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The Strategic Role of Infant Mortality in the Process of Economic Growth: An Application for High Income OECD Countries

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Abstract

Health is one of the necessary elements in order to socially develop a society. Providing quality and affordable healthcare is one of the most important challenges facing many nations. Developing and pervading the health services accelerate socio-economic development. Thus, there has been a strong relation between the level of social welfare and health measure. Because development is not only the rate of per capita income, but also includes basis social indicators such as infant mortality rate, life expectancy, health expenditure, and education.

Using panel data analysis techniques, this study investigates empirically the relationship between economic growth and infant mortality that is one of the basis variables of health sector over the period 1970-2007 for a sample of 25 high income OECD countries. Our empirical evidence reveals that there is a significant and negative relationship between infant mortality rate and real per capita GDP in selected countries. So, it is concluded that the infant mortality rate of the countries decreased as countries became rich and powerful and new levels of strategic thinking, which will find innovative solutions, have an important role in decreasing infant mortality rate and growing economic power of the countries.

Keywords: Infant mortality rate, Economic growth, Panel data analysis.

Introduction

Innovation and strategy are crucial to overcoming healthcare issues. Innovation is defined as people working together to develop and implement new ideas creating value. Strategy is a plan of action designed to reach a particular goal. Innovation without strategy is not relevant, and strategy without innovation is not sustainable. Providing quality and affordable healthcare is one of the most important problems facing many nations. The increasing costs of care affect both government and business. Furthermore, it affects the rapid spread of disease to vulnerable populations. Thus, today's healthcare issues require new levels of strategic thinking, which will find innovative solutions (Thomas and Wolf, 2009).

Fleuren et al. (2004) represented the main stages in innovation process and related categories of determinants. According to the authors, characteristics of the socio-political context, is one of the innovation determinants, contain willingness of the patient to cooperate with the innovation, financial burden of the innovation implemented on the

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patient, and as a result of innovation the physical and emotional effects on patient. From the other determinants, characteristics of the organization consist of the implemented decision-making process in the organization, can be classified as top-down and bottom-up, the hierarchical procedures in the organization, the number of employees in the organization, the frequency of staff turnover in the organization, and the degree of staff capacity in the department implementing the innovation. Determinants related to the adopting person or health professional are as following: support from of colleagues in implementing the innovation, support from of other health professionals in implementing the innovation, extent to which the health professional has the skills needed to implement the innovation, extent to which the health professional has the knowledge, and the extent to which the health professional has ethical problems with the innovation. Finally, characteristics of the innovation are specified as the frequency of use of the innovation, the observability of results of the innovations, the relative advantages of the innovation, the necessity of the innovation for the patient by the authors (Fleuren et al. 2004).

Determining the health problems, the solution of the problems, the planning, programming and evaluating of the studies are depend on numerical statement of health issues. With this aim, obtained worthies are defined as the health measure (Özden, 1993: 17). It can be counted infant mortality rate, total mortality rate, nutritional conditions, average life expectancy, the number of doctor consultations per capita, hospital beds density per 1000 population, total expenditure on health and health policies as the health measures (Kızılçelik, 1996: 40).

Income is an important factor affecting directly or indirectly health as well. Higher income level have shaped the conditions to effect life quality by providing better qualified goods, have better life conditions and better housing and better sanitation. Thus, income is important factor affecting substantially and positively health level. Many studies both on a cross-sectional data and panel data basis support the view that there is a statistically significant and positive relation between income and health status.

.In this study, the relationship between real per capita GDP and the infant mortality rate is examined. The infant mortality rates are affected by the factors such as the nutrition, the genetical status, the abortion, age of mother, tobacco smoke, alcohol and drug consumption as well as social factors (Corman and Grossman, 1985: 213-236). But, this study is focused on the relationship between the infant mortality rate and real GDP.

The structure of this study is the following. Next, we examine the previous literature on health care determinants. Section two describes the data and methods and section three reports the empirical results. Finally, the study ends with a conclusion.

1. Literature Review

Many researchers believe that the distribution of material well being is improved by the increase in per capita GDP. Goldstein (1985) assumes that economic factors have strongly effect on infant mortality rates. Similarly Ram (1985) mentions that average per capita income is important variable about the improvement in basis needs fulfillment. According to Bruno et al. (1996) and Deininger and Squire (1996), the economic growth reduces poverty depending on the level of income distribution (Kalim and Shahbaz, 2010).

Kalim and Shahbaz (2010) investigate the causal relationship between economic growth and social development in Pakistan for the period of 1971-2005. They used social development index that comprise constituents such as telephone lines, urban population, life expectancy at birth, infant mortality rate, calories intake, the ratio of physicians, pupil teacher ratio, and adult literacy rate. They conclude that the effect of social development on economic growth is much greater than the effect of economic growth on social development. Similarly, Hussain, Malik and Hayat (2009) investigate the relation between demographic variables and economic growth in Pakistan for the period of 1972-2006, using time series econometric technique. They emphasize that reduction in the infant mortality rate will contribute in positive direction in improving the pace of economic growth.

Fuchs (1974) asserts that a minimum income level is quite important in people's health care, however, when it is exceeded this income level, especially in developed countries, there hasn't been a high correlation between health indicators and income. Pritchett and Summers (1996) estimate an income elasticity of child mortality between -10,2 and -10,4 for developing countries and they conclude that the direction of this relation is from income to health status, which means that increasing income will improve positively health status.

Ozcan (2002) show that mortality rate decline working through the channels of education and fertility promotes economic growth. McGuire and Frankel (2005) differently than other researchers focus on the subjects such as modernization, education, and disease control instead of the rate of growth, the provision of safe water and sanitation, fertility rate. They assert that modernization, education, and disease control played important role in reducing the risk of early death in Cuba between the years 1900 and 1960. Corman and Grossman (1985), who investigated the effect of mother's education on the infant mortality rate, find that mother's education have a negative and significant effect on the infant mortality.

Strulik (2004) point out that geographic location has a purely exogenous effect on mortality. Bloom and Sachs (1998) show that tropical population are disadvantaged population in life expectancies at birth even after controlling for income levels. Thereby, according to Bloom and Sachs (1998), tropical regions affect negatively economic development (Strulik, 2004).

Younger (2001) investigates the reasons of decreases in the infant mortality rate since its distributional characteristics are sensitive to the welfare of the poor, and estimates a cross country model for declines in infant mortality using growth regressions. Younger (2001) concludes that both the number of doctors and the number of hospital beds have no a significant effect, while primary school enrolments and diphtheria vaccination rates for infants have statistically significant effect on the decline of infant mortality rates.

Jamison, Jamison and Hanushek (2006) show that improved education quality increases the rate of decline in infant mortality especially in open economies than in closed economies. Cutler, Deaton and Muney (2006) support the view that there is a direct positive effect of education on health.

Using a cross-country dataset, Papageorgiou and Stoytcheva (2008) examine the relationship between female human capital inequality and infant mortality. They show that infant mortality rates reach to higher levels as education inequality among women measured by Gini coefficient rises.

Zakir and Wunnava (1999) test the factors affecting infant mortality rates using cross-sectional data for the year 1993. They use the number of births per women (fertility rates), female literacy rate, per capita GNP, percentage of women in labour force and government spending on health-care as the dependent variables in explaining infant mortality rates. They conclude that fertility rates, female participation in the labour force, per capita GNP and female literacy rates significantly affect infant mortality rates. But, government expenditure on health as a percentage of GNP doesn't play an important role in explaining infant mortality rates.

2. Data and Methodology

2.1.Data

We investigate the impact of the real per capita GDP on the infant mortality rate. For this purpose, the equation (1) is estimated with the two-way fixed effects estimator.

$$IMR_{i,t} = \alpha + \beta_1.GROWTH_{i,t-1} + v_{i,t} \tag{1}$$

We used the growth rate of the real gross domestic product per capita in first differenced logarithmic form (GROWTH) and the infant mortality rate (IMR) as data in this study. Data were gathered on yearly basis from 1970 to 2007 of 25 countries. Real per capita GDP (RGDP) data were taken from Penn world table 6.3 version and IMR data were obtained from OECD 2009 health database and E views 6.0 is used in order to carry out in this study.

The countries consist of Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, The United Kingdom, and The United States.

The descriptive statistics of the variables used in the regression analysis are presented in Table 1. As can be seen our sample countries grew, on average around 10% infant mortality rate, and real GDP per capita in excess of $23000.

Table 1. Descriptive Statistics of Selected Variables

Variables	Mean	St.Deviation	Min (country)	Max (country)
IMR	9.931	6.82	1.40 (Iceland)	55.5 (Portugal)
RPGDP	23055	9138	5680 (Poland)	77581 (Luxembourg)
Observation	950	950	950	950

Author's calculations

Note: The table gives descriptive statistics for the variables used in the regression. RPGDP denotes real per capita gross domestic product, IMR denotes the infant mortality rate that is defined as the number of infants dying before reaching one year of age, per 1,000 live births in a given year.

2.2. Empirical Analysis

2.2.1.Panel Unit Root Tests

Firstly, we test the stationarity of the variables included in the regression model in order to obtain unbiased estimations. In this sense, we use the approaches of Im, Pesaran and Shin (2003) (hereafter IPS), ADF Fisher, PP Fisher, Levin, Lin and Chu (2002) (hereafter LLC). A first generation of models has analyzed the properties of panel-based unit root tests under the assumption that the data is independent and identically distributed (i.i.d) across individuals.

In general, this type of panel unit root tests is based on the following regression:

$$\Delta Y_{i,t} = \beta_i . Y_{i,t-1} + Z_{i,t} . \gamma + u_{i,t} \quad (2)$$

where i = 1,2,…,N is individual, for each individual; T=1,2,…,T time series observations are available, $Z_{i,t}$ is deterministic component and $u_{i,t}$ is error term. The null hypothesis of this type is ρ_i=0 for $\forall_i$. The first of first generation panel unit root tests is LLC that allow for heterogeneity of individual deterministic effects and heterogeneous serial correlation structure of the error terms assuming homogeneous first order autoregressive parameters. They assume that both N and T tend to infinity but T increase at a faster rate, so N/T $\rightarrow$0. They assume that each individual time series contains a unit root against the alternative hypothesis that each time series stationary. Thus, referring to the model (2), LLC assume homogeneous autoregressive coefficients between individual, i.e. $\beta_i = \beta$ for all I, and test the null hypothesis $H_0 : \beta_i = \beta = 0$ against the alternative $H_A : \beta_i = \beta \prec 0$ for all i. The structure of the LLC analysis may be specified as follows:

$$\Delta Y_{i,t} = \alpha_i + \beta_i . Y_{i,t-1} + \delta_i . \tau + \sum_{j=1}^{p_j} \phi_{ij} . \Delta Y_{i,t-j} + u_{it} \quad (3)$$

where i = 1,…, N t= 1,…,T τ is trend, α_i is individual effects, u_{it} is assumed to be independently distributed across individuals. LLC estimate to this regression using pooled OLS. In this regression deterministic components are an important source of heterogeneity since the coefficient of the lagged dependent variable is restricted to be homogeneous across all units in the panel (Barbieri, 2006). Other test, IPS test allows for residual serial correlation and heterogeneity of the dynamics and error variances across units. Hypothesis of IPS may be specified as follows:

$$H_0 : \beta_i = \beta = 0 \quad H_A : \beta_i \prec 0 \quad \text{for all i}$$

The alternative hypothesis allows that for some (but not all) of individuals series to have unit roots. IPS compute separate unit root tests for the N cross-section units. IPS define their t-bar statistics as a simple average of the individual ADF statistics, t_i, for the null as:

$$\bar{t} = \sum_{i=1}^{N} t_i / N$$

It is assumed that t_i are i.i.d and have finite mean and variance and E(t_i), Var(t_i) are computed using Monte-Carlo simulation technique. Other test Maddala and Wu (1999) consider deficiency of both the LLC and IPS frameworks and offer an alternative testing strategy (Barbieri, 2006). MW is based on a combination of the p-values of the test statistics for a unit root in each cross-sectional unit.

2.2.2. Estimation

The-Two Way Fixed Effects Model

Fixed effects model can be formulated as

$$y_{it} = x'_{it}.\beta + \alpha_i + \varepsilon_{it} \tag{4}$$

where α_i denotes all the observable effects and it is group-specific constant term in the regression model. α_i equals $z'_i.\alpha$ in the regression (4). If z_i is unobserved, but correlated with x_{it}, then the coefficient of β is biased and inconsistent under assumptions of $E(u_{it}) = 0$; $E(u^2_{it}) = \sigma^2$ all i; $E(u_{it}.u_{jt-s}) = 0$ for $s \neq 0$ and $i \neq j$

$$y_{it} = \alpha_0 + X_{it}.\beta + \alpha_i + \gamma_t + \varepsilon_{it} \tag{5}$$

Equation (5) can be formulated as a two-way fixed effects model controlling for unmeasured time-invariant differences between units and unit-invariant differences between time periods. α_i denotes individual-specific effects and γ_t denotes period-specific effects (Worrall and Pratt, 2004).

3. Empirical Results

Table 2 shows the results of first generation panel unit root tests for used the variables. As is seen from Table 2, the results show that null hypothesis of a unit root for real per capita GDP data can be rejected at the 5 % significance level in first difference and logarithm form of the variable, while the results indicate that IMR series is stationary at the 5 % significance level.

Table 2. Panel Unit Root Tests (1970-2007)

Series	LLC	IPS	ADF	PP
RPGDP	5.82 (1.00)	12.23 (1.00)	3.44 (1.00)	3.53 (1.00)
DLRPGDP	-15.57*(0.00)	-14.86*(0.00)	305.51*(0.00)	317.80*(0.00)
IMR	-24.06*(0.00)	-16.36*(0.00)	355.23*(0.00)	417.84*(0.00)

Author's calculations
Note: Probability values are reported in the parentheses. * denotes the rejection of the null at the 5% level. The operator D is difference operator. L is the logarithm of the variable.

Table 3. Test of Cross-Section and Period Fixed Effects

Redundant Fixed Effects Tests **Test cross-section and period fixed effects**			
Effects Test	**Statistic**	**d.f.**	**Prob.**
Cross-section F	**23.897265**	**(24,863)**	**0.0000**
Cross-section Chi-square	471.356045	24	0.0000
Period F	**11.985913**	**(36,863)**	**0.0000**
Period Chi-square	375.050134	36	0.0000
Cross-Section/Period F	**24.080978**	**(60,863)**	**0.0000**
Cross-Section/Period Chi-square	909.886152	60	0.0000

Author's calculations

Table 3 shows the results of test of both cross section and period fixed effects. We estimate the relationship among the infant mortality rate and real per capita GDP using two-way fixed effects estimator. Employing the two-way fixed effects model will give reliable results since the probability values of both cross section F and period F statistic are smaller than significance level (0.05).

Table 4. The Results for Two-way Fixed Effects Model

Dependent Variable: **IMR**				
Coefficient	**t-ratio**	**Std. error**	**Prob.**	
C (constant)	38.48	3.39	11.33	0.00
DLRPGDP	**-2.89**	**-2.54**	**1.13**	**0.01**

Author's calculations

The results obtained from the two-way fixed effects are shown in Table 4. The coefficient of -2.89 can be interpreted as 10 percentage increases in host country's real per capita GDP will lead to decrease the infant mortality rate in the ratio of 28.9 percent. The coefficient has the expected sign and is statistically significant. According to the empirical findings, real per capita GDP have a negative impact on the infant mortality rate as expected.

4. Conclusion

Income is a factor affecting directly or indirectly health. Higher income level have shaped the conditions to effect life quality by providing better qualified goods, have better life conditions and better housing and better sanitation. Thus, income is important factor affecting substantially and positively health level. This study supports the view that there is a positive relation between income and health status as many other studies both on a cross-sectional data and panel data basis.

The infant mortality rate is one of the important indicators from the health measure. The infant mortality rates are affected by the factors such as the nutrition, the genetical status, and the abortion, age of mother, tobacco smoke, alcohol and drug consumption as well as social factors.

In this study, we investigate the impact of the real per capita GDP on the infant mortality rate. For this purpose, we used the real gross domestic product per capita and the infant mortality rate as data in this study. Data were gathered on yearly basis from 1970 to 2007 of 25 countries. Firstly, we applied the first generation panel unit root tests. After stationarity tests had been carried out, it was investigated the relationship between the infant mortality rate and real per capita GDP. So, we concluded that real per capita GDP seemed to respond negatively to infant mortality rate in 25 high income OECD countries. Also, this empirical evidence obtained with developed panel estimation method is consistent with other studies subjected to this issue. Consequently, we conclude that we conclude that the countries, which give an answer to innovation, are more successful in diminishing infant mortality rate than others.

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Appendix: Data Sources

The infant mortality rate data is gathered from *OECD Health Data 2009*

Historical real per capita GDP data is from the University of Pennsylvania and is published in their *Penn World Data Table Version 6.3*