

Nabila Asghar¹, Asma Awan², Hafeez ur Rehman³
HEALTH/GROWTH DYNAMICS IN PAKISTAN:
A SIMULTANEOUS MODEL

This study is an attempt to reveal health/growth dynamics in Pakistan for the period 1974-2009 using simultaneous model consisting of two stochastic equations. Simultaneity is confirmed through the application of Hausman simultaneity test, and stationarity of the variables is observed through Ng-Perron unit root test. Using full information method 3SLS the study supports strong positive association between health and economic growth and confirms two-way causation between the variables. The study points out to the need to invest in human capital for raising workers' productivity. The study suggests that the government should pursue growth-directed economic policies for achieving social well-being of the masses.

Keywords: health; economic growth; simultaneous model; 3SLS.

JEL Classification: F43, I1.

Набіла Асгар, Асма Аван, Хафіз ур Реман
ДИНАМІКА ОДНОЧАСНОГО ЗРОСТАННЯ ЕКОНОМІКИ ТА
ОХОРОНИ ЗДОРОВ'Я В ПАКИСТАНІ: СИНХРОННА МОДЕЛЬ

У статті зроблено спробу виявити динаміку одночасного зростання економіки та охорони здоров'я в Пакистані за період 1974-2009 р.р. з використанням синхронної моделі, що складається з двох стохастичних рівнянь. Синхронність підтверджено застосуванням тесту синхронності Хаусмана, а стаціонарність змінних перевірено критерієм одиничних коренів Ng-Перрона. Використовуючи метод повної інформації 3SLS, дослідження підтверджує сильний позитивний зв'язок між здоров'ям та економічним зростанням і двосторонній причинний зв'язок між цими змінними. Вказано, що існує необхідність інвестицій у людський капітал для підвищення продуктивності робітників. Робота показує, що уряд повинен продовжити розвиток політики, спрямованої на зростання економіки і досягнення соціального добробуту мас.

Ключові слова: здоров'я; економічне зростання; синхронна модель; 3SLS.

Набіла Асгар, Асма Аван, Хафіз ур Реман
ДИНАМИКА ОДНОВРЕМЕННОГО РОСТА ЭКОНОМИКИ И
ЗДРАВООХРАНЕНИЯ В ПАКИСТАНЕ: СИНХРОННАЯ МОДЕЛЬ

В статье сделана попытка выявить динамику одновременного роста экономики и здравоохранения в Пакистане за период 1974-2009 г.г. с использованием синхронной модели, состоящей из двух стохастических уравнений. Синхронность подтверждается применением теста синхронности Хаусмана, а стационарность переменных проверяется критерием единичных корней Ng-Перрона. Используя метод полной информации 3SLS, исследование подтверждает сильную положительную связь между здоровьем и экономическим ростом и наличие двусторонней причинной связи между переменными. Указывается, что существует необходимость инвестиций в человеческий капитал для повышения производительности рабочих. Работа показывает, что правительство должно продолжить развитие политики, направленной на рост экономики и достижение социального благополучия масс.

¹ PhD Scholar, Department of Economics, Government College University, Faisalabad, Pakistan.

² PhD Scholar, Department of Economics, University of Punjab, Lahore, Pakistan.

³ Professor, Chairman, Department of Economics, University of Punjab, Lahore, Pakistan.

Ключевые слова: *здоровье; экономический рост; синхронная модель; 3SLS.*

Introduction. Since the evolution of growth theory, growth economists and social scientists have extensively tried to analyze the relationship between health and economic growth (Romer, 1986; Lucas, 1988; Rebelo, 1991). Many studies consider human capital vital for economic growth and conclude that economic returns of better health are strong, sizeable and responsible for variations in economic growth across the regions (Hansen and King, 1996). Life cycle models have also laid emphasis on the significant role of health in determining future income and consumption levels (Smith, 1998, 1999). However, researchers have paid less attention to the two-way relationship between health and economic growth. Ehrlich and Lui (1991) and Meltzer (1995) made initial efforts in this regard. Pritchett and Summers (1996) pointed out that causality runs from income to health and Easterlin (1999) and Bloom and Canning (2000) asserted that causality runs from health to income.

Recent wave of theoretical literature has directed attention of researchers towards bidirectional relationship between health and economic growth indicating that economic growth results in more research and innovations in medical science, better sanitation facilities, improved nutrition and increased health services which lead to improvement in health through an increase in life expectancy and reduction in infant mortality rate. Weil (2007) asserted that a healthier person accompanied with longer life expectancy always saves and invests more during his/her lifetime. The study concludes that health not only increases workers' productivity through enhancing physical and mental capacities but also raises labour participation rate which raises incomes of workers.

In the context of Pakistan various studies have been conducted on health-growth nexus, which primarily aim at modeling the economic effects of health on economic growth and these studies ignore the bidirectional relationship between the variables. However, positive impact of health on economic growth has been supported by recent studies. Being signatory to Millennium Development Goals (MDGs) and keeping in view the improvement in health indicators, Pakistan has launched various programmes under national health policy and has experienced an improvement in health indicators over time due to control of various diseases, expansion of immunization, provision of training to nursing staff and health care facilities. Historical profile of health indicators and health expenditure is reported in Table 1.

Table 1 shows that health conditions in Pakistan have improved over time and nearly fourfold increase in total health expenditure have been observed since 1998. However, the spending on health as percentage of GDP remained low throughout the reference period. This calls for a need to increase expenditure on health as a percentage of GDP for improving health conditions particularly in the rural areas of the country.

The objective of this study is to contribute to the existing literature through joint determination of health growth dynamics within the framework of simultaneous model in Pakistan and to recommend policy options in the light of empirical findings. This study differs from other studies as it uses simultaneous model consisting of two stochastic equations and 3SLS estimation technique.

Table 1. Health Indicators and Expenditures in Pakistan, selected years

Years	Infant Mortality Rate Per 1000	Life Expectancy (Years)	Crude Birth Rate	Total Health Expenditure (bln. Rs.)	Health Expenditure as % of GDP
1970	109	50.6	—	0.195	0.45
1978	95	56.5	40.9	1.07	0.67
1984	127	60.9	43.3	3.09	0.83
1988	108	—	40.5	7.17	1.19
1994	101.4	60	37.6	10.56	0.75
1998	81.5	62	32.7	19.18	0.77
2004	82.0	63.9	27.8	32.81	0.58
2008	70.2	63.7	28.7	60.00	0.57
2009	68.2	64.1	28.4	74.00	0.56

Source: Pakistan Economic Survey, various issues.

The organization of the study is as follows: Section 2 reviews past empirical research; data and model specification are presented in Section 3; research methodology, results and discussion are presented in Section 4; and Section 5 concludes the research with policy recommendations.

Review of Literature. There is an ample theoretical and empirical literature available on the link between health and economic growth. The pioneer work of Myrdal (1952) threw light on the nature and economic gains of health for economic growth. Grossman (1972) developed a model augmented with health capital variable and shows that increased health status helps the workers to work more and earn more. Mankiew et al. (1992) used extended Solow model by including human capital in addition to other variables and supported the view that health is indeed a critical input for economic growth. Empirical literature on health-growth nexus can be subdivided into two broad categories, i.e. micro- and macrolevel studies. Microlevel studies include the work of Stronks et al. (1997); Bhargava (1997); Strauss and Thomas (1998); Savedoff and Schultz (2000) and Liu et al. (2003) among others and these studies stated the positive effect of health on workers' productivity. Macrolevel studies include World Bank (1980); Wheeler (1980); Meltzer (1992); Barro (1997) and Gallup and Sachs (2001) among others and these studies found positive association between health and economic growth.

Bloom et al. (2001) used Two Stage Least Square (2SLS) approach to estimate the Solow growth model augmented with human capital as an additional variable and find that health capital has significantly contributed to economic growth. Bhargava et al. (2001) used adult survival rate and life expectancy as a proxy for health and find positive association between health and economic growth. However, when they used fertility rate as a proxy for health, they came up with negative association between health and economic growth. Weil (2005) finds that health explained income variations across countries. The study concludes that 17% to 20% of the variability in economic growth among countries can be attributed to the difference of the availability of health facilities.

Not many studies are available in the existing literature that analyzed the relationship between health and economic growth in the context of Pakistan economy. The nature and strength of relationship between the two variables are not clear. Using OLS technique for estimation, Malik (2005) failed to find association between health

and economic growth, but he finds significant impact of health on economic growth as 2SLS technique is used for estimation on the same model. Khan et al. (2008) tried to investigate long- and short-run dynamics of health-growth nexus for the period 1972-2006 using Johansen cointegration approach and error correction model. This study found positive long-run relationship between health (life expectancy and mortality rate) and economic growth, but failed to find significant long-run relationship between health expenditure and economic growth. Saboor et al. (2009) attempted to measure the long-run association between health expenditure and economic growth during 1980-2004 using Johansen cointegration approach. The study failed to find significant association between the variables.

After reviewing empirical literature related to health-growth nexus, it can be concluded that the existing literature supported the viewpoint that health is an essential ingredient of economic growth in developing countries. Many studies conducted on the subject matter are confined to single equation model in which there is a possibility of wrong inference, especially in the presence of simultaneity between health and economic growth. To the best of our knowledge, not a single study is available that have utilized 3SLS estimation techniques in analyzing health-growth nexus in Pakistan. This study is an attempt to investigate the health-growth dynamics within the framework of multiequation model for Pakistan. The results of the study may be helpful for policy makers for designing the health policy consistent with the economic conditions of the country.

Data and Model Specification. Using annual data the present study investigates the relationship between health and economic growth for the period 1974-2009. Data has been taken from Pakistan Economic Survey (various issues) and World Development indicators. The study uses life expectancy as an indicator of health. Jacobs and Rapaport (2002) claim that social scientists prefer this indicator as it captures duration of survival. Economic growth is measured in terms of real gross domestic product (RGDP) and adult literacy rate is used as a proxy for educational status of the population.

Model Specification. The study uses the following structural equations to investigate the health-growth interactions in Pakistan.

Health Equation:

$$\ln Health_{1t} = \alpha_{10} + \alpha_{12} \ln RGDP_{2t} + \beta_{11} \ln AID_{1t} + \beta_{12} \ln Edu_{2t} + \varepsilon_{1t} \quad (1)$$

Economic Growth Equation:

$$\ln RGDP_{2t} = \alpha_{20} + \alpha_{21} \ln Health_{1t} + \beta_{23} \ln ED_{3t} + \beta_{24} \ln GovtExp_{4t} + \varepsilon_{2t} \quad (2)$$

α_{12} and α_{21} represent coefficients of dependent variables whereas betas (β s) indicate coefficients of exogenous or independent variables. From the above model, it can be observed that simultaneity is present in the model as RGDP determines health in first equation whereas health itself determines RGDP in second equation.

Endogenous Variables

ln Health = Log of health

ln RGDP = Log of real gross domestic product

Exogenous Variables

ln AID = Log of foreign aid

$\ln \text{Edu}$ = Log of Education

$\ln \text{ED}$ = Log of external debt

$\ln \text{GovtExp}$ = Log of government expenditure

The expected signs of the variables are positive except β_{23} that carries negative sign while β_{24} may take positive or negative sign.

Theoretical Expectations

Health Equation. Equation 1 shows that health is determined by economic growth (RGDP), foreign aid, and education (adult literacy rate). It is expected that economic growth has positive impact on health, therefore, α_{12} will be positive. The possible rationale behind this positive association is that economic growth results in provision of better health facilities and an increase in spending on health. Foreign aid is also expected to be favourable for health in capital scarce country like Pakistan as it can be used effectively to assist health projects needed for economic development of the country. Burnside and Dollar (1998) concluded that foreign assistance is effective in reducing infant mortality rate only under strong economic management. In addition to this, Fielding et al. (2005; 2006) also found positive impact of foreign aid on health outcomes.

Education exerts positive impact on health as it enhances health related awareness and gives various choices and opportunities that result in better health status. According to Adams (2002), health economists have widely acknowledged the positive relationship between education and health. Grossman and Kaestner (1997) concluded that there exists a positive causal relationship between education and health. Therefore, parameters related to education and foreign aid are expected to be positive.

Economic Growth Equation. Equation 2 describes economic growth as a function of health, external debt and government expenditures. Health positively effects economic growth through human capital formation, therefore, α_{21} is expected to be greater than zero. Many studies have supported positive relationship between life expectancy and economic growth (see, for example, Weil, 2007). These studies concluded that increased life expectancy is the result of human capital investment which is regarded as an engine of economic growth. Bloom and Canning (2005) considered health a form of human capital which raises economic growth.

The coefficient of external debt is expected to be negative due to debt overhang hypothesis¹. Geiger (1990) and Sawada (1994) found negative and significant relationship between foreign debt and growth. With regard to impact of government spending on economic growth, literature appears to be inconclusive. Some studies supported positive association (see, for example, Aschauer, 1990; Alexiou, 2007) and others concluded that an increase in government size hampers the process of economic growth (see, for example, Lee, 1995). The literature shows that the positive and negative outcomes depend upon the nature of expenditures, mode of financing, economic management and prevailing economic conditions of the country.

Research Methodology, Results and Discussions.

Stationarity Tests. Before investigating the nature of long-run relationship between the variables included in the model, it is considered to be imperative to

¹ Debt overhang is a situation where the debt of a nation exceeds its future capacity to service.

determine the order of integration of the selected variables. In the literature various standard unit root tests are available, like ADF, PP and Ng-Perron, for observing the stationarity of the variables. Most of the studies have used ADF and PP tests for determining the order of integration of the variables. These tests have some weaknesses that make the result somewhat unreliable. Ng-Perron test is considered to be more powerful and recommended as it overcomes the issues related to poor size and power distortions. Therefore, this study uses Ng-Perron test for observing the order of integration of the variables. In order to conserve space and time the study will not offer detailed explanation of unit roots test as they are well-documented in the existing literature.

The unit root test results reveal that all the variables are not stationary at levels. However, variables appear to be stationary at first difference, i.e. I(1).

After confirming the order of integration of the variables, all the assumptions of 3SLS approach are confirmed. In order to conserve the space the results are not reported here. However, the results may be provided to the interested readers upon request.

Table 2. Ng-Perron Test Results 1974-2009

Variables	MZ _α		MZ _t		MSB		MPT	
	Deterministic terms		Deterministic terms		Deterministic terms		Deterministic terms	
	c	c, t	c	c, t	c	c, t	c	c, t
Ng-Perron in Levels								
ln health	-1.84	2.71	-0.76	0.83	0.41	0.30	10.87	38.35
ln RGDP	1.13	-7.34	0.96	-1.91	0.85	0.26	53.49	12.40
ln Aid	1.70	-7.06	1.11	-1.83	0.65	0.25	37.40	12.95
ln Edu	0.07	-4.51	0.04	-1.48	0.55	0.32	22.06	20.05
ln Debt	1.50	-2.79	2.0	-1.13	1.33	0.40	129.8	31.25
ln Govtexp	-1.37	-15.79	-0.55	-2.81 [^]	0.39	0.17 [^]	11.63	5.77 [^]
Ng-Perron in First Differences								
dln health	-46.7*	0.72	-2.52**	0.25	0.15*	0.35	2.73**	39.29
dln RGDP	-17.3*	-17.4**	-2.91*	-2.92**	0.16*	0.16 [^]	1.53*	5.40**
dln Aid	-46.8*	-46.6*	-4.82*	-4.81*	0.10*	0.10*	0.56*	2.02*
dln Edu	-22.06*	-17.4**	-3.32*	-2.95**	0.15*	0.16 [^]	1.11*	5.23**
dln Debt	-17.84*	-17.4**	-2.97*	-2.87 [^]	0.16*	0.16 [^]	1.42*	5.65 [^]
dln Govtexp	-12.3**	-12.45	-2.48**	-2.49	0.20**	0.20	1.99**	7.32
Critical values ^a								
1%	-13.8	-23.8	-2.58	-3.42	0.17	0.14	1.78	4.03
5%	-8.10	-17.3	-1.98	-2.91	0.23	0.17	3.17	5.48
10%	-5.70	-14.2	-1.62	-2.62	0.27	0.18	4.45	6.67

Note: * denotes significance at 1 %, ** denotes at 5 % and [^] denotes at 10 % significance level. a > Asymptotic critical values taken from Ng-Perron (2001, Table 1). c – denotes constant and c, t – denotes constant and trend. MZ_α – Modified Philips-Peron test. MZ_t – Modified PP t-test = MZ_α * MSB. MSB – Modified Sargan-Bhargava test. MPT – Modified Point Optimal test.

3SLS Results. The results of 3SLS are presented in Table 3.

Table 3 reports the estimates of 3SLS along with the respective probabilities. The results of the study show that most of the variables are statistically significant and have expected signs. Furthermore, the empirical results also support bidirectional relationship between health and economic growth. The summary statistics are reported

in the lower part of Table 3. It can be observed that the value of R2 is fairly high and standard error of regression is reasonably low for both equations.

Table 3. 3SLS Estimates of Health-Growth Model 1974-2009
Dependent Variables: ln Health and ln RGDP

Variables	Health equation (ln Health)	Economic growth equation (ln RGDP)
Dependent Variables		
ln Health1t	—	6.34* prob (0.01)
ln RGDP2t	0. prob (0.01)	—
Independent Variables		
ln Aid1t	0.016 prob (0.77)	—
ln Edu2t	0.083** prob (0.03)	—
ln Debt3t	—	0.434** prob (0.04)
ln Govtexp4t	—	0.026 prob (0.36)
Intercept	3.30* prob (0.0)	-20.46* prob (0.01)
Summary Measures		
R ²	0.948	0.937
Adjusted R2	0.943	0.932
SE of Regression	0.013	0.17

Note: * and ** show significance of the variable at 1% and 5% respectively.

Discussion Related to Estimates of Health Equation. In health equation 2 out of 3 variables are statistically significant, i.e. ln RGDP and ln Edu. Both variables have positive impact on health with reported coefficients 0.048 and 0.083 respectively. The low value of coefficients may be due to the fact that economic performance of Pakistan remained highly volatile in the past two decades. Therefore, the economy was unable to provide sufficient inputs required for improvement in health standards. This indicates that available health facilities help raising social welfare, workers' productivity and their income, but this appears to be quite negligible. It brings up the need for substantial increase in government expenditure particularly on education as it tends to develop health behaviour necessary for better health.

The coefficient of foreign aid appears to be positive but insignificant. This shows that foreign aid exerts negligible impact on health. It may be due to the reason that foreign aid is not properly utilized in Pakistan due to mismanagement, acceptance of conditional foreign aid, corruption and poor governance. As a result Pakistani economy fails to achieve maximum benefits from foreign aid.

Discussion Related to Estimates of Economic Growth Equation. The results of the study show there exists a positive and significant relationship between health and economic growth. Pakistan spends less than 2% of GDP on health, but still improvement in various health indicators has been observed during the past two decades. It may be due to the reason that an increase in health facilities leads to an increase in productivity, life expectancy and improvement in human and physical capital, which in turn lead to an increase in economic growth.

The relationship between external debt and economic growth appears to be positive and significant. This finding is consistent with the study of Siddiqui and Malik (2001). They conclude that foreign debt of Pakistan is positively related to economic growth whereas foreign debt servicing is negatively related to economic growth. The positive association between foreign debt and economic growth may be due to the

availability of sufficient resources needed for development purposes and the use of modern technology in the production process particularly in industrial sector.

This study finds positive and insignificant relationship between government spending and economic growth, therefore, no valid inferences can be drawn from this result.

Conclusion and Recommendations. The present study is an attempt to explore the relationship between health and economic growth in Pakistan using annual data for the period 1974-2009. After confirming the stationarity of the variables through Ng-Perron unit root test, simultaneous model is estimated with 3SLS method. The results show that most of the variables are aligned with theoretical expectations and support bidirectional relationship between health and economic growth. Both variables cause each other, however, the economic impact of health on economic growth appears to be substantial as indicated by larger value of respective coefficient. Furthermore, the study finds that education (adult literacy rate) contributes significantly to raising health standards. Surprisingly, foreign debt has positive impact on economic growth in Pakistan. The impact of government expenditures on economic growth appears to be positive and insignificant. The key finding of the study is that there exists a bidirectional relationship between health and economic growth in Pakistan. The results of the study point out that Pakistan needs to spend more on human capital for achieving sustained economic growth accompanied with social welfare. Proper management of all social welfare-based programmes is the only way to achieve decent standard of living. Furthermore, there is a need to formulate and implement sound macroeconomic policies consistent with the prevailing economic conditions of the country for achieving rapid economic growth.

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Стаття надійшла до редакції 16.05.2012.