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To Investigate the Long–run Equilibrium Relationship Between Health Expenditure and Gross Domestic Product: A Case Study of Pakistan

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Abstract

GDP is the best single measure of the economic well being of a society. Higher the level of Gross Domestic Product (GDP) of a country higher will be the living standards. A larger GDP of a country will help to afford better health care for her citizens. This paper investigates the possible existence of long-run relationship between GDP and Health Expenditures (HE) in Pakistan for 1980-2004 using co-integration analysis. Results indicate that GDP and HE are stationary and hence a long-run relationship between the two variables cannot exist. Still the Johansen's procedure to test for co-integration between the variables was applied. The results again conformed that no co-integrating vector can be found, confirming the unit root tests. Hence GDP growth neither causes HE growth nor is affected by it.

Key words: Co-integration, granger-causality, health expenditures, gross domestic product, Pakistan.

Introduction

Gross Domestic Product (GDP) is the best single measure of the economic well being of a society. Higher the level of GDP of a country the higher will be the living standard. A larger GDP of a country will enable her to afford better health care for her citizens. GDP does not directly measure those things that make life valuable, but it does measure our ability to afford goods and services to make our lives better a meaningful life. The real GDP of Pakistan has increased substantially that is by 8.4 percent in 2004-05 as compared to 6.4 percent of last year (Govt. of Pakistan, 2004-05). In addition to growth of GDP, recent developments in medical science also contributed significantly in increasing the life expectancy in many Asian countries (World significant role in the socio-economic development of its citizens. In spite of improvement in other macroeconomic variables the progress in this sector is very slow as compared to other countries in this region. In June 2001, a new health policy was announced to reduce mortality, eliminate malnutrition and to increase the health services. As Pakistan is a signatory to the Millennium Development Goals (MDGs), efforts are being concentrated on removing the poverty and diseases.

The significance of the health sector can be realized from the fact that out of eight MDGs three are directly related to the health sector which are: (1) Reducing child mortality; (2) Improving maternal health; (3) Combating HIV/AIDS, malaria and other diseases. Both the development and non-development health expenditures have been increased in the last few years. Still there is enough scope to invest more in the health sector, because the incremental benefits generated by the additional expenditures are leveled off by the rising population of the country. Therefore this study aims to empirically examine the long-run relationship between health expenditures (HE) and the gross domestic product (GDP); and to check the direction of causality between them.

Materials and Methods

Many time series are non-stationary and in general OLS regressions between non-stationary data are spurious. The presence of unit roots in the autoregressive representation of a time series leads to non-stationarity, and such series, referred to as being integrated of order one ($I(1)$), must be first-differenced to render them stationary (or integrated of order zero). Where ($I(1)$) series move together and their linear combination is stationary, the series are cointegrated and the problem of spurious regression does not arise. Cointegration implies the existence of a meaningful long-run equilibrium (Granger, 1988). Since a cointegrating relationship cannot exist between two variables which are integrated of a different order, we first test for the order of integration of the variables.

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In testing for the presence of unit roots in the individual time series using the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1981, Said and Dickey, 1984), both with and without a deterministic trend, we follow the sequential procedure of Dickey and Pantula (1987): the null of the largest plausible number of unit roots, assumed to be three, is tested and, if rejected, that of two unit roots is tested and so on until the null is not rejected. The number of lags in the ADF-equation is chosen to ensure that serial correlation is absent using the Breusch-Godfrey statistic (Greene, 2000). If they are integrated of the same order, Johansen's (1988) procedure can then be used to test for the presence of a cointegrating vector between GDP and HE. The procedure is based on maximum likelihood estimation of the error correction model:

$$\Delta z_t = \delta + \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + \cdots + \Gamma_{p-1} \Delta z_{t-p+1} + \pi z_{t-p} + u_t \quad (1)$$

Where $Z_t = [GDP_t, HE_t]$, GDP_t is real gross domestic product per capita, HE_t is real per capita health expenditures, $\Delta z_t = z_t - z_{t-1}$, and π and Γ_i are (n×n) matrices of parameters with $\Gamma_i = -(I - A_1 - A_2 - \ldots - A_i)$, (i=1,…,k-1), and $\pi = I - \pi_1 - \pi_2 - \ldots - \pi_k$. The term πz_{t-p} provides information about the long-run equilibrium relationship between the variables in z_t. Information about the number of cointegrating relationships among the variables in z_t is given by the rank of the π-matrix: if π is of reduced rank, the model is subject to a unit root; and if $0<r<n$, where r is the rank of π, π can be decomposed into two (n×r) matrices α and β, such that $\pi = \alpha\beta'$ where $\beta' z_t$ is stationary. Here, α is the error correction term and measures the speed of adjustment in Δz_t and β contains r distinct cointegrating vectors. The Johansen procedure estimates (1), and trace statistics are used to test the null hypothesis of at most r cointegrating vectors against the alternative that it is greater than r. If cointegration is established, then Engle and Granger (1987) error correction specification can be used to test for Granger causality. If the series GDP_t and HE_t are both I(1) and cointegrated, then the ECM model is represented by the following equations.

$$\Delta GDP = \alpha_0 + \sum_{i=1}^{n} \beta_i \Delta GDP_{t-i} + \sum_{i=1}^{n} \beta_j \Delta HE_{t-i} + \delta ECT_{t-i} + \mu_t \quad (2)$$

$$\Delta HE = \phi_0 + \sum_{i=1}^{n} \sigma_i \Delta HE_{t-i} + \sum_{i=1}^{n} \sigma_j \Delta GDP_{t-i} + \lambda ECT_{t-i} + \varepsilon_t \quad (3)$$

where Δ is the difference operator, μ_t and ε_t are the white noise error terms, ECT_{t-i} is the error-correction term derived from the long-run cointegrating relationship., while *n* is the optimal lag length orders of the variables which are determined by using the general-to-specific modelling procedure (Hendry and Ericsson, 1991). Our null hypotheses are as follows. HE_t will Granger cause GDP_t if $\beta_j \neq 0$. Similarly, GDP_t will Granger cause HE if $\sigma_j \neq 0$. There will be bi-directional causality if $\beta_j \neq 0$ and $\sigma_j \neq 0$. To implement the Granger-causality test, *F*-statistics are calculated under the null hypothesis that in Eqs. (2) and (3) all the coefficients of β_j , $\sigma_j = 0$.

Annual time series data (secondary data) on health expenditures and gross domestic product was collected from the Economic Surveys of Pakistan 2004-05 and 1996-1997.

Results and Discussion

The time series properties of the series are examined by employing testing procedures of Dickey and Pantula (1987) and test for unit roots. Table 1 presents the unit root tests results based on ADF-Regression for one unit root, both with and without linear trend. The series GDP_t appears to be stationary in trended model and non-stationary in non-trended model. Whereas series HE_t appears to be stationary in both models. We therefore conclude that both HE_t and GDP_t are trend stationary, that is integrated of oreder zero- I(0). Table 2 presents the trace statistics, these results show that no co-integrating vector is present so that a long-run relationship between GDP_t and HE_t does not exist.

TABLE 1: Augmented Dickey-Fuller (ADF) unit root test results

VARIABLE	NON-TRENDED MODEL	TRENDED MODEL
GDP	0.11	-3.91
HE	-5.53	-5.31
CRITICAL VALUES	-3.02	-3.66

Note: critical values (95% confidence level) are taken from Fuller (1976, pp. 373).

TABLE 2: Cointegration results

H_O	H_A	TRACE STATISTICS
R=0	R=1	12.29 (20.18)
R≤1	R=2	5.52 (9.16)

Note: Critical values (95% confidence level) in parentheses (Pesaran *et al*, 2000);

This paper investigates the possible existence of long-run relationship between GDP and HE in Pakistan for 1980-2004 using co-integration analysis. Unit root results indicate that GDP and HE are stationary and hence a long-run relationship between the two variables cannot exist. Still the Johansen's procedure to test for co-integration between the variables was applied. The results again conformed that no co-integrating vector can be found, confirming the unit root tests. Hence GDP growth neither causes HE growth nor is affected by it. McCoskey and Selden (1998) also investigated the relationship by using the health care expenditures and GDP, OECD countries panel data. They were able to reject the null hypothesis that these series contain unit roots. Their results help to mitigate the concern that national health care expenditures are misspecified. Similarly, Hansen and King (1996) also observed the unit roots in the time series. They show that if we examine the time series from each of the OECD countries separately, we can rarely reject the unit root hypothesis for health care expenditure and GDP. In addition, their country-by-country tests rarely reject the hypothesis of no cointegration among health care expenditure and GDP. Hansen and King's above mentioned findings suggest that panel estimates of health care expenditure and GDP relationship may be spurious.

Conclusions

This paper investigates the possible existence of long-run relationship between GDP and HE in Pakistan for 1980-2004 using co-integration analysis. Unit root results indicate that GDP and HE are stationary and hence a long-run relationship between the two variables cannot exist. Still the Johansen's procedure to test for co-integration between the variables was applied. The results again conformed that no co-integrating vector can be found, confirming the unit root tests. Hence GDP growth neither causes HE growth nor is affected by it. Moreover, it is also possible that health expenditures may be misspecified and in some situations the estimates of health expenditure and GDP relationship may be spurious.

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