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# DETERMINANTS OF HEALTH CARE EXPENDITURE IN PAKISTAN

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**Abstract**. The paper examines the determinants of health care expenditure in Pakistan using time series data. This is an extension of the research work, which has studied the determinants of health expenditure using conventional log-linear model and the cointegrating technique to find the short-run and long-run relationship between health expenditure and socio-economic factors in Pakistan. The empirical modeling is based on a multivariate model that allows for trending data as well as an intercept and a trend in the cointegrating relation. The results of the paper show that socio-economic factors such as per capita GDP, urbanization, literacy rate, crude birth rate, and foreign aid play an important role in determining health care expenditure in Pakistan.

## I. INTRODUCTION

During the 1980s, Pakistan experienced substantial economic and agricultural growth, resulting in rising incomes and aggregate food self-sufficiency. Despite these gains, Pakistan's demographic and health indicators continue to lag, with low life expectancy (63 years), prevalence of infectious and communicable diseases, high maternal and child mortality rate (83 per 1000), and high fertility coupled with a young age structure and increasing urbanization (*World Development Report* 2003). Health services do not reach the majority population, even though most of it, including rural areas, reside near public health facilities (*Pakistan Integrated Household Survey* 2001-02).

Usually, health is a priority area of government activities. The high correlation between the expenditure on health and productivity in developing

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countries like Pakistan is enough to emphasize the importance of delivery of health services as an aid to growth (*Economic Survey* 2002-03). The better allocation of health expenditure is ensured to stipule health facilities in a country. In addition, socioeconomic conditions are also important in influencing the allocation of health care expenditure. For example, the level of education and the coverage of national health programs are, in that order, the most important factors in determining health conditions. These factors also play an important role as determinants of the availability of health-related personnel and infrastructure. Siddiqui *et al.* (1995) suggest that changes in per capita GDP has a significant affect on health resources. Moreover, urbanization and education were also found to be important variables for the determination of health expenditure, however, per capita GDP and education were strongly collinear.

Traditionally, specification of econometric models has been based on theoretical considerations, whereas less attention has been given to the statistical properties of the data. Indeed, economic theory, which is about long-run effects, thereby suggests economically well-founded identifying restrictions on the long-run structure, whereas much less is usually known about the short-run structure or adjustment to equilibrium.

The objective of the paper is to find the determinants of health expenditure in Pakistan using conventional OLS regression method and modern cointegration approach. The uniqueness of this study is that the above mentioned approaches have been used in the same data set.

The paper is organized as follows. Pakistan health care expenditure model is presented in Section II. Section III presents the empirical results. Section IV describes the cointegration analysis and the final section provides a brief conclusion.

## II. THE HEALTH CARE EXPENDITURE MODEL

In this section, the methodology has been provided which analyzes the relationship between health expenditure and socio-economic variables. The most general measure of resource availability is the per capita income. In this study, income is measured in terms of GNP per capita. A micro study by Grossman (1972), Muurinen (1982) and Wagstatt (1986) observes slight correlation between income and the utilization of expenditure on health care. To the contrary, Newhouse found that over 90 percent of the variance in per

capita medical expenditure is explained by variation in per capita GDP.[1] He found income elasticity for health care spending greater than one, and concluded that medical care, by the technical definition, is a luxury good. These results were consistent to an earlier study by Kleiman (1974). These papers established the precedent viewing income as a major determinant of health expenditure and have been reinforced by the results of numerous subsequent studies.

In this paper, the degree of urbanization has been measured as the urban population as a percentage of total population. Study by Gugler and Flanangan (1978) suggests that urbanization in developing countries is followed by the emergence of overcrowded shantytowns with inadequate sanitation facilities and overcrowding. The process primarily coincides with the development of industrialization. Health care expenditure is, therefore, hypothesized to be positively related to the degree of urbanization.

The age structure of the population is of prime importance in determining the level of health care expenditure because the demand for medical services fluctuates with age. Population under 15 years and more than 65 years of age have the tendency to utilize medical services more than the rest population living in a country. Therefore, the demand for health care could be expected to increase the higher the percentage of population. This argument holds true because those who survive beyond the age of five often develop immunity against the major killer such as malaria (Nkrumah, 1973). There is justification, however, for testing this hypothesis. Those who are under 15 and happen to utilize medical care are often extremely sick and the cost of treating them is high because their parents have put off seeking medical care until their disease has reached such an advanced stage that it is almost impossible to treat.

Crude birth rate raise the cost of maintaining a given health level. Hence, we hypothesize a positive correlation between the crude birth rate and health care expenditure. Another variable is the 'share of health care expenditure in total public expenditure' which is expected to be a positively associated with the dependent variable (Leu, 1986).

In developing countries, foreign exchange is usually scarce with Pakistan as no exception. In most of the countries, an inflow of foreign capital (aid) accentuates the rate of investment in most sectors by providing the foreign exchange component of investment. Apart from the salaries of

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[1]Newhouse (1977) regresses per capita medical expenditures on GDP per capita for 13 countries.

health personnel, a greater part of health care expenditure requires foreign exchange. For example, the purchase of medical supplies such as imported drugs, equipment and spare parts requires foreign exchange. We, therefore, hypothesize a positive correlation between foreign aid and health care expenditure *ceteris paribus*. However, numerous problems exist in relating this variable to health care expenditure. For example, foreign aid can be channeled to other sectors depending on government priorities.

For the foregoing discussion, our model can be written as follows:

$$PCHE_i = \beta_0 \times GDPP^{\beta_1} \times CBR^{\beta_2} \times HSTE^{\beta_3} \times Litrate^{\beta_4} \times Urban^{\beta_5} \times Deppop^{\beta_6} \times Faid^{\beta_7} \times e^{\varepsilon_i} \quad (1)$$

$$\beta_1 > \beta_2 > \beta_3 > \beta_4 > \beta_5 > \beta_6 > \beta_7 > 0$$

where

*PCHE* = Per Capita Health Expenditure

*GDPP* = Gross Domestic Product Per Capita

*CBR* = Crude birth rates (*CBR*) is annual number of births per 1000 population.

*HSTE* = Share of Health Expenditure in the total public expenditure

*Litrate* = Literacy rate in the country

*Urban* = Urbanization is as percentage of the total population.

*Deppop* = Share of the population under 15 years of age and over 65 as percentage of total population.

*Faids* = Foreign aid received per capita in US dollar in a year.

This model is estimated by two methods. Firstly, it has been estimated using a multiple regression analysis. Tests are conducted for misspecification of the model, *i.e.* heteroskedasticity and autocorrelation in the residuals (Chi squared test) and against functional misspecification. Secondly, we have used cointegration technique based on time series data. The time series approach, however, raises statistical and methodological issues not previously relevant to the cross-section studies. The stationarity of the data set is an important assumption underlying conventional regression analysis. It has been known for some time that the correlation coefficient between unrelated non-stationary time series tends to positive or negative unity as the length of time in question increases (*see* Yule, 1926). Therefore, it is possible that the strong positive correlations that Culyer (1990) and Hitiris and Posnett (1992) observed between health care expenditure and GDP were a

result of non-stationarity in the respective time series rather than evidence of an actual economic relationship.

All data series used in this article are collected on annual basis. The data has been used from numerous sources. These include *Economic Survey* (Finance Division, Government of Pakistan), *Budget in Briefs* (Finance Division, Government of Pakistan), *Annual Budget Statement* (Provincial Finance Departments) and *Population and Housing Census Reports* (Government of Pakistan).

## III. ESTIMATION RESULTS AND DISCUSSION

The Equation (1) has been estimated using a multiple regression analysis. We restricted the estimations to linear multiplicative functional form (or double-log) because this form has been formed to be the most empirically adequate for health care expenditure.[2] The results from the estimation of the model are presented in Table 1. The equation for the explanatory variables is specified in log-linear (double-log) form, which means the coefficients can be interpreted directly as partial elasticities. With 18 degrees of freedom, the reported $R^2$ (Adjusted) for the model is 99.18 percent. The model was not found to be functionally misspecified according to the Ramsey's RESET-test. The F-statistic is found to be significant.

Consistent with the results of earlier studies, per capita GDP is highly significant and positive in the model presented. The income elasticity in the model is less than one but approximately close to one. It suggests that health care expenditure increases at approximately the same rate as income. The only difference is that compared to the OECD countries – where reported income elasticity for health care expenditure is 1.5 to 2.

Literacy rate and urbanization have been found significant. Literacy rate with a positive and significant coefficient indicates that educated people demand more health facilities compared to the less educated and with no education. The negative coefficient of urbanization explains that it reduces the government expenditure on health. The theoretical status of urbanization variable is however unclear. According to Cumper (1984), high population density is found in urban settlements may lead to greater availability of social services. This in turn may offset negative features such as increased disease transmission and greater demand for health care expenditure. Gbesemete and Jonsson (1990) have reported a positive and statistically

[2]Gerdtham *et al.* (1988, 1990) used cross-section data and also pooled data for health care

significant correlation between population density and infant mortality and negative correlation between infant mortality and health care expenditure. However, Crude Birth Rate has a positive and significant relationship with health care expenditure in this model.

TABLE 1

Model Estimation: Linear Multiplicative Specification

| Dependent Variable: Per Capita Health Expenditure | | | |
|---|---|---|---|
| Variable | Coefficient | Std. Error | t-Statistics |
| Constant | 22.275 | 12.690 | –1.756*** |
| LGDPP | 0.862 | 0.323 | 2.669** |
| LCBR | 0.975 | 0.289 | 3.368* |
| LHSTE | 1.208 | 0.090 | 13.504* |
| Llitrate | 1.701 | 0.606 | 2.805** |
| Lurban | –3.691 | 3.436 | –2.997* |
| Ldeppop | 5.146 | 3.436 | 1.498 |
| Lfaid | 0.195 | 0.053 | 3.699* |
| Observations | | 26 | |
| $R^2$ | | 0.99 | |
| Adjusted $R^2$ | | 0.99 | |
| F-statistics | | 433.65 | |
| Durbin-Watson | | 2.11 | |

*Rejection at 1%
**Rejection at 5%
***Rejection at 10%

The dependent population under 15 and over 65 as a percentage of total population (Deppop) is included in the model. We have expected a positive correction between the named variable and health expenditure. The positive co-efficient reported for this variable, however, is of interest despite its low level of significance. This is contrary to Kleiman (1974) who reported a negative sign. The finding firmly augments the commonly held view that the main consumers of health services are those below 15 years of age and population aged 65 and plus. The 'share of health expenditure in total public

expenditure (HSTE)' is significant and has a positive correlation with per capita health expenditure. In countries, centrally providing a national health care system, supply considerations often determine the size of public health care expenditure. This confirms the findings of previous studies that attribute the low per capita health care expenditure of Pakistan to scale economies associated with a central National Health Service System (Leu, 1986).

The foreign aid variable has been a significant and shows a positive relation with health expenditure. Health care expenditure increases by 0.20 percent when foreign aid per capita increases by 10 percent. It reinforces the view that in developing countries like Pakistan with limited resources, increased foreign aid among other things is essential for higher allocation of resources to the health sector. With increased foreign aid most countries probably are able to keep their commitment to the health care sector, which otherwise mostly suffers from budget cuts in times of crisis.

## IV. COINTEGRATION APPROACH

This is an important issue from a public policy perspective since the government's ability to manage expenditures on health care hinges, at least in part, on obtaining an accurate estimate of the determinants of HCE. Accurate knowledge of the time series properties of HCE and other socio-economic variables is a prerequisite to empirical testing. Following the above mentioned reasoning, we can use the cointegration approach. however, it raises statistical and methodological issues. The main issue is stationarity of the data set which is an important assumption underlying conventional regression analysis. It has been known for some time that the correlation coefficient between unrelated non-stationary time series tends to positive or negative unity as the length of time in question increases. Therefore, it is possible that the strong positive correlations that Culyer (1990) and Hitiris and Posnett (1992) observed between health expenditure and GDP were a result of non-stationarity in the respective time series, rather than evidence of an actual economic relationship. The purpose here is to examine this possibility in relation with the socio-economic variables and health care expenditure in Pakistan.

The main advantage of the cointegration technique is twofold. First, it is easy to distinguish between short-and long-run response. Second, the speed of adjustment toward the long-run values can be directly estimated. The estimation of health expenditure using Error Correction Mechanism (ECM) involves three steps. The first step is to examine the time series under consideration in order to determine whether the time series has a unit root,

that is, whether it is first difference, second difference or *n*-difference stationary series.[3]

If the variables are found to be non-stationary, then the second step is to investigate the cointegration between these variables. If they are found to be cointegrated, the variables possess long-run elasticities that may be estimated from the cointegrating regression. Finally, the short-run elasticities and the speed of adjustment can be estimated from an ECM.

With respect to the first step, a number of unit root tests have been proposed since the original work of Dickey and Fuller in 1976. Among these tests is the augmented Dickey-Fuller (ADF) test that involves running a regression for each considered series with first lagged level and the lagged first differences as independent variables. In general, the ADF takes the following form:

$$\Delta X_t = a_0 + a_1 X_{t-1} + \sum_{i=1}^{n} a_i \Delta X_{t-i} + e_t \qquad (2)$$

where $\Delta$ is the first difference operator and $e_t$ is a stationary random error. The conventional Dickey-Fuller (DF) test is based on the above equation when the right-hand-side summation is deleted. The null hypothesis indicates that the undifferenced form of the series is non-stationary, *i.e.* contained a unit root. To reject the null hypothesis, the coefficient on the lagged level term, in this case $a_0$, must be statistically significant and larger in absolute terms than the critical values reported in Fuller (1976). In this study, ADF test is employed to check the stationarity in the series.

Engle and Granger (1987) have emphasized the importance of testing for cointegration among the variables included in the model. They argued that the variables are said to be cointegrated if each, taken separately, is non-stationary but some linear combination of the variables is stationary. Because there are more than two variables, this study uses the procedure described in Engle and Yoo (1987) to test for cointegration. Based on this procedure, the equation (1) cointegrating regression is estimated. The residuals obtained from equation (1) are then subjected to a Dickey-Fuller test. Failure to reject the null hypothesis of a unit root is evidence against cointegration since a unit root is indicative that the linear combination of the variables and for different sample sizes. If the variables are cointegrated for the coefficients *βs*

[3]A time-series process is called stationary if the mean and variance are constant over time and if the autocorrelation between values of the process at two points, say *t* and *s*, depends only on the distance between these time points and not on the time period itself.

are long-run elasticities respectively. The final step in the analysis is to construct and estimate the following ECM:

$$\Delta PCHE_t = J_0 + \sum_{i=0}^{n} J_{1i}\Delta GDPP_{t-i} + \sum_{i=0}^{m} J_{2i}\Delta CBR_{t-i} + \sum_{i=0}^{n} J_{3i}\Delta HSTE_{t-i}$$
$$+ \sum_{i=0}^{n} J_{4i}\Delta Lirate_{t-i} + \sum_{i=0}^{n} J_{5i}\Delta Urban_{t-i} + \sum_{i=0}^{r} J_{6i}\Delta Deppop_{t-i} + \quad (3)$$
$$\sum_{i=0}^{s} J_{7i}\Delta Faid_{t-i} + J_8 U_{t-1} + Z_t$$

where the lag order $n$, $m$ and $s$ are chosen so as to make $Z_t$ white noise, and

$$U_{t-1} = PCHE_{t-1} - \beta_0 - \beta_1 gdp_{t-1} - \beta_2 CBR - \beta_3 HSTE - \beta_4 Litrate - \beta_{55} Urban - \beta_6 Deppop - \beta_7 Faid \quad (4)$$

Coefficients $J_{1i}$ to $J_{7i}$ give the short-run elasticities respectively while $J_8$ represents the speed of adjustment toward the long-run equilibrium.

The empirical analysis for cointegration starts with examining the logarithmic form of the eight series to determine if they are first difference stationary. Following Godfrey and Tremayne (1988), Handa and Ma (1989) and Muscatellli and Hurn (1992), the augmented Dickey-Fuller (ADF) test[4] was employed to this end, the results of which are summarized in Table 2.[5]

As can be seen, all variables except per capita foreign aid are found to be non-stationary in levels. Consequently, the results of both Culyer (1990) and Hitiris and Posnett (1992) may have been biased as they were based on variables defined in terms of levels (*i.e.* undifferenced). However, it is possible that a linear combination of the non-stationary variables exists which is itself I (0), *i.e.* the variables are cointegrated.[6]

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[4]The testing strategy described by Perron (1988, pp. 314-317) was followed in this instance using the SHAZAM econometrics package (White, 1978).

[5]More detailed results are available, upon request, from the authors.

[6]Strictly speaking, a linear combination of variables integrated to different orders would not be expected to result in a stationary series (see Engle and Granger, 1991, p. 6). But, according to Muscatelli and Hurn (1992, p. 12):

... it is arguable that, given the problems with the testing procedures for integration an cointegration, as long as the chosen set of regressors and regressand cointegrate among themselves so as to produce a stationary residual, we need to worry less about the degree of integration of the individual variables.

TABLE 2

Order of Integration: Summary of ADF Test Results

| Variable | Stationary Level using ADF Test |
|---|---|
| LPCHE | I (1) |
| LGDPP | I (1) |
| LCBR | I (1) |
| LHSTE | I (2) |
| Llitrate | I (1) |
| Lurban | I (2) |
| DEPPOP | I (2) |
| Lfaid | I (0) |

If all of the non-stationary variables in a particular model are explanatory variables and there exists a linear combination of them which is I (0) implies that the model is restricted to reflect this 'cointegrating regression', the model therefore can be estimated using OLS without any further adjustment to yield consistent estimates.[7] However, if the dependent variable is numbered among the non-stationary variables and a cointegrating regression is found between this (the regressand) and the other non-stationary variables (the regressors), then OLS should only be used to estimate the model if an error-correction mechanism (ECM) is used.[8]

Table 3 presents the possibility of cointegration between the variables included in the model which is examined by estimating the cointegration regression. On the basis of the AEG test for residuals in the equation, the cointegration hypothesis cannot be decisively rejected. Moreover, t-values obtained from AEG test are negative and larger in absolute terms than the corresponding critical values reported by Engle and Yoo suggesting stationary residuals. Furthermore, the residuals correlogram indicate integration of order zero. On the basis of all of the above, the variables are

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[7]However, the *t*-statistics on the individual variables are still not reliable.

[8]For a fuller discussion of cointegration theory and ECMs see Dolado *et al.* (1990), Engle and Granger (1991) and Muscatelli and Hurn (1992).

cointegrated. After using AEG test on each series individually, we see that there is no cointegration between PCHE and all other variables used in the model.

TABLE 3

Integration Regression: Using Augmented Engle-Granger (AEG) Test

| Variable | With No Trend | With Trend |
|---|---|---|
| All variables | –4.106* | –4.008** |
| Same stationary level variables | –3.136** | –3.266*** |
| LGDPP | –1.898 | –1.862 |
| LCBR | –2.376 | –2.114 |
| LHSTE | –1.609 | –0.929 |
| Llitrate | –1.426 | –1.055 |
| Lurban | –1.423 | –1.242 |
| LDeppop | –2.205 | –1.336 |
| Laid | –2.337 | –2.581 |

*Rejection at 1%

**Rejection at 5%

***Rejection at 10%

The next step is to estimate Error Correction Mechanization (ECM) from the above mentioned model. The results for the ECM are reported in Table 4, together with a summary of the elasticities. The equation performs quite well and the coefficient for the error-correction variable ($U_{t-1}$) is significantly different from zero, which indicates the acceptance of the cointegration hypothesis. There is also no evidence of residual autocorrelation in the model.

The long-run elasticity of LGDPP is 0.86, which is greater than the short-run (impact) elasticity of 0.49. This indicates inelasticity of PCHE with respect to prices for both in the short and long run. Furthermore, the long-run income elasticity is much larger than the short run, indicating that PCHE is income elastic. Thus, it is greater in the long run compared to the short run. The CBR, HSTE and Faid are significant in the short run which shows that these variables are more important for policy purpose in Pakistan's context.

TABLE 4

Error correcting model of Health Care Expenditures

| Regressor | Dependent Variable: LPCHE Parameter estimate | t-statistics |
|---|---|---|
| Constant | 0.070 | 0.539 |
| ΔLGDPP | 0.490 | 0.940 |
| ΔLCBR | 1.260 | 1.110 |
| ΔLHSTE | –7.384 | –0.705 |
| ΔLlitrate | 0.927 | 1.237 |
| ΔLurban | 0.918 | 2.576* |
| ΔLDepop | 8.933 | 18.092* |
| ΔLFaid | 0.230 | 4.156* |
| $U_{t-1}$ | –1.150 | –4.332* |
| $R^2$ | 0.959 | |
| Adjusted $R^2$ | 0.938 | |
| DW | 2.043 | |

*Rejection at 1%

**Rejection at 5%

***Rejection at 10%

## V. CONCLUSION

The results of the paper show that socio-economic factors play an important role in determining health care expenditure in Pakistan. The 'share of health expenditure in total public expenditure (HSTE)' is the most significant variable affecting health status. Therefore, this variable is important for the overall improvement of health status in Pakistan. It also reinforces the fact that government should increase the share of health care expenditure for the provision of better health services in the country. Literacy rate and GDP are also essential variables, which illustrate a positive relationship with health care expenditure. Urbanization can be used as a core variable to develop health status but its effectiveness may be limited. The crude birth rate and foreign aid are important in the short run, which shows that these variables are also important for policy purpose in Pakistan's context.

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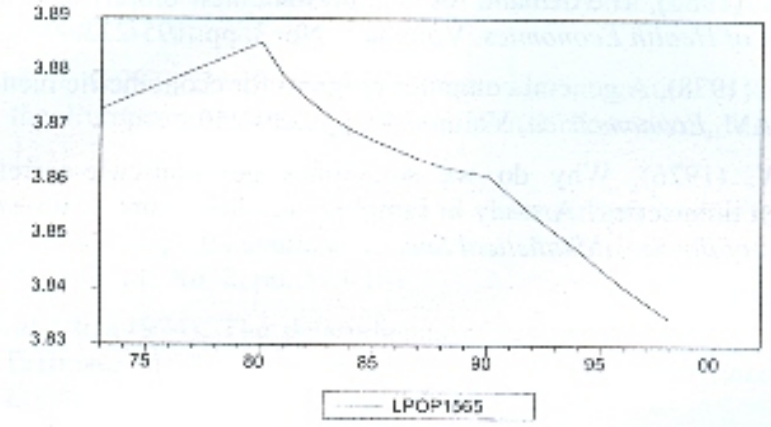
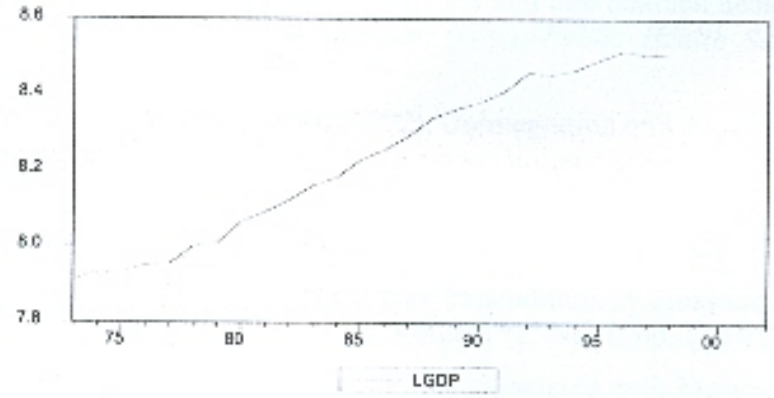
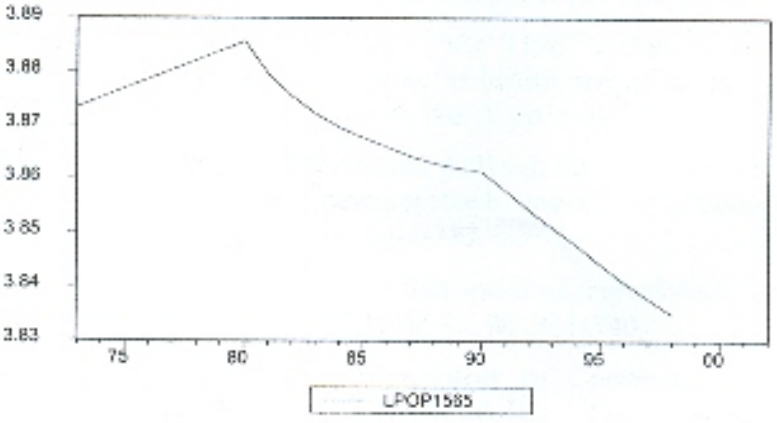
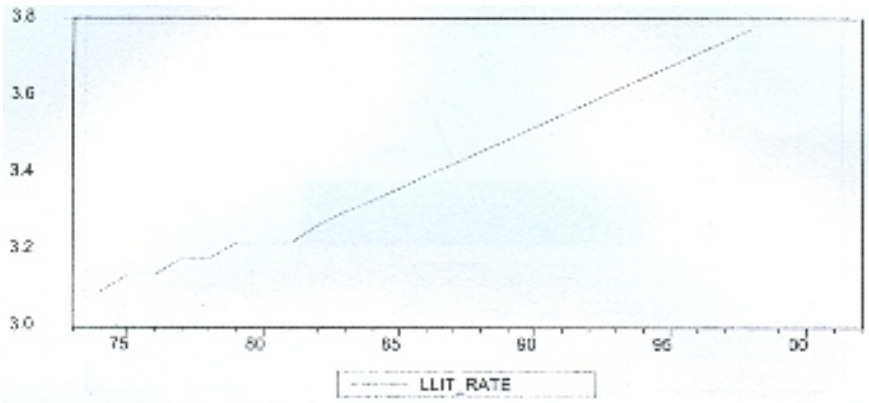
## APPENDIX

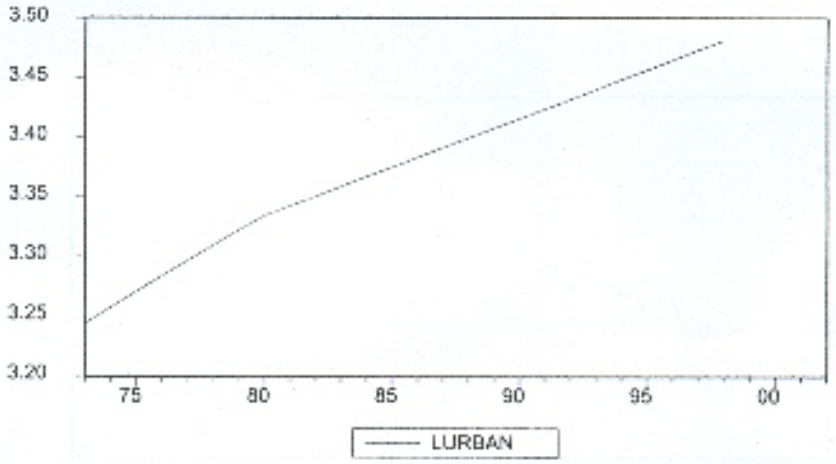
### Visual Data Display of the Dependent and Independent Variables Used in This Paper




3.8
3.6
3.4
3.2
3.0
75
80
85
90
95
00
LLIT_RATE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75
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95
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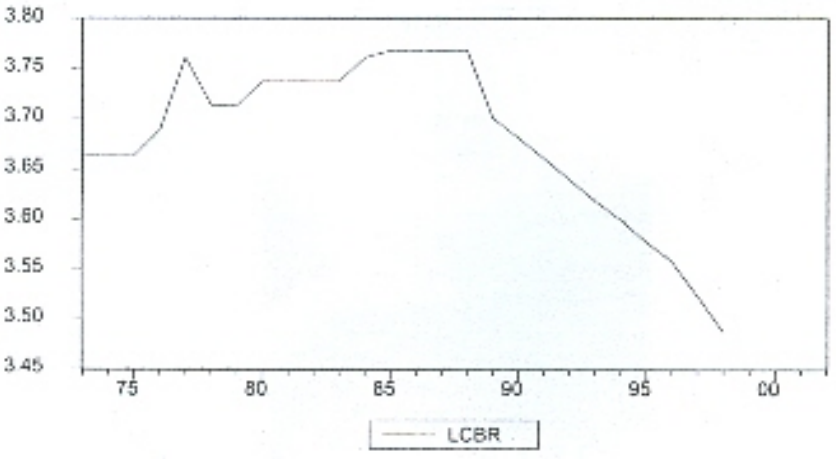
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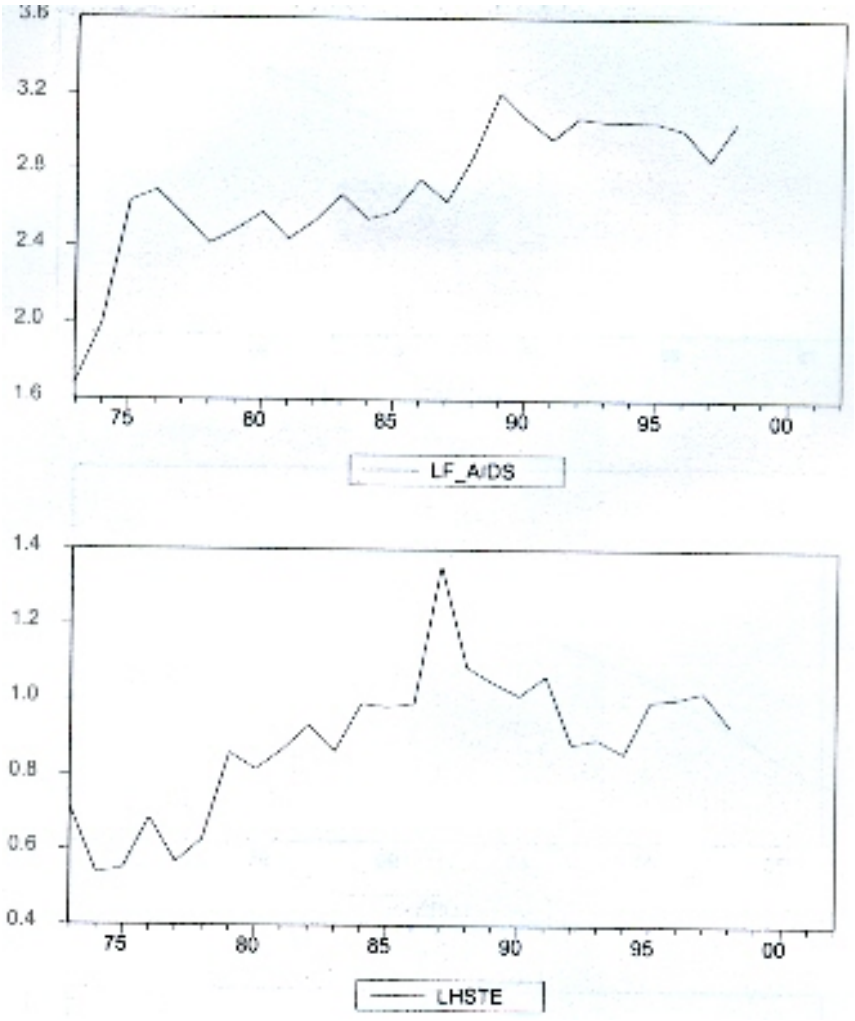
LCBR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1.0
0.8
0.6
0.4
75
80
85
90
95
00
LHSTE