Health Inputs, Health Outcomes and Public Health Expenditure: Evidence from the BRICS Countries

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Abstract: This study aims at examining the differences in the health care systems of emerging economies of BRICS based on the panel data fetched from the World Health Organization and World Bank Databases. It estimates the health production function based on Grossman's theoretical framework. Despite of its limitations, the estimation of health production function can help indicate the relative significance of these factors. This may help policy makers to focus on the most effective variables given the fiscal constraints. The study is based on the analysis from the panel data of the five BRICS nations, Brazil, India, China, Russian Federation and South Africa. The analysis is based on the panel data regression with fixed effects model.

The results show a positive relation between health outcome and the GDP Per capita, Adult literacy rate, and Out of Pocket expenditure. The environmental pollution represented by CO_2 emissions per capita metric ton and Female workforce participation rate shows a negative relation with health outcomes. The age dependency ratio also shows a positive elasticity with IMR confirming the negative relation between age dependency relation and health production. The public health expenditure is showing a positive elasticity with IMR. This implies that higher public expenditure indicates higher IMR or lower health outcomes.

The efficiency of public expenditure for financing quasi-public goods like education or health is debatable .The evidence from the BRICS countries in the present study reinstates that an increase in the size of public health expenditure alone cannot assure increased health outcome, unless the quality of delivery and finance system is significantly improved.

Keywords: Health Outcomes, BRICS, Public Health Expenditure
JEL Classification: I 1, I 113, I 118, H51

1. Introduction

The reform of health delivery system is one of the essential elements of overall development of a country. Most common policy response to the demand for improved healthcare is to increase the public health expenditure. However, taking into account the complexity of the determinants of health outcomes, it can be naïve to presume a direct positive relation between public health expenditure and health outcome. The Governments in developed countries with better health indicators have large growing public health expenditures; nevertheless the role of public expenditure in health care provision has been constantly debated.

The literature shows that incase of some countries an expansion of public expenditure improves the health outcomes whereas in some cases it is ineffective .The issue becomes complicated due to the involvement of a variety of factors in the health care production function. There are a number of empirical studies examining the effects of health determinants on health outcomes. Most of these studies provide international comparison for developed country groups e.g. OECD countries whereas others are based on micro data for an individual country. The policy makers in emerging economies and the less developed countries should not overlook these evidences.

This paper aims at examining the differences in the health care systems of emerging economies of BRICS based on the panel data fetched from the World Health Organization and World Bank Databases. It estimates the health production function based on Grossman's theoretical framework. In spite of its limitations, the estimation of health production function can help indicate the relative significance of various factors in production of health .This may help policy makers to focus on the most effective variables given the fiscal constraints. The study is based on the analysis from the panel data of the five BRICS nations, Brazil, India, China, Russian Federation and South Africa.

The study is divided into five sections. Section 2 provides a literature survey. Section 3 explains the theoretical model used for the present study. The methodology and data sources used in the study are discussed in Section 4. The study is concluded in Section 5.

2. Literature Survey

The literature on health production function examines the relation between various socio-economic and environmental factors as inputs producing health outcomes. These studies bring out the relative significance of various factors as inputs into the health production. These studies can be broadly classified into international comparisons and country specific studies. The international comparisons examine the relative importance of these health inputs across the country groups while country-specific studies examine the health inputs and public expenditure effects on various regions within a country.

International Comparisons:

The seminal paper on Health Production Function by Grossman (1972) forms the underlying framework for many theoretical as well as empirical studies on health care production. Grossman treats health care as a durable capital stock that can be used for production of healthy life. This paper presents the model for demand for good health. He assumes that individuals inherit a fixed stock of health which decreases by age and can be increased by increasing investment in health. In this framework the shadow price of health care depends on many variables other than cost of health care. Grossman specifies investment in health as a function of medical care; time spent investing in health, with education as a technological shifter. He admits that other market goods besides medical care could also be in the production function, for example, housing, diet, recreation, cigarette smoking, and alcohol consumption.

The literature reports a variety of factors as health inputs. A consensus on the relative significance of these inputs for health output is also not observed in the literature. Newhouse (1977) estimated

the relationship between health care expenditures per capita and Gross Domestic Product (GDP) per capita for 13 developed countries in the early 1970s. He estimated the income elasticity to be between 1.15 and 1.31, and per capita GDP explained over 90% of the variation in health expenditures per capita.

The increasingly comprehensive and granular international data made available by the international agencies like WHO, IBRD and UNDP, has encouraged more rigorous research with larger sets of explanatory variables, larger cross section of countries, or with pooled time-series cross section data.

Manning et al (1987) estimate the effect of cost sharing on out of pocket health care spending. They use randomized data. The increase in health expenditure is observed to be positively correlated with increase in private insurance. Newhouse and Phelps (1976), treat health insurance as endogenous. They observe that if insurance is treated as exogenous, the demand for medical care responds to insurance induced variation in price. However the results are conflicting if the insurance is considered an endogenous factor (Parkin*et al*. 1987, 1989; Gerdtham and Jonsson, 1991a, 1991b; Hitiris and Posnett, 1992; Blomqvist and Carter, 1997). These studies focussed mostly on the factors determining health expenditure.

Wilkinson (1992) examines income distribution as a strong determinant of health outcome in form of increased life expectancy at birth on the basis of cross sectional analysis of developed countries. .
Pritchett and Summers, (1996) have tried to establish a link between differences in income, using measures such as GDP per capita and health status. Richer countries do have longer life expectancies and lower mortality rates. Within the group of advanced countries, such as OECD, studies indicate a statistically insignificant relationship between health outcomes and income levels (e.g. Le Grand, 1987; Hitiris and Posnett, 1992; and Judge *et al*. 1998).

These discrepancies have led some studies to focus on the other factors like differences in the distribution of income. Some studies have argued that income inequality is associated with worse health outcomes (e.g. Le Grand, 1987; Wilkinson, 1992; Smith, 1996). Kenkel (1997) investigates the relationship between schooling and health by focussing on health behaviours as the inputs into health production function. This empirical study observes that while part of the relation between schooling and health behaviour is explained by differences in health knowledge, most of schoolings effects remain after differences in knowledge are controlled for.

Anderson (1997) and Anderson *et al*. (2000) discuss differences in health outcomes between the high health expenditure USA and other countries. They find that even though the USA has spent more per capita on health than other countries, its health outcomes are not near the top. On the other hand, Wolfe (1986) argues that there is a positive link between medical expenditures and health status once lifestyle factors such as cigarette and alcohol consumption are considered. Auster *et al*. (1969) estimate mortality regressions across states in the USA as a function of medical expenditures per capita, median family income, cigarette consumption per capita, and median education.

Kutzin, Kashin and Jacob (2010) provide comparative assessment of health financing reforms in transition economies. The findings interestingly indicate effectiveness of implementation reform processes, sequencing and coordination of actions in improving health indicators.

Greene (2006) uses the World Health Organization's (WHO) panel data set on health care delivery, which is a 191 country, five year panel. The study observes that the wide variation in cultural and economic characteristics of the worldwide sample of countries produces a large amount of unmeasured heterogeneity in the data.

Berger and Messer (2010) analyze effects of public financing of health expenditures, health insurance and other factors on health outcomes using panel data across 20 OECD countries,to examine the effects of public financing of health, insurance coverage and other factors on health outcomes. The study observes significant effects of factors other than public expenditure on health outcomes and indicates that the countries may want to reduce the proportion of public expenditures.

The findings suggest that reforms aimed at increasing efficiency need to take into account the nature and causes of inefficiencies.

As observed by Grigoli and Kapsoli (2013), simply increasing public expenditure in the health sector, may not significantly affect health outcomes if the efficiency of this spending is low. The results suggest that African economies have the lowest efficiency. At current spending levels, they could boost life expectancy up to about five years if they followed best practices.

According to Musgrove (1996) the appropriate role of the state in health is complex both in economic theory and in practice. Theory identifies three reasons for state action: public goods or services with large externalities (involving efficiency); poverty (involving equity); and failings peculiar to insurance markets for health care (where both inefficiency and inequity arise). The insurance domain presents the most costly and difficult problems, and explains why, in contrast to other sectors, governments tend to finance an increasing share of health care as incomes rise.

Tandon (2004) provides a global overview of health's share of government spending and summarizes key theoretical and empirical perspectives on allocation of public resources to health vis-à-vis other sectors from the perspective of reprioritization, one of the modalities for realizing fiscal space for health.

Tandon (2004) observes that, theory and cross-country empirical analyses do not provide clear-cut explanations for the observed variations in government prioritization of health. Standard economic theory arguments that are often used to justify public financing for health are equally applicable to many other sectors including defense, education, and infrastructure. "To date, empirical work on prioritization has been sparse: available cross-country econometric analyses suggest that factors such as democratization, lower levels of corruption, ethno linguistic homogeneity, and more women in public office are correlated with higher shares of public spending on health; however, these findings are not robust and are sensitive to model specification. Evidence from case studies suggests that country-specific political economy considerations are key, and that results-focused reform effort — in particular efforts to explicitly expand the breadth and depth of health coverage

as opposed to efforts focused only on government budgetary targets — are more likely to result in sustained and politically-feasible prioritization of health from a fiscal space perspective." Tandon et al (2004)

Country specific studies:

The country specific studies focus on the relation between health inputs and health outcomes within a country. The effectiveness of increase in public health expenditure is studied across the reform process .Some studies use cross section analysis across the states to examine the effects of various health determinants on health outcomes. A number of country specific studies are published by WHO on this subject. The following section summarizes some selected representative studies.

Beer and Broomberg (1990) discuss the implementation of national health insurance program as the effective measure to improve health outcomes in South Africa.

Cavagnero et al (2006) explore specific effects of institutional changes in health sector in Argentina on health care utilization and out of pocket spending. The study observes that richer sections are more likely to prefer out of pocket spending or health insurance over the public health care .The need to improvise the quality of public health care system and delivery is observed.

Chawla, Berman and Caviorsca (1996) estimate the total expenditure on health in Poland in 1994. The study observes that private expenditure on health in Poland is a significant proportion of total expenditure on health, and in particular on financing outpatient care. Importantly, informal payments made by patients to physicians are shown to contribute as much as double of the physician's salary, and thus form an important source of earnings for physicians. These transitional economies face a big challenge in managing existing resources in the health sector more effectively to meet the health care needs of their population. The paper highlights the need for better understanding of the current availability and distribution of resources in the health sector and their directions of flow, in both public and private sectors, and suggests using tools such as National Health Accounts to track and monitor changes in the financing of the health care system.

Asenso- Okyere (1995) studies the public health financing in Ghana .This study points out inadequacy of public expenditure and great inequality in rural and urban areas as regards access to health care as the reasons for low health outcomes.

Marquez (2008) discuss selected health challenges in the Russian Federation, focusing on outcomes, expenditures and options for policy and institutional reforms in the health care system. Fayissa and Gutema (2008) estimate health production function for Sub –Saharan Africa based on Grossman framework with panel data. Overall results suggest that 'a health policy, which may focus on the provision of health, services, family planning programs, and emergency aids to the exclusion of other socioeconomic aspects may do little in efforts directed toward improving the current health status of the region'.

In India various cross sectional studies are available examining the relative significance of health inputs in health outcomes. These studies include interstate and inter country comparisons in cross

sectional framework. R.B. Lal studied private household expenditure, private and government healthcare expenditure in Singapore area (GOI, 1946). The study by Indian Institute of Management, Ahmedabad reviews health finance covering all the levels of health expenditure – state, municipal, corporate and household (IIM, 1987). Tulasidhar and Sarma (1993) did a comparative study of different states of India with respect to public expenditure, medical care at birth and infant mortality. They found that in all the states per capita real public spending grew faster than real per capita state domestic product. Duggal (1996) Bhat (1996, 2000) discuss the public-private participation in health sector and how this can be optimised for best results. The later study discusses importance of regulating the private sector in India and how public- private partnership can bring needed resources while also taking care that the vulnerable groups – the poor and rural populations – have access to health facilities.

These studies mainly focus on the dependence on private financing and out of pocket expenditure in India. The state level financing studies focus on the equity aspect of public financing of health care. (Dreze and Sen 1995; Mahal, Srivastava and Sanan 2000), Mahal et al (2000) Bhat (2004). The empirical studies are constrained by data quality, standardization issues hampering the comparability across countries. (Heijink et al, 2010)

The international comparisons across developed country groups are commonly found in the literature. However, the literature survey indicates a lack of international comparisons across emerging economies. The present study tries to estimate the health production function for emerging economies of BRICS countries based on Grossman theoretical framework.

3. Theoretical Model

The present study is based on the Grossman model for estimation of health outcomes. According to this model health care is regarded as the durable capital good used to produce health outcome. The individuals have to decide the level of investment in health to maximize utility. In Grossman model the investment in health is specified as a function of medical care, the time spent investing in health and education as a technological shifter.

The present study specifies health production function across five BRICS countries across sixteen years. On the basis of the literature reviewed in the previous section this study analyses various socio –economic and environmental factors as inputs in the production of the health good.

The studies on developed nations use Crude Mortality Rate as a proxy for health outcome (H), Grossman, (1976), Berger and Messer (2002).However, taking into account the demographic composition of the emerging economies, Infant Mortality Rate can be considered as a better indicator of health outcome. Hence, in the present study the Infant Mortality Rate (IMR) is used as a proxy measure for health outcome.

Health (H) is specified as a function of a variety of inputs including public health expenditure as percentage of GDP, total health expenditure as percentage of GDP, out of socket spending as percentage of private health expenditure and private insurance as percentage of private health expenditure, age composition and adult literacy rate, female workforce participation and pollution.

The present model includes Public health expenditure as percentage of GDP, Total health expenditure as percentage of GDP, Out of Pocket Spending as percentage of Private Health Expenditure and Private Insurance as percentage of Private health expenditure. The Private insurance and Out Of Pocket spending are the market driven factors while the public expenditure on health is the policy variable. The data on these variables is derived from the World health Organization database.

The living standard of people across these countries over the years is significant in determining health outcomes. The GDP Per Capita (Y_{PC})is considered to be a representative of living standards. The study uses per capita GDP at PPP at constant US $ at 2005 prices to enable the comparison across BRICS countries.

The positive correlation between education and health is well documented. This study includes the Adult literacy rate (L) as a proxy for level of education. The countries with higher literacy rate are expected to produce health more efficiently.

Age dependency ratio (DEM), is included, as health capital in Grossman's model depreciates with age. The higher age dependency ratio reflects lower health outcomes.
Previous studies indicate an adverse relation between Female Workforce participation rate and health outcomes. The Female workforce participation rate is believed to affect the health provision at home. The present study includes labor ratio of female to male workforce as an indicator of female workforce participation.

This study also includes CO 2 emissions per capita metric ton as an indicator of pollution across the countries over the period under study.

The production function explaining health outcomes in terms of IMR in country i in year t is as follows:

$$H_t = f\,(Y_{PCit},\ L_{it},\ DEM_{it}\ ,\ THE_{it},\ O_{Hit},\ G_{Hit},\ INS_{PVTit},\ ,FWP_{it}\ ,V_{it}) \tag{1}$$

where

H_{it} = Infant Mortality Rate for country i in year t
Y_{PCit} = GDP per capita at PPP constant US $ at 2005 prices, for country i in year t
L_{it} = Adult Literacy Rate for country i in year t
DEM_{it} = Age Dependency Ratio for country i in year t
THE_{it} = Total Health Expenditure Per Capita at PPP US $ for country i in year t
O_{Hit} = Out of Pocket Spending as percentage of Total Health Expenditure for country i in year t
G_{Hit} = Public Health Expenditure as percentage of GDP for country i in year t
$INS_{PVTit,}$ = Private Health Insurance as percentage of Total Health Expenditure for country i in year t
FWP_{it} = Labour Ratio Female to Male for country i in year t
V_{it} = CO 2 emission per capita metric ton for country i in year t

4. Data sources and Empirical Results

4.1 Data sources

The World Health Organization and World Bank Database is the primary source of data for the analysis. The data used for the analysis is for five BRICS countries including Brazil, Russian Federation, India, China, and South Africa for 16 years from 1995 to 2010.

4.2 Empirical Results

The variables and descriptive statistics are presented in Table 1 below.

Table 1 Summary Statistics

Variables	Mean	Std. Deviation	Variance
INFANT MORTALITY RATE (H)	34.9891	18.27261	333.888
GDPPC (Y)	6593.7225	3522.07757	12405030.419
PVTINSURANCE(INS)	24.7728	26.58278	706.644
ADULTLITERACY RATE(L)	83.9443	13.85497	191.960
PUBLIC HEALTH EXPENDITURE(G_H)	2.6696	1.01630	1.033
OUT OF POCKET EXPENDITURE (O_H)	72.8188	45.83745	2101.071
TOTALHEALTHEXPENDITURE(THE)	427.2000	301.14513	90688.390
CO2 EMISSIONS(V)	5.3405	3.99054	15.924
FEMALEWORKFORCE PARTICIPATION(FWP)	51.8000	12.30856	151.501
AGEDEPENDENCY RATIO (DEM)	52.1604	8.28855	68.700

Table 2 presents the estimates of equation 1. The White method is used to correct any heteroscedasticity present in the disturbance term of the regression. The fixed effect is found to be effective as the number of time series data points are larger (16 years)and the number of cross sectional data points is much smaller(5 countries). The results of the random effect model are found to be weaker and not significantly different than the fixed effect model.

Column 1 shows the regression results with GDP per Capita, Health expenditure and Age Dependency Ratio included. The dummy variables are also included in this regression to control for country and year fixed effects.

In table 2, Column 2 presents the estimated parameters for all the variables included as health inputs in the present study. The elasticity of GDP Per capita in this case is positive and significant. This is similar to the previous studies on developed countries. For example, Berger and Messer(2002), Hitris and Posnett (1992).

Table 2 Results of Fixed Effect Panel Data Analysis

Explanatory Variable	Dependent Variable LN (H)	
	Column(1)[b] Coefficient (t-Statistic)	Column(2)[b] Coefficient (t-Statistic)
$LN(Y_{PC})$	-0.061215 (-0.170428)	0.971696 (2.288249)
$LN(L)$	-	-0.425697 (-0.620101)
$LN(G_H)$	-	0.209761 (1.287341)
$LN(THE)$	-0.184975 (-0.728434)	-0.425514 (-1.547291)
$LN(INS)$	-	-0.091683 (-2.618125)
$LN(O_H)$	-	0.234239 (2.434588)
$LN(V)$	-	-0.051609 (-0.180112)
$LN(FWP)$	-	0.753499 (0.889527)
$LN(DEM)$	0.857302 (0.951995)	2.916233 (2.801554)

Notes:

 a) t – statistics is reported in the parentheses.

 b) The sample data of five BRICS countries from 1995 to 2010 is used for estimation.

Adult literacy rate shows negative elasticity consistent with the well accepted positive relation between education and health outcomes, indicating higher literacy rate resulting into lower IMR and higher health conditions.

The total health expenditure is showing a weak but significant positive elasticity. This may be explained by the large share of private health expenditure in these countries leading to inequitable access to health care.

Private insurance and Out of Pocket expenditure is showing a negative elasticity as expected. The environmental pollution represented by CO2 emissions per capita metric ton is a new variable added to the model. It is showing a positive relation with infant mortality rate.

The estimates of the Female workforce participation rate are positive supporting the hypothesis that rise in female to male labor ratio leads to lower health at home .The age dependency ratio also shows a positive elasticity with IMR as expected.

The parameter estimates for Public health expenditure is showing a positive weak but significant elasticity. This implies that higher public expenditure indicates higher IMR or lower health outcomes. This observation is recorded by many empirical studies discussed in the literature survey section. For example, Hitris and Posnett (1992), Anderson (1997) and Anderson *et al.* (2000) Berger and Messer (2010).

5. Conclusion:

The study supports the finding that in developing economies, where the per capita incomes are low, indiscriminate increase in the Government health expenditure with its high opportunity cost can have adverse effect on health outcomes. The possible reason for this anomaly can be that the marginal benefit from increased public expenditure can be less than the marginal cost of higher taxes.

The analysis presented in this study points towards the fact that increase in public expenditure is not sufficient to achieve the desired improvement in health outcomes.

The problems of efficiency of the role of Government in health provisioning arise mainly because of the peculiar nature of the health as a commodity. Health is a social good. However, it does not have all the characteristics of a pure public good. Health has positive externalities but its consumption is not characterized by non- rivalry and non –excludability which are the two typical attributes of a public good. The provision of health care is constrained by the resources at the disposal of the Government and private individual which leads to excludability and rivalry. Hence, the price mechanism works effectively. The consumption of health can also be regarded as a public good having positive externalities as it results in an increase in collective social benefits. Hence, health can be categorized as a quasi-public good.

The empirical findings of this study of emerging BRICS countries show a negative correlation between public health expenditure and infant mortality rate. These findings support the evidence from the prior literature that an increase in the size of public health expenditure cannot assure increased health outcome.

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