1999) The Theory and Practice of Spatial Econometrics.

12. Lesage James P, Robrt Kelly Pace (2009) Introduction to Spatial Econometrics. Chapman and Hall/CRC.

13. Easterly William (2002) The Elusive Quest for Growth: Economists Adventures and Misadventures in the Tropics. The MIT Press. Cambridge. Massachusetts.

14. Central Bank of the Islamic Republic of Iran. (2012) National Accounts of Iran. Retrieved from http://cbi.ir/SimpleList/2072.aspx.

15. Statistical Centre of Iran. (2012) Statistical Yearbook. Retrieved from http://salnameh.sci.org.ir/AllUser/DirectoryTreeENComplete.aspx

Appendix 1

Table 1: Result of tests and estimations

Province	28					
Estimation Method	**OLS**		**SAR**		**SEM**	
R-Square adjusted	0.8274		0.8292		0.8408	
Variables	**OLS**		**SAR**		**SEM**	
	Coefficient	**P-Value**	**Coefficient**	**P-Value**	**Coefficient**	**P-Value**
- Spatial Lag	---	---	0.0999	0.4676	0.3810	0.1188
- Constant	10.4466	0.0347	10.1158	0.0165	11.4619	0.0077
- Population growth rate	2.2798	0.0009	2.1814	0.0001	2.4328	0.0001
- Health expenditure to GDP	-340.3977	0.0000	-345.3903	0.0000	-326.0328	0.0000
- Number of high school students	0.1041	0.0888	0.0901	0.0968	0.0794	0.1311
- Number of hospital beds	10.3130	0.0000	10.0811	0.0000	9.9826	0.0000

The spatial correlation test:

Moran's I-statistic	**Value**		**P-Value**	
	1.9287		0.0538	
Lagrange multiplier test	**SAR**		**SEM**	
	Value	**P-Value**	**Value**	**P-Value**
	0.5794	0.4466	0.9789	0.3225

Appendix 2

Fig. 1: Clustered Iran map