LIFE EXPECTANCY, PUBLIC HEALTH SPENDING AND ECONOMIC GROWTH IN NIGERIA: A VECTOR AUTOREGRESSIVE (VAR) MODEL

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Abstract

The main focus of this study is to empirically analyze the relationship existing among life expectancy, public health spending and economic growth in Nigeria. A vector Autoregressive (VAR) model approach was employed in analyzing the data. The results of the study revealed that there is no bi-directional causality between life expectancy and public health spending in Nigeria. In the same vein, the study also revealed that there is no bi-directional causality between life expectancy and economic growth in Nigeria over the years. However, the study confirmed that there is bi-directional causality between public health spending and economic growth in Nigeria. Based on the findings of the study, it was recommended that for Nigeria to experience a sustainable economic growth, it has become imperative for her to put in place measures that would boost the life expectancy of her citizenry by increasing her public health spending as this will serve as a panacea for her economic backwardness.

Keywords: Life Expentancy, Health Spending, Economic Growth

1. Introduction

Nutrition and health play a substantive role in economic growth (Fogel, 2002). Long term impact of health on economic growth can be understood in the more general context of the relation between human development and economic growth. Human development is understood as an intergenerational process of human capital accumulation that is slowed down by market failures that can be strong enough to result in poverty traps. In turn, human development has a dynamic interaction with long-term economic growth drawing from the economy, their resources for human capital investment and returning it to a generation. In this long-term context, it is easy to see that health and in particular, early child development plays a crucial role in human capital investment and therefore in long-term economic growth. Human capital and its impact on economic growth and welfare are closely interrelated. If a country wants to develop successfully economically, a fair amount of money should be spent on health care in the development process. This is a very important change of the mindset, the mechanism by which health and health care lead to economic growth, which is centered on the development of human capital, a term that refers to education, training and health. (Scheffler, 2004).

In the health sector, between 1986 and 1990, health expenditure as a percentage of GDP, in Nigeria, averaged 0.32 percent and hardly changed between 1995 and 1999 when it averaged 0.33 percent. When comparing the performance of Nigeria with other African countries, it was observed that in 1990, government expenditure on health as a fraction of GDP was 2.7 percent against 3.5 percent in Ghana, 4.3 percent in Kenya and between 1995 and 1997, 4 percent in Seychelles (Olaniyi and Adam, 2003). Poor expenditure on health sector in most developing countries is worsened by an inverted nature of health expenditure pyramid. About three quarters of all public expenditure on health are for expensive medical care that benefits a small minority of the population living in the urban areas. A high proportion of the budget for health, 80 to 90 percent in some countries, is spent on hospitals, almost all of which are located in the cities. At the same time, only about 60 percent of the people have access to primary health care. A high proportion of the poor and of those living in rural areas, is not reached by the health care system and is forced to rely on home remedies and traditional medicine (Griffin and Mckinlay, 1992).

2. Literature Review

A group of literature in recent years has tried to examine the link between health expenditure and health outcomes especially as it affects under-five mortality, infant mortality and life expectancy at births. The available studies so far document a range of effects-from no impacts, to limited impacts, and to impacts on only specific interventions.

Early studies as summarized by Musgrove (1996) found no evidence that total spending on health has any impact on child mortality. Filmier and Pritchett (1997) presented empirical evidence that suggests that public spending on health is not the dominant drive of child mortality outcome, income inequality, female education, and cultural factors such as: the degree of ethnolinguistic fractionalization explain practically all of the variation in child mortality across countries. Based on these findings policy that encourage economic growth, reduce poverty and income inequality and increase female education would do more for attaining child mortality reductions than increasing public spending on health. Similar findings of lack of significance of public health expenditure have been presented by others (see Kin and Moody, 1992, Musgrove 1996) Filmier and Pritchett (1999) found that government health expenditure accounts for less than one-seventh of one percent variation in under-five mortality across country, although the result was not statistically significant. They conclude that 95 percent of the variation in under-five mortality can be explained by factors such as: a country's per capita income, female educational attainment, and choice of region. A number of other studies have linked changes in mortality rates in terms of resource use at hospital, managed care, educational status of parents, females and children technological change (Filmier et al, 1997; Cutler 1995; Geweke *et al*, 2003; Kesseler and Mc Clellion, 2000, Mc Clellan and Noguchi, 1998; Mazunde 2007; Goldman and smith 2002; Glied and Lieras Muney, 2003). In the work of Burnside and Dollar (1998), there is no significant relationship between health expenditure spending and the change in infant mortality in low-income countries.

The good policies and institutions (as measured by the world bank's country policy and institutional assessment or CPIA index) are important determinants of the impact of government health expenditures on outcomes, in particular, as the quantity of policies and institution improves (as the CPIA index rises), the impact of government health expenditures on maternal mortality, under weight children under-five and tuberculosis mortality also increase and is statistically significant (Wagstaff and Cleason 2004). However, they conclude that impact of government expenditures on under-five mortality remains not significant different from zero.

The effects of public financing of health expenditures, insurance coverage and other factors on health outcomes are examined by Berger and Messer (2002) with health production models estimated, using 1960-1992 data across 20 0ECD countries. They find that mortality rates depend on the mix of health care expenditures and the type of health coverage. In particular, increases in the publicly financed share of health expenditures are associated with increase in mortality rates. These authors therefore conclude that as countries increases the level of their health expenditures they may want to avoid increasing the proportion of their expenditures that are publicly financed.

Nixon and Ulmann (2006) show that although health expenditure and the number of physicians have made significant contribution to improvements in infant mortality, health care expenditure has made relatively marginal contribution to the improvement in life expectancy in the countries over the period of the analysis covering 1980-1995. Also in a cross-sectional data covering 117 countries for the year 1993, Zakar and

Wunnva (1997) found that government expenditure on the health care as a percentage of GNP does not play a major role in determining infant mortality rates. They provide a detailed review of 16 studies that have examined the relationship between health care inputs and health outcome, using macro-level data. They also undertook their own study using data for 15 European countries over the period 1980-1995. They concluded that health expenditure and the number of physicians have made a significant contribution to improvements in infant mortality.

Seewananyana and Younger (2004) found that, in Uganda, increase in health care expenditures particularly on vaccination, is expected to impact positively on infant mortality rate in Uganda by 2015. According to them, increasing in vaccination rate to 100 percent would have the largest and probably most cost effective, impact, reducing infant mortality by 16 deaths per thousand birth.

Baldacci *et al* (2003) and Gupata *et al* (2002) concluded that social spending is an important determinant of health and education outcomes. These studies found that the effect of social spending on human development indicators is stronger in cross-sectional samples that when the time dimension is also added. They opined that education spending has a greater effect on social indicators than health outlays. The positive effect of social spending on social indicators is also supported by Anand and Ravallion (1993), who equally found a positive relationship between public expenditure on health care and the health status of the poor.

Day and Tousignant (2005), among others, examine the relationship between health outcomes and health spending in Canada for the periods 1960-1997, 1950-1997 and 1926-1999 and concluded that although some causal relationship between a measure of the health status of the population and real per capita health expenditure were statistically significant. These relationships were not very strong. The authors indicated that their findings may be due to model mis specification or may reflect the fact at high level of population health, the return to increases in health spending are small.

Cremisux *et al* (1999) examine the relationship between health indicators such as infant mortality rates and life expectancy and total (public & private) per capita spending on health, using pooled time-series cross-section data for the ten province for the period 1978-1992. Cremieux *et al* (2005 a,b) estimated a similar model using data for the period 1981-1998, but disaggregated per capita health spending into three categories: public spending on drugs private spending on drugs, and non-drug health care spending. Kee (2001), used pooled time- series cross sectional data for the ten provinces for the 1975-1996 period similar to Cremieux *et al* (1999), Kee (2001) regressed indicators of population health status (infant mortality rates, life expectancy and age standardized mortality rates) on a number of variables, including real per capita public expenditure on health. However, unlike Cremieux *et al.* (1999), who use a pooled generalized least square estimation procedure, Kee (2001) used instrumental variables estimation to control for possible simultaneity between health status and public spending on health. All three of these studies found a statistically significant relationship between health status and both health spending and per capita income. In the same vein, Awe and Ogungbenle (2009) in their study titled social spending, human capital formation and output expansion in Nigerian economy using annual time series data spanning from 1977 to 2005 exploited A Vector Autoregressive (VAR) model approach found that there existed a casual linkage among social spending, human capital formation and output expansion in Nigeria.

Using demographic and health survey (DHS) data, Wang (2002) investigated the low-income countries both at the national level, and for rural and urban areas separately. He found that at the national level, public health expenditure significantly reduces child mortality. While Harttgen and Misselhorn (2006) found that access to health infrastructure is important for child mortality, socio-economic factors are often found to be good determinants of health outcomes (Notre and Mc Kee, 2004: Young, 2001; Strheger, 2001). Numerous studies (especially those using micro-data) show a close association between child mortality and socio-economic status (for example, Preston, 1975, 1985; Hobcraft *et al*, 1984; Hill, 1985; World Bank, 1993).

3. Methodological Framework

i. Model Specification

With reference to Scarpetta and Basairini (2001) and Mankiew *et al* (1992) in order to determine the relationship among economic growth,(Y_t), public health spending (HEX) and life expectancy (LEB), hence

Y_t = f(HEX, LEB)……………………(1)

$Y_t = Ø + \lambda HEX_t + \psi\, LEBt + \mu_t$..............................(2)

Identification and choice of variables

Y_t= Economic Growth in Nigeria which is proxied by gross domestic product (GDP),

HEX_t= Public health Expenditure in Nigeria

LEB_t= Life Expectancy in Nigeria.

ii. Estimation Techniques

The estimation technique employed in the study is the Vector Autoregressive {VAR} model which is discussed as follows:

Stationarity Test

In the literature, most macroeconomic time series variables have unit roots and regressing non stationary variables in the model might lead to spurious regression results {Granger, 1986}. In this study, unit root test is conducted on all the variables in order to ascertain the stationary status of the variables. The first or second difference terms of most variables will; usually be stationary {Ramanathan, 1992}. The stochastic characteristics of each time series were tested at levels for stationary in this study by considering their order of integration. The order of integration assisted us in determining the subsequent long run relationship among the variables. The study used Philip Perron unit root test for this purpose because Philip Perron {pp} test statistics, which is a modification of the Augmented Dickey Fuller {ADF}, takes into account the less restrictive nature of the error process. Moreover, this replaces the use of lags of the Augumented Dickey Fuller {ADF} test which has been arbitrary {Nyong, 2003}

Co-integration Regression and Vector Error Correction Model

The co-integration regression is specified as follows:

In order to buttress stationarity the null hypothesis of no co integration is rejected, if the estimated {pp} test statistics is larger than its critical value 1%, 5% or 10% level of significance. After conducting the stationarity test, we test for co-integration among the series. Co integration indicates the presence of a linear combination of non stationary variables that are stationary and the variable does not have a mean {drift} to which it returns. The presence of co integration however implies that a stationary long run relationship among the series is present. The procedure adopted in this study is a representation of the approach of analysis of multivariate co integrated systems developed and expanded by Johansen and Juselius {1990,1992, and 1994}. Unlike the Engle granger static procedure, the Johansen vector autoregressive {VAR} procedures allows the simultaneous evaluation of multiple relationship and imposes no prior restrictions on the co integration space. In addition, the adoption of VAR was informed by the fact that VAR technique is commonly used for analyzing the dynamic impact of random disturbances {shocks} on the system of variables. Also since few restrictions are placed on the way in which the system variables interact, this method is well suited for examining the channels through which a variable operates. In effect, the strength of the VAR model lies in its ability to incorporate the residual from the past observation into the regression model for the current observation. The technique also has the advantage of being easy to understand, generally applicable and easily extended to nonlinear specifications and models that may contain endogenous right hand side variables {Philips, 1987}. Peseran *et al* {2001} further asserts that this technique allows a mixture of 1{1} and 1{0} variables are regressors, that is, the order of integration of relevant variables may not necessarily be the same.

Following Pesaran *et al* {2001}, the VAR of order p, denoted by VAR [p] can be constructed thus;

$$Z_t = \mu + \sum_{t=1}^{p} \beta_t Z_{t-1} + \varepsilon_t \text{ ------------------------------------ } (3)$$

Where Z_t = the vector of both X_t and Y_t where y_t is the dependent variable and X_t = f{hex, Leb}. Which is the vector matrix that represents a set of explanatory variables. In this model, economic growth is the dependent variable while public health expenditure and life expectancy are the explanatory variables. $\mu = \{\mu_y, \mu_x\}$ which is the vector of constraints {drifts} and is the stochastic term. t is a time or trend variable, b, is a matrix VAR parameters for lag i. N= (N_y, N_x).

According to Persarran *et al* {2001}, Vector Error Correction Model {VECM} can be developed as follows:

$$Z_t = \mu + \alpha_t + \lambda Z_{t-1} + \sum_{t=1}^{P=1} Y_t \Delta Y_{t-1} + \sum_{i=0}^{P=1} Y_t \Delta X_{t-1} + \sum_t \text{ ------------- } (4)$$

Where Δ is the first difference operator. The model in equation (4) is the vector error correction model for the co integrated series. In this case, the short run dynamic of the variables in the system are represented by the variables in levels.

Impulse Response Function

VAR model is the best method for investigating shocks transmission among variables. A shock to the i- th variable not directly affects the i-th variable but is also transmitted to all of the other endogenous variables through the dynamic {Lag} structure of the VAR. An impulse response function of the VAR traces the effect of a one time shock to one of the innovations on current and future values of the endogenous variables. The accumulated response is the accumulated sum of the impulse responses.

Variance Decomposition

While impulse response function traces the effects of a shock to one endogenous variable to the other variable in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR.

Types and Sources of Data

The study relied on Secondary data. Therefore, secondary data were collected on GDP in Nigerian economy, public expenditure on health in Nigeria, life expectancy in Nigeria spanning from 1977 to 2008. Various issues of the Central Bank of Nigeria (CBN) Statistical Bulletin and National Bureau of Statistics Digest were consulted.

4. Empirical Results

Table 1. 1: *Correlation matrix of selected variables*

	GDP	HEX	LEB
GDP	1.0000	0.88160	0.3134
HEX	0.8160	1.0000	0.2229
LEB	0.3194	0.2293	1.0000

Source: *Authors' computation.*

The result in table 1.1 gives a preliminary idea of the relationship among GDP, HEX and LEB. A cursory look at table 1.1 confirms that there is positive correlation among GDP, HEX and LEB. Although correlation should not be seen as causality. This is because correlation among unrelated series may be strong while causality is non-existent.

Table 1.2: *Philips-Perron Unit Root Tests For Selected Series.*

	PP Stat		Critical value		Order of integration	1%
Series	Levels	1^{st} diff	2^{nd} diff	5%		
GDP	23.25677	-1.161286	-8.453898	-2.967767	1(2)	- 1.3689194
HEX	-2.324060	-7.78916	-	-2.96397	1(1)	-3.679322
LEB	-8.488359	-	-	-2.963972	1(0)	- 1.3670170

Source: *Author s' Computation*

The Philip- Perron (pp) test was conducted on all the variables at levels, first difference, and second differences. The results are presented in table 1.2 above. The results show that LEB was stationary at its levels except GDP and HEX which were non-stationary at their levels as confirmed by the values of the Mackinonn (1976) associated one sided-p-values in each series. A further test for unit root at first difference made HEX to be stationery while at 2^{nd} difference, GDP became stationary. This result confirms that LEB is integrated of order zero, 1(0), HEX is integrated of order one, 1(1) and GDP is integrated of order two, 1(2) respectively.

The properties exhibited by the time series variables above created the necessary condition for this Vector Autoregressive (VAR) analysis since all the series are integrated of different order which implies that a necessary condition for co-integration has not been met, hence, the use of VAR has become imperative.

Endogeneity Test

Table 1.3: *Vector Auto-Regressive Results*

	GDP	**HEX**	**LEB**
GDP (-1)	**1.081963**	**0.066438**	**5.40E-08**
GDP(-2)	**0.252827**	**-0.04949465**	**-4.77E-08**
HEX(-1)	**3.281039**	**-0.951726**	**-2.04E-07**
HEX(-2)	**-6.724799**	**0.703355**	**-1.41E-06**

LEB(-1)	**-54310.81**	**1065.297**	**0.4501855**
LEB(-2)	**48316.77**	**-3443.651**	**0.265220**
C	**344387.7**	**106437.3**	**14.835382**
R2	**0.9791991**	**0.740172**	**0.835382**
F-stat	**172.5382**	**10.44524**	**18.60712**

Source : Authors' Computation

The results in table 1.3 indicate that there is strong relationships existing among GDP, HEX, and LEB. Though the coefficient of the lags might not have significant interpretations, the results show the level of endogeneity of the selected variables. Comparing the critical F-values and the R^2s, it can be deduced that. GDP, HEX and LEB are more exogenous than being endogenous variables having R^2 ranging from 98% to 84% respectively.

Table 1.4: *Pairwise granger causality Tests*

Null	Hypothesis	Obs	f-statistics	Prob
HEX GDP	Does not granger cause GDP Does not granger cause HEX	29	0.75465 7.98619	0.4810 0.0022
LEB GDP	Does not granger cause GDP Does not granger cause LEB	29	0.07363 0.04258	0.9292 0.9584
LEB HEX	Does not granger cause HEX Does not granger cause LEB	29	0.18004 0.05054	0.8364 0.9508

Source: *Authors' Computation*

From table 1.4, it can be deduced that HEX granger caused GDP while GDP also granger caused HEX confirming that there is bi-directional causality between HEX and GDP. On the other hand, LEB did not granger cause GDP while GDP also did not granger cause LEB confirming that there is causality between LEB and GDP. In the same Vein, LEB did not granger cause HEX while HEX also did not granger cause LEB confirming that there is no causality between LEB and HEX in Nigeria.

Impulse Response as evidenced in appendix i

1. A standard deviation change (shocks) in GDP was initially around zero equilibrium but gradually increased from less than 1% to about 100%
2. A standard deviation change (shocks) in GDP was initially less than 1% but gradually produced unstable effects on HEX both negative and positive up till the 9th to period when the effect diverged drifting more above zero equilibrium and became more explosive towards the positive drift.
3. A standard deviation change in GDP to LEB was around zero equilibrium through out the period indicating that shocks from GDP

had stable effect on the LEB throughout the period confirming that LEB is a better predictor of GDP in Nigeria.

4. A standard deviation in HEX to GDP was at zero equilibrium from 1st period having unstable effect on GDP drifting away from equilibrium by 1% at 9th period but later declined to about 1% towards the negative drift.
5. A standard deviation change (shocks) in HEX to HEX initially produced a stable effect at zero equilibrium up to 6th before it became explosive from 7th period to 9th period drifting away from equilibrium position
6. A standard deviation change (shocks) from HEX produced stable effect on LEB throughout the period. (confirming that HEX is a better predictor LEX in Nigerian Economy)
7. A standard deviation change from LEB to GDP produced a stable effect on GDP throughout the period confirming that GDP is also a better predictor/determinant of LEB in Nigeria. A standard deviation change from LEB produced a stable effect on HEX from LEB in Nigeria
8. A standard deviation change from LEB produced a stable effect on HEX from 1st period to 10th period implying that HEX is a better determinant of LEB in Nigeria
9. A standard deviation change (shocks) from LEB produced a stable effect on LEB throughout the periods.

Variance Decomposition as evidenced in appendix ii

The variance decomposition as evidenced suggests that shocks from GDP had 100% effect on GDP at 1st period but the effect gradually decreased to about 70% at the period. On the other hand, the shocks from HEX to GDP gradually increased from 1% at 2nd period to about 40% at 10th period. However, it seemed there was no shock received by GDP from LEB from 1st period to 9th period except less than 1% shocks in the 10th period.

The shocks received from GDP by HEX was 60% at 1st period which gradually decreased to 20% at 4th period but .later decreased to 10% at 10th period. On the other hand, shocks from HEX to HEX was about 40% at 1st period and increased steadily to about 100% at 10th period confirming that HEX is majorly affected by its own shocks. Shocks from HEX to LEB seemed to be stable throughout the period (around zero equilibrium level). Confirming that HEX is a good determinant of LEB in Nigeria. Shocks received by LEB from GDP was ground zero equilibrium level from 1st period to 6th period and drifted slightly from equilibrium at 1% from the period to 10th period confirming that GDP is a good predictor of LEB shocks received by LEB from HEX was zero till about 5th period when it gradually increased from about at 1% to 20% at 10th period. Shocks received by LEB from LEB was initially at about 100% and gradually reduced to about 80% at 10th period confirming that its own shocks affected LEB predominantly.

Discussion of Findings.

The result of this study revealed that positive relationship exists among gross domestic product, (GDP), public health expenditure (HEX) and life expectancy (LEB) in Nigeria as evidenced in table 1.1. This result is in agreement with earlier studies carried out by Sewancyana and Younger (2004), Anand and Rewillion (1993), Hojiman (1996), Bidani and Ravallion (1997) and Gupta *et al* (2003) who found a positive relationship between public expenditure on health and health status.

The result of the study also indicated that Gross domestic product (GDP), public health expenditure and life expectancy in Nigeria are more exogenous variables than being endogenous variables implying that the selected variables are the major determinants of each other in the model as evidenced in table 1.3. This result is in congruence with the outcomes of the studies carried by Berger and Messer (2002), Crimieux *et al* (1999), Kee (2001), Crimeux *et al* (2005) who found a statistically significant relationship between such as; infant mortality rate, life expectancy and age standardized mortality rate health status and both health spending and per capital income.

The result in table 1.4 confirmed that there is no causality running from life expectancy (LEB) in Nigeria and economic growth (GDP) and conversely running from economic growth (GDP) to life Expectancy in Nigeria implying that life expectancy and economic growth did not granger cause each other.

In the same vein, the study revealed that there is no causality between life expectancy and public health expenditure in Nigeria. This result is at variance in with Day and Tousignant (2005) who found out in their study that causal relationship existed between health outcomes and health spending in Canada for the periods 1960-1967, 1950-1997 And 1926-1996 and concluded that some causal relationship between a measure of the health status of the population and real per capital health expenditure were statistically significant.

On the other hand, the study revealed that there is bi-directional casuality running from public health expenditure and economic growth in Nigeria. This result is in agreement with Awe and Ogungbenle (2009) who found that there is causal linkage between social spending and economic growth in Nigeria.

Infact, the results obtained from impulse response function and variance decomposition of the vector Autoregressive (VAR) model revealed that HEX is a better predictor of LEB in Nigeria. Summarily, the GDP is equally found to be a better predictor of LEB in Nigeria. The GDP is predominantly affected by its own shocks confirming that it is the most exogenous variable among the selected variables of interest.

Conclusion and Policy Implication.

Based on the findings of this study, the study hereby logically and sequentially concludes that there is no causal linkage between life expectancy in Nigeria and public health expenditure over the years in Nigeria. Therefore, for life expectancy to improve in Nigeria, it becomes imperative for government to increase her public health spending. In addition, it has been established in this study that there is also no causal linkage between life expectancy in Nigeria and economic growth implying that for Nigeria to experience a sustainable economic growth, it becomes necessary for her to put in place measures to boost the life expectancy of her citizenry as this will serve as a panacea for her economic backwardness. On the other hand, the study has established causal linkage between public health expenditure and economic growth in Nigeria indicating that if government can increase her public health expenditure in Nigeria,this will invariably boost her economic growth.

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GDP has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		9.735247	1.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	3.30E+11
HAC corrected variance (Bartlett kernel)	3.37E+11

Phillips-Perron Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 05/16/13 Time: 12:20
Sample (adjusted): 1978 2008
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.189932	0.019295	9.843656	0.0000
C	127695.7	125683.2	1.016013	0.3180

R-squared	0.769654	Mean dependent var	782735.8
Adjusted R-squared	0.761711	S.D. dependent var	1216110.
S.E. of regression	593642.4	Akaike info criterion	29.48828
Sum squared resid	1.02E+13	Schwarz criterion	29.58080
Log likelihood	-455.0684	Hannan-Quinn criter.	29.51844
F-statistic	96.89756	Durbin-Watson stat	1.920711
Prob(F-statistic)	0.000000		

(GDP) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.258560	0.9199
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	5.37E+11
HAC corrected variance (Bartlett kernel)	3.09E+11

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 05/16/13 Time: 12:22
Sample (adjusted): 1979 2008
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.123102	0.126512	-0.973043	0.3389
C	205835.5	163519.7	1.258782	0.2185

R-squared	0.032709	Mean dependent var	121199.7
Adjusted R-squared	-0.001837	S.D. dependent var	757718.3
S.E. of regression	758414.1	Akaike info criterion	29.98019
Sum squared resid	1.61E+13	Schwarz criterion	30.07360
Log likelihood	-447.7028	Hannan-Quinn criter.	30.01007
F-statistic	0.946813	Durbin-Watson stat	2.766209
Prob(F-statistic)	0.338864		

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.11578	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	3.61E+11
HAC corrected variance (Bartlett kernel)	3.61E+11

Phillips-Perron Test Equation
Dependent Variable: D(GDP,3)
Method: Least Squares
Date: 05/16/13 Time: 12:22
Sample (adjusted): 1980 2008
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1),2)	-1.651191	0.163229	-10.11578	0.0000
C	172151.7	116212.4	1.481355	0.1501

R-squared	0.791230	Mean dependent var	53168.99
Adjusted R-squared	0.783498	S.D. dependent var	1338087.
S.E. of regression	622609.0	Akaike info criterion	29.58770
Sum squared resid	1.05E+13	Schwarz criterion	29.68199
Log likelihood	-427.0216	Hannan-Quinn criter.	29.61723
F-statistic	102.3290	Durbin-Watson stat	1.931333
Prob(F-statistic)	0.000000		

Null Hypothesis: HEXP has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.095948	0.9966
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	6.81E+11
HAC corrected variance (Bartlett kernel)	6.81E+11

Phillips-Perron Test Equation
Dependent Variable: D(HEXP)
Method: Least Squares
Date: 05/16/13 Time: 12:23
Sample (adjusted): 1978 2008
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HEXP(-1)	0.183543	0.167475	1.095948	0.2821
C	153050.0	157127.7	0.974048	0.3381

R-squared	0.039770	Mean dependent var	191113.5
Adjusted R-squared	0.006659	S.D. dependent var	856065.6
S.E. of regression	853210.7	Akaike info criterion	30.21374
Sum squared resid	2.11E+13	Schwarz criterion	30.30626
Log likelihood	-466.3130	Hannan-Quinn criter.	30.24390
F-statistic	1.201101	Durbin-Watson stat	2.107452
Prob(F-statistic)	0.282120		

Null Hypothesis: D(HEXP) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.508982	0.0012
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.15E+11
HAC corrected variance (Bartlett kernel)	7.15E+11

Phillips-Perron Test Equation
Dependent Variable: D(HEXP,2)
Method: Least Squares
Date: 05/16/13 Time: 12:24
Sample (adjusted): 1979 2008
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HEXP(-1))	-0.847511	0.187957	-4.509069	0.0001
C	171116.3	163047.9	1.049485	0.3029

R-squared	0.420670	Mean dependent var	24550.49
Adjusted R-squared	0.399980	S.D. dependent var	1129761.
S.E. of regression	875124.2	Akaike info criterion	30.26646
Sum squared resid	2.14E+13	Schwarz criterion	30.35987
Log likelihood	-451.9969	Hannan-Quinn criter.	30.29634
F-statistic	20.33170	Durbin-Watson stat	1.997848
Prob(F-statistic)	0.000106		

Null Hypothesis: LEB has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.879855	0.9997
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.032936
HAC corrected variance (Bartlett kernel)	0.129389

Phillips-Perron Test Equation
Dependent Variable: D(LEB)
Method: Least Squares
Date: 05/16/13 Time: 12:25
Sample (adjusted): 1978 2008
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEB(-1)	0.120932	0.025058	4.826110	0.0000
C	-5.404454	1.158134	-4.666519	0.0001

R-squared	0.445415	Mean dependent var	0.182460
Adjusted R-squared	0.426291	S.D. dependent var	0.247725
S.E. of regression	0.187635	Akaike info criterion	-0.446290
Sum squared resid	1.021005	Schwarz criterion	-0.353775
Log likelihood	8.917502	Hannan-Quinn criter.	-0.416133
F-statistic	23.29133	Durbin-Watson stat	0.099656

Null Hypothesis: D(LEB) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.791584	0.8071
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.002421
HAC corrected variance (Bartlett kernel)	0.009784

Phillips-Perron Test Equation
Dependent Variable: D(LEB,2)
Method: Least Squares
Date: 05/16/13 Time: 12:25
Sample (adjusted): 1979 2008
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LEB(-1))	0.004070	0.038508	0.105697	0.9166
C	0.006970	0.011429	0.609875	0.5469

R-squared	0.000399	Mean dependent var	0.007672
Adjusted R-squared	-0.035301	S.D. dependent var	0.050057
S.E. of regression	0.050933	Akaike info criterion	-3.052266
Sum squared resid	0.072637	Schwarz criterion	-2.958853
Log likelihood	47.78399	Hannan-Quinn criter.	-3.022382
F-statistic	0.011172	Durbin-Watson stat	0.101008
Prob(F-statistic)	0.916576		

Null Hypothesis: D(LEB,2) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.564507	0.4874
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000243
HAC corrected variance (Bartlett kernel)	0.000778

Phillips-Perron Test Equation
Dependent Variable: D(LEB,3)
Method: Least Squares
Date: 05/16/13 Time: 12:26
Sample (adjusted): 1980 2008
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LEB(-1),2)	-0.057051	0.060083	-0.949532	0.3508
C	0.001104	0.003042	0.362820	0.7196

R-squared	0.032314	Mean dependent var	0.000634
Adjusted R-squared	-0.003526	S.D. dependent var	0.016137
S.E. of regression	0.016166	Akaike info criterion	-5.345363
Sum squared resid	0.007056	Schwarz criterion	-5.251067
Log likelihood	79.50776	Hannan-Quinn criter.	-5.315831
F-statistic	0.901610	Durbin-Watson stat	0.267265
Prob(F-statistic)	0.350773		

Pairwise Granger Causality Tests
Date: 05/16/13 Time: 12:27
Sample: 1977 2008
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
HEXP does not Granger Cause GDP	30	1.08648	0.3528
GDP does not Granger Cause HEXP		0.82776	0.4487
LEB does not Granger Cause GDP	30	2.48487	0.1037
GDP does not Granger Cause LEB		17.0820	2.E-05
LEB does not Granger Cause HEXP	30	0.64171	0.5348
HEXP does not Granger Cause LEB		1.29561	0.2915

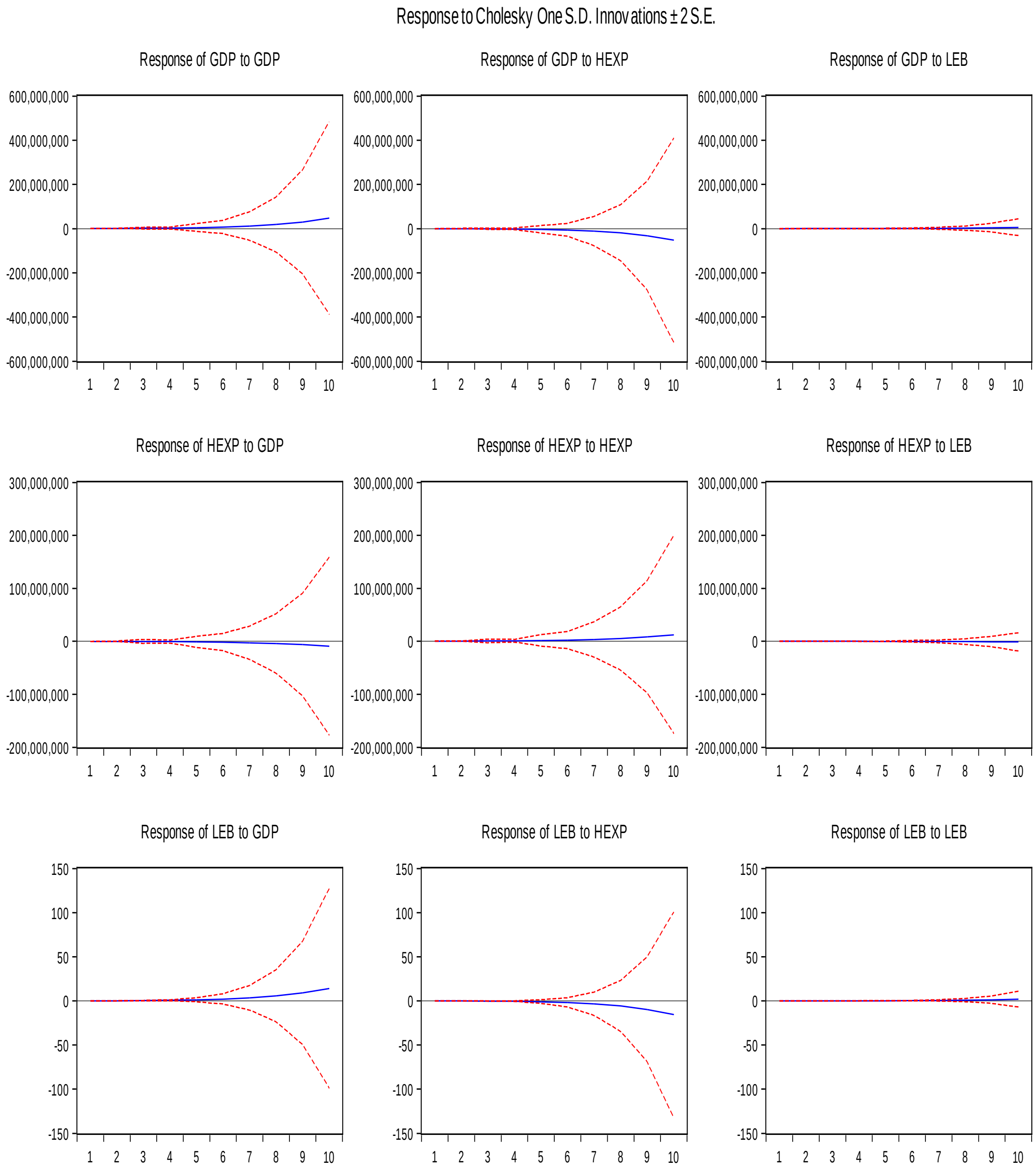
Vector Autoregression Estimates
Date: 05/16/13 Time: 12:29

Sample (adjusted): 1979 2008
Included observations: 30 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	GDP	HEXP	LEB
GDP(-1)	0.899506	-0.026568	2.08E-09
	(0.28442)	(0.31594)	(1.4E-08)
	[3.16261]	[-0.08409]	[0.15101]
GDP(-2)	0.279392	0.281768	3.24E-08
	(0.36680)	(0.40745)	(1.8E-08)
	[0.76170]	[0.69154]	[1.82543]
HEXP(-1)	-0.146674	0.357508	-1.03E-08
	(0.26755)	(0.29719)	(1.3E-08)
	[-0.54822]	[1.20294]	[-0.79394]
HEXP(-2)	-2.000403	1.315812	-4.17E-07
	(3.64267)	(4.04635)	(1.8E-07)
	[-0.54916]	[0.32519]	[-2.36478]
LEB(-1)	958657.9	-1738572.	1.920499
	(801573.)	(890402.)	(0.03878)
	[1.19597]	[-1.95257]	[49.5199]
LEB(-2)	-560533.7	1690622.	-1.012882
	(834486.)	(926962.)	(0.04037)
	[-0.67171]	[1.82383]	[-25.0870]
C	-18030228	2074374.	4.196594
	(1.3E+07)	(1.4E+07)	(0.61128)
	[-1.42710]	[0.14781]	[6.86527]
R-squared	0.993847	0.823474	0.999725
Adj. R-squared	0.992242	0.777424	0.999653
Sum sq. resids	8.20E+12	1.01E+13	0.019191
S.E. equation	597019.1	663180.0	0.028885
F-statistic	619.1701	17.88211	13920.24
Log likelihood	-437.5737	-440.7267	67.74989
Akaike AIC	29.63825	29.84844	-4.049993
Schwarz SC	29.96520	30.17539	-3.723047
Mean dependent	4371457.	411774.6	46.42486
S.D. dependent	6778133.	1405699.	1.550383

Determinant resid covariance (dof adj.)	4.76E+19
Determinant resid covariance	2.15E+19
Log likelihood	-795.4013
Akaike information criterion	54.42676
Schwarz criterion	55.40759

APPENDIX i


Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of GDP to GDP
Response of GDP to HEXP
Response of GDP to LEB
Response of HEXP to GDP
Response of HEXP to HEXP
Response of HEXP to LEB
Response of LEB to GDP
Response of LEB to HEXP
Response of LEB to LEB
600,000,000
400,000,000
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0
-200,000,000
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-200,000,000
150
100
50
-50
-100
-150
1 2 3 4 5 6 7 8 9 10

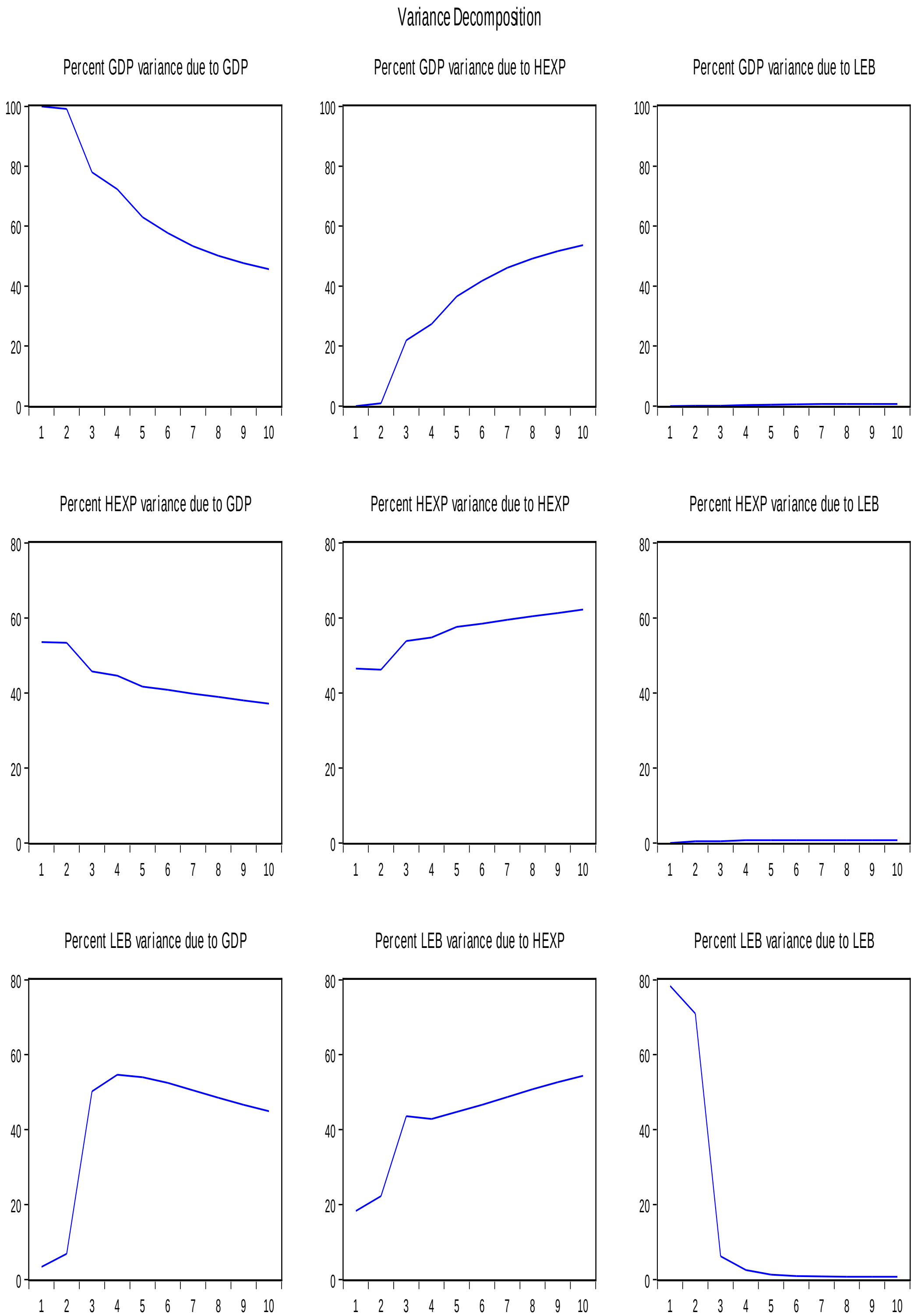
APPENDIX ii

Variance Decomposition of GDP: Period	S.E.	GDP	HEXP	LEB
1	597019.1	100.0000	0.000000	0.000000
2	859758.9	99.09222	0.826477	0.081306
3	2186945.	77.95006	21.95875	0.091186
4	3659419.	72.34139	27.33298	0.325623
5	6743796.	63.02942	36.54226	0.428314
6	11669578	57.70503	41.74649	0.548482
7	19937527	53.28495	46.10150	0.613544
8	33456628	50.13499	49.21452	0.650485
9	55066292	47.66348	51.66228	0.674236
10	89359511	45.67674	53.63707	0.686189

Variance Decomposition of HEXP: Period	S.E.	GDP	HEXP	LEB
1	663180.0	53.52755	46.47245	0.000000
2	717427.4	53.39074	46.22522	0.384042
3	1152520.	45.74702	53.84478	0.408195
4	1619599.	44.56348	54.76002	0.676493
5	2483248.	41.68439	57.57613	0.739480
6	3871391.	40.84811	58.40762	0.744272
7	5940582.	39.73765	59.50886	0.753491
8	9161368.	38.88308	60.38326	0.733667
9	13912422	38.00543	61.26393	0.730638
10	20992398	37.09292	62.18200	0.725081

Variance Decomposition of LEB: Period	S.E.	GDP	HEXP	LEB
1	0.028885	3.306873	18.31571	78.37742
2	0.065715	6.802766	22.19977	70.99746
3	0.355038	50.16786	43.63098	6.201163
4	0.851935	54.64841	42.82192	2.529670
5	1.802157	53.93616	44.75507	1.308767
6	3.383190	52.49904	46.58519	0.915771
7	5.957557	50.50673	48.72812	0.765155
8	10.08745	48.51319	50.77977	0.707042
9	16.60649	46.62608	52.68363	0.690292
10	26.82040	44.90923	54.40206	0.688711

Cholesky Ordering: GDP HEXP LEB


Variance Decomposition
Percent GDP variance due to GDP
Percent GDP variance due to HEXP
Percent GDP variance due to LEB
Percent HEXP variance due to GDP
Percent HEXP variance due to HEXP
Percent HEXP variance due to LEB
Percent LEB variance due to GDP
Percent LEB variance due to HEXP
Percent LEB variance due to LEB