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An Investigation into the Channel of Public Expenditure to Boost Industrial Productivity in Pakistan

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ABSTRACT

It is a fact that public expenditure has a strong association with industrial productivity. The industrial sector recorded slow growth of 5.43%, which adds 20.90% to the GDP of Pakistan (2017-2018). This study aims to find the effects of public expenditure on Total Factor Productivity (TFP) in the industrial sector of the country. The study constructed two different models. In the first model, the study used time series data from 1975 to 2018, and the growth of adjusted TFP was calculated by the growth accounting method. In the second model, the study collected data from 1977 to 2018 and checked the impact of government expenditure on the TFP growth in the industry. The unit root tests, Ordinary Least Square (OLS), and Vector Error Correction Model (VECM) were employed. The findings of the study revealed that public expenditures on education were significant and positively related to TFP growth in industries. Public expenditure on health, agriculture, and inflation had a significant and positive association with TFP growth in the industries. Foreign direct investment had a negative but significant impact on TFP growth. The results of the present study suggest that industrial productivity can be increased by increasing the expenditure on education and health.

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1. Introduction

The prime objective of implementing public policies is to attain sustainable output along with increased living standards. Every country is endowed with some natural resources and its production capabilities in different sectors. Here, most important question is, what should be the optimal combination of traditional inputs like capital and labor, and what should be the contribution of technological advancement or institutional changes?.

According to classical economists, labor and capital are two major determinants of output while technological progress was not considered as the main determinant of output. On the contrary. Solow, Marx, Swan, and Schumpeter believed in technological & institutional changes. They claim that technological progress in the industrial sector is solely responsible for economic development because it strengthens production activities (Fazal, Gillani, Amjad, & Haider, 2020).

Total Factor Productivity (TFP) is crucial for the flourishing of the industrial sector. TFP got importance by the articles of both Solow (1956) & Swan (1956), in which they highlighted the strong factor which strengthens the production in the industrial sector.

The basic problem associated with the developing countries is either input resources are limited or they are not fully utilized. Only a few studies are available which were conducted to evaluate TFP in Pakistan (Wizarat, 2004). Unlike developed countries, the industrial sector of developing countries like Pakistan has a lesser contribution to GDP. Since independence (1947), the share of the industrial sector has remained very low in Gross Domestic Product (GDP). The textile industry has remained the major contributor in industrial share and other industries like the sugar industry, tea refineries, and cement also have little but significant share (Wizarat, 2004).

At the time of independence, the share of large-scale industry in total GDP was just 1.8% while the share of small-scale manufacturing was 4.6%. The manufacturing sector exhibited a growth rate of 7.73% in 1950 and a growth rate of 15.73% was observed in large-scale industries while the growth rate of small-scale industry was 2.3%. At that time, the import restriction policies played a significant role in the industrial sector of Pakistan. The demand for home appliances increased significantly during that period caused high industrial growth. The exports of Pakistan increased at a slow pace till 1992. After opening up its economy at the end of the last century, exports of Pakistan increased significantly but after the financial crisis of 2008 exports remain stagnant due to low capital stock and unskilled labor (Bhatti, Chaudhry, & Bashir, 2021).

Public expenditure is an important tool for boosting the growth of the industrial sector of any country (Bhatti & Fazal, 2020). In Pakistan, the share of public expenditure on the industry is minimal. The growth of the industrial sector is bound to flourish with the agricultural sector, as the agricultural sector provides inputs to the industrial sector. So for industrial development, the development of the agriculture sector is mandatory.

Investment in human capital can also raise the TFP. Expenditure on education provides educated, technical, and skilled manpower. Pakistan is fundamentally an agricultural economy and most of its population lives in rural areas where, there are few educational and technical facilities, which results in a low literacy rate and low factor productivity. In Pakistan literacy rate in rural areas is just around 49%. The health sector is also negligible but an important factor to raise the TFP is the very existence of healthy and creative workers who can perform better than those unhealthy and physically unfit workers (Gillani, Shafiq, & Ahmad, 2019). The active private sector can play a favorable environment for the economy to boost. Public expenditure complements private investment and creates an environment where private produce increases the output (Diao, Hazell, Resnick, & Thurlow, 2006).

In the last three decades or so, Pakistan is facing many macroeconomic issues including stagflation, budget deficit, capital flight, and high population (Azam, Nawaz, & Riaz, 2019). These issues along with some social issues are creating obstacles for Pakistan to get higher economic growth rates. These obstacles can be removed with the help of effective public policies and increased TFP (Nawaz, Ahmadk, Hussain, & Bhatti, 2020).

In developing countries, during the past two decades, overall public expenditures have risen by 6% per year. The public expenditure of developing countries in Asia increased by 8% and industrial productivity also increased significantly. At the same time, Pakistan is placed at the bottom concerning industrial productivity. This situation has brought the attention of the researchers to work on the TFP growth models and suggest policies to increase the TFP. This study aims to provide the solution by estimating TFP growth models and highlighting factors that can raise total TFP by utilizing public expenditure.

2. Literature Review and Theoretical Framework

A corpus of the literature shows that target-oriented public policy can raise the TFP and there is also debate in the literature regarding the measurement of TFP in the manufacturing sector. Classical economists believe in the traditional inputs (labor and capital) as a source of growth but the neo-classical school of thought believes in the concept of TFP. The Cobb-Douglas production function (CDPF), which is centered on the assumption of constant returns to scale, is helpful for the measurement of TFP. It also explains how TFP can be effaced by public expenditure.

Solow (1956) was the first economist to give the idea of TFP by raising an important question that why do some countries grow quickly relative to other countries and why some countries have sluggish growth patterns. Solow explained this important question by giving three arguments: Firstly, some countries are enriched in the capital, so they focus on capital-intensive products. Secondly, some countries are labor abandoned, so they focus on labor-intensive products and use labor resources efficiently; Thirdly, technological advancement is a major factor that causes the difference in production between the countries.

Concerning technological advancement, the role of WTO has remained significant as it provides the opportunity to countries to transfer technology from one country to another. Foreign direct investment has and is playing a significant role in this technological movement from one country to another (Shafiq, Hua, Bhatti, & Gillani, 2021; Yang & Shafiq, 2020). The competitive market structures, production efficiencies, and innovations in the production methods become possible due to the movement of technology from developed countries to developing countries that have increased the economic growth rates (Akinlo, 2005). The more integrated countries can take more advantage of the updated technology (Romer, 1992; Sala-i-Martin, 1996).

The effect of TFP on the economic growth for Pakistan is also tested by the researchers. H. A. Pasha, Ghaus, and Hyder (2002) concluded that the stagnation of TFP has decreased the growth rate of Pakistan and human capital is a major contributor towards TFP. The estimates of the study showed that an improvement in the human capital of Pakistan increased the TFP of Pakistan by 0.2% yearly. In another study, T. Mahmood, Ghani, and Din (2006) took two sample years (1995-96 and 2000-01) and evaluated the performance of 101 large-scale industries by using the production frontier approach. The results of the study concluded on the note that the pace of the growth of large-scale industries is quite slow. Furthermore, Lipsey estimated the technological variations and TFP. The authors concluded the study on the note that the variations in TFP are not caused by technological changes.

Raheman, Afza, Qayyum, and Bodla (2008) used the Malmquist index approach (the bilateral index that can be used to compare the production technology of two economies) to estimate the growth of TFP by taking efficiency and technological variation. Regression results showed the mixed trend in all industries and concluded that technological efficiency is necessary to increase the growth of the industrial sector in Pakistan. Prescott (1998) concluded in his study that technological growth will be smooth if the available resources are efficiently used. This will result in the form of increased TFP and a higher standard of living. In another study, Mahadevan (2000) concluded that the resources and technology were not used optimally in Singapore.

Wizarat (1981) conducted a study on Pakistan's economy and concluded that foreign aid has remained one of the important factors which contributed positively towards TFP. According to Emmanuel and Oladiran (2015), the government of Nigeria must allocate a significant part of the budget to the industrial sector. Nishimizu and Robinson (1984) established a positive and significant relationship between trade policies and TFP growth. The results also suggested that government expenditure play a significant role in establishing human capital and hence economic growth (Zhuang et al., 2021).

Khan (2005) determined TFP in Pakistan by taking the data from 1960 to 2003. Primarily, TFP was estimated with help of its major determinants. The results suggested that FDI, financial institutions, and stability of the economy are major contributors towards TFP while expenditure on education was found insignificantly related to TFP.

H. K. Ahmad (2011) stated that TFP can be estimated with the help of three approaches namely, econometric approach, growth accounting approach, and index number approach. The growth accounting approach got recognition after the study of Kendrick in 1961 and after that Nadiri (1970) and Griliches (1973) used the growth accounting approach to measure TFP. The growth accounting approach has some demerits but researchers use it due to feasibility (H. K. Ahmad, 2011; Baier, Dwyer Jr, & Tamura, 2006). Various studies have used this approach to measure TFP in Asian countries (K. Ahmad & Heng, 2012; Sabir, Ahmed, & Policy, 2003).

Having gone through the literature, it can be said that the majority of studies, especially on the Pakistan economy, as a whole growth of TFP has been calculated. Only a few studies have focused to estimate the sector-wise growth of TFP. Different techniques have been used to calculate TFP but the majority of studies used the growth accounting method for the measurement of TFP because it is feasible to use this method. The growth of TFP is a path to reduce poverty hence its very importance compels on the need to focus on its fair measurement. The literature review also realized that there is an ardent need for allocation of funds for public expenditures on the industrial sector and economic productivity and economic growth of the economy.

2.1. Measurement of Total Factor Productivity

In the light of literature, the present study has used a growth accounting approach to estimate the TFP. According to this approach, TFP is the remaining output that is obtained by using basic inputs (labor and capital). This approach decomposes the output into three groups namely, output from capital; output from labor; and remaining treated as TFP or from technological variation.

We utilized the following equation as a production function.

$$Y = f\ (K, L, t) \tag{1}$$

Where Y is variation in output, K is part of output obtained from the capital, L is part of output obtained from labor and t is the share of technological change in the output. Here technological variations will consist of advanced production methods, improvement in education, knowledge, and skills utilization. The equation (2) is formed on the assumption of constant return to scale.

$$Y = A(t).f(K, L, A) \tag{2}$$

The equation (2) is formed in terms of production per work

$$y = A(t).f(k, a) \tag{3}$$

Where Y/L= y and K/L= k

By dividing equation (3) with Y and differentiating this equation with referencing to time

$$y*/Y = A*/A + Sk[k*/k] \tag{4}$$

y^*/Y will be equal to $\Delta y/Y$. The equation can be written as

$$y = SKk + SLl + TFPG \tag{5}$$

Equation (5) is rearranged for TFPG and can be written as:

$$TFPG = y - SKk - SLl \tag{6}$$

The equation (6) is written in the following form

$$TFPGit = V*it - \alpha K*it - \beta L*it \tag{7}$$

Here $TFPG_{it}$ = growth rate of TFP, V_{it} = output growth rate, K_i =growth rate of capital, and L_i = growth rate of labor.

3. Data and Methodology

For the estimation of TFP, the study used the time series data of 43 years from 1975 to 2018. Series for growth domestic product (GDP) in the industry was calculated by using 1999-2000 base year. Series of capital stock was generated by using the Perpetual Inventory Method.

For the model estimation, 41 years of data from 1977 to 2018 were used. The impact of public expenditure on health (PSH) and public expenditure on education (PSE) was assessed on Total Factor Productivity (TFP) growth in the industrial sector (TFPI). Other control variables in the model included inflation rate (INF), foreign direct investment (FDI), and growth of TFP in the agriculture sector (TFPA) Solow residual was measured by TFP growth, which was calculated by growth accounting technique.

Data on PSH and PSE was obtained from an economic survey of Pakistan and world development indicators. Both the variables were measured in per capita terms and then divided by GDP deflator to convert into real form. The growth accounting technique was used to calculate TFPA. Data on FDI and inflation rates (INF) was sourced from Pakistan economic survey (various issues) and world development indicators respectively. The logarithm of each variable was used to avoid any difficulty and to ease the interpretation.

Time series data always have fluctuations and random walks, so a stationarity test is mandatory for the time-series data to proceed further. To use appropriate econometric technique Augmented Dickey-Fuller unit root test was applied. The results of the Augmented Dickey-Fuller unit root test suggest that all variables are integrated of order 1. So to proceed further Johansen Cointegration test was applied (results are presented in Appendix 2). For optimal lag selection, we used Ljung Box Q-Stat. Results suggested that three lags are optimal. So the model was estimated by using the lag length of 3.

3.1. Model specification

In order to assess the impact of public expenditure on TFP, following model was constructed:

$$TFP_I = \beta_0 + \beta_1 LPSE + \beta_2 LPSH + \beta_3 LTFPA + \beta_4 LFDI + \beta_5 INF + \varepsilon_t \quad (8)$$

All the variables are taken in log form. β Coefficients of independent variables are expected to have the following signs.

$\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 <> 0$ and $\beta_5 > 0$

4. Results and Discussion

The equation (8) is used to measure TFP

$$TFPG_{it} = V^*_{it} - 0.61K^*_{it} - 0.39L^*_{it} \quad (9)$$

The average growth rate of TFP is obtained from equation (9) is 2.88%. Different studies have estimated the average growth rate of TFP between 0.9 (Raheman et al., 2008) and 2.37 (Z. Mahmood & Siddiqui, 2000).

Table 1
Normalized Cointegration Coefficients

LTFPI	LPSE	LPSH	LTFPA	LFDI	INF
1	0.301	0.540	1.580	- 0.090	0.020
S.E	(0.140)	(0.090)	(0.560)	(0.040)	(0.000)
t-value	-2.150	-6.001	-2.821	2.250	-3.431

Following relationships between regressors and regress and are obtained from the results presented in Table 1:

TFPI = -6.750+ 0.301LPSE +0.540LPSH + 1.580LFTPA -0.090LFDI + 0.020INF

TFP growth in the industrial sector is significantly affected by public expenditures on health and education. One percent increase in government expenditure on education increases TFP in the industrial sector by 0.301 percent. While a one percent increase in public health expenditure raises industrial productivity by 0.540 percent. The impact of foreign direct investment is negative and significant. If FDI increases by one percent then industrial productivity growth exhibits a decline of 0.090 percent. Growth in agricultural productivity and industrial productivity are positively related. An increase of one percent in agricultural productivity leads to a significant increase of 1.580 percent in industrial productivity. An increase of one percent in inflation also causes a significant impact of 0.020 percent on industrial productivity.

Short-Run Estimates and Error Correction:

Table 2 presents the results of the vector error correction (VECM) model. VECM gives short-run estimates at lag 1 and the coefficient of error correction term.

Table 2
Vector Error Correction Model Results

Variables	ECM	ΔLPSE	ΔLPSH	ΔLTFPA	ΔLFDI	ΔINF
Coefficients	-0.440	-0.181	0.590	-0.200	-0.252	-0.322
S.E	0.210	0.170	0.230	0.251	0.301	0.250
t-values	-2.095	-1.064	2.565	-0.796	-0.837	-1.288

The results indicate that in the short run, the error correction coefficient is negative and significant which means that there is a stability of the long-run relationship among the concerned variables. The value of the error correction coefficient is 0.44 which shows that 44 percent of correction takes place in the first period to keep the long-run relationship among the variables. In the short run, coefficients of independent variables exhibit frequent and immediate changes in the signs therefore, they are difficult to interpret (Brooks, 2008). To check the stability of our model and consistency of the findings, different diagnostic tests under VECM and ECM approaches are used to confirm that the model is stable and normally distributed, and free of autocorrelation and heteroscedasticity problems (Appendix 1).

5. Conclusion

The core objective of the study was to find out the relation between TFP growth in the industrial sector and public expenditure on education and health. TFP growth affects industrial output through a much diverse mechanism rather than changes in traditional factors including capital and labor inputs. TFP growth is mainly determined by technical changes including advancement in technology, improvement in skills, and enhancement in the knowledge of the workers, which increases overall efficiency in the production process. The present study used the most suitable approach to construct the TFP index for the industrial sector i.e. growth accounting technique. Besides public expenditure, the study captured the impact of variables including foreign direct investment, inflation, and agricultural TFP growth, on industrial sector productivity. To check the presence of a long-run relationship among the variables, time-series data for 1977-2018 was used. The stationarity of the data was examined by the Augmented Dickey-Fuller test, where all the variables were found to be integrated of order 1. Cointegration results confirmed the presence of a long-run relationship between dependent and independent variables.

Results of the study indicated that public expenditure is crucial for enhancing the performance of the industrial sector. Public expenditure on health and education improves the quality of human capital and is pivotal for the growth of industrial TFP (Hao, Shah, Nawazb, Barkat, & Souhail, 2020). These findings are consistent with many other studies which confirm that public expenditure on the social sector like health and education is beneficial for TFP growth in the industrial sector (Pasha et al., 2011; Shafiq & Gillani, 2018).

The agricultural and industrial sectors are directly or indirectly associated with each other and are significantly affected by each other's performance (Noshad, Amjad, Shafiq, & Gillani, 2019). The findings of the study confirmed that industrial sector productivity is largely determined by the growth of agricultural TFP. FDI has a negative and significant effect on industrial (TFP) growth. This may be because, in Pakistan, financial institutions are underdeveloped and are not performing efficiently. Moreover, weak financial infrastructure in the country prevents the economy from reaping the maximum benefits of spillover effects of foreign direct investment (Falki, 2009). Inflation provides a positive stimulus to the industrial sector in Pakistan. Results confirmed that inflation has a significant impact on the TFP in the industrial sector in the long run. Khan (2005) also found a positive link between inflation and industrial output growth.

5.1. Policy Recommendations

Based on the findings, the study has some important policy recommendations. The government needs to pay more attention to the industries to enhance the TFP in the sector. For this purpose, more funds allocation is required to support the sub-sectors of industries to increase production and efficiency. One of the important reasons why Pakistan cannot get the advantage of the spillover effects of FDI is weak financial infrastructure and negligence of authorities. In this case, the government can devise policies to improve infrastructure in financial institutions and impose some restrictions on foreign investment to attain spillovers from foreign investors.

Industries in Pakistan heavily rely on the agricultural sector for inputs. Therefore, there is a need to improve the productivity of the agricultural sector. Government should increase investment opportunities in agriculture and also formulate an appropriate policy framework to address the issues hindering the progress of this sector. These may include improved production methods, provision of agricultural machinery to the farmers at low cost, provision of easy credit facilities, and easy availability of high-quality seeds. Education and health expenditure are crucial for TFP growth in the industrial sector. There is a need to increase investment in health and education sectors by the government especially in rural areas of the country. This includes setting up schools, health centers, technical education institutes, and research institutes across the country. Although the increase in the overall price level has a positive effect on industrial productivity, yet there is a need to have a proper check on inflation to avoid a reduction in the real income of common citizens.

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APPENDIX 1

Stationarity of Variables

Augmented Dickey Fuller Test:

Variables	ADF Statistics				Conclusion
	Level		First Difference		
	Intercept	Intercept and trend	Intercept	Intercept and trend	
Gy	9.66***	10.36***	8.85***	8.71***	I(0)
Gk	7.70***	7.72***	7.55***	7.42***	I(0)

(Note: ***, **, * indicates significance level at 1, 5 and 10 percent respectively.)

Phillip-Perron Test

Variables	PP Statistics				Conclusion
	Level		First Difference		
	Intercept	Intercept and trend	Intercept	Intercept and trend	
Gy	7.70***	7.78***	33.78***	35.78***	I(0)
Gk	9.36***	10.35***	38.02***	38.47***	I(0)

(Note: ***, **, * indicates significance level at 1, 5 and 10 percent respectively.)

Regression Results

Dependent Variable: LGY
Method: Least Squares
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.029821	0.012578	2.370945	0.0228
LGK	0.611931	0.107982	5.666953	0.0000

R-squared	0.451588	Mean dependent var	-0.011961
Adjusted R-squared	0.437526	S.D. dependent var	0.087002
S.E. of regression	0.065250	Akaike info criterion	-2.573642
Sum squared resid	0.166043	Schwarz criterion	-2.490053
Log likelihood	54.75965	Hannan-Quinn criter.	-2.543203
F-statistic	32.11436	Durbin-Watson stat	1.917674
Prob(F-statistic)	0.000002		

Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.355350	Prob. F(2,37)	0.7033
Obs*R-squared	0.772691	Prob. Chi-Square(2)	0.6795

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001677	0.013230	-0.126746	0.8998
LGK	-0.015537	0.119802	-0.129691	0.8975
RESID(-1)	0.009608	0.178338	0.053875	0.9573
RESID(-2)	0.145832	0.173872	0.838733	0.4070

R-squared	0.018846	Mean dependent var	0.000000
Adjusted R-squared	-0.060707	S.D. dependent var	0.064429
S.E. of regression	0.066356	Akaike info criterion	-2.495107
Sum squared resid	0.162914	Schwarz criterion	-2.327929
Log likelihood	55.14969	Hannan-Quinn criter.	-2.434230
F-statistic	0.236900	Durbin-Watson stat	2.004398
Prob(F-statistic)	0.870059		

Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test:

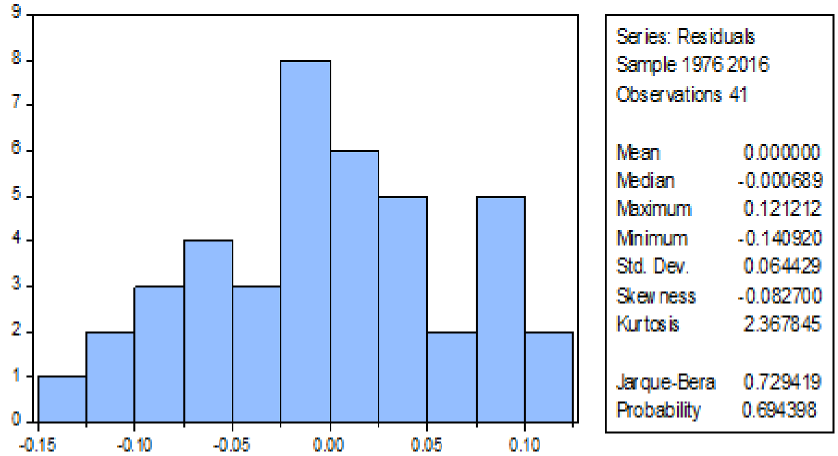
F-statistic	0.355350	Prob. F(2,37)	0.7033
Obs*R-squared	0.772691	Prob. Chi-Square(2)	0.6795

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001677	0.013230	-0.126746	0.8998
LGK	-0.015537	0.119802	-0.129691	0.8975
RESID(-1)	0.009608	0.178338	0.053875	0.9573
RESID(-2)	0.145832	0.173872	0.838733	0.4070

R-squared	0.018846	Mean dependent var	0.000000
Adjusted R-squared	-0.060707	S.D. dependent var	0.064429
S.E. of regression	0.066356	Akaike info criterion	-2.495107
Sum squared resid	0.162914	Schwarz criterion	-2.327929
Log likelihood	55.14969	Hannan-Quinn criter.	-2.434230
F-statistic	0.236900	Durbin-Watson stat	2.004398
Prob(F-statistic)	0.870059		

Normality Test



Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.521899	Prob. F(1,39)	0.4743
Obs*R-squared	0.541418	Prob. Chi-Square(1)	0.4618
Scaled explained SS	0.335043	Prob. Chi-Square(1)	0.5627

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003656	0.000930	3.931433	0.0003
LGK	-0.005768	0.007984	-0.722426	0.4743

R-squared	0.013205	Mean dependent var	0.004050
Adjusted R-squared	-0.012097	S.D. dependent var	0.004795
S.E. of regression	0.004824	Akaike info criterion	-7.782778
Sum squared resid	0.000908	Schwarz criterion	-7.699189
Log likelihood	161.5470	Hannan-Quinn criter.	-7.752340
F-statistic	0.521899	Durbin-Watson stat	2.646545
Prob(F-statistic)	0.474343		

Ramsey RESET Test

Ramsey RESET Test
Equation: UNTITLED
Specification: LGY C LGK
Omitted Variables: Squares of fitted values

	Value	Df	Probability
t-statistic	0.950655	38	0.3478
F-statistic	0.903745	(1, 38)	0.3478
Likelihood ratio	0.963679	1	0.3263

F-test summary:

	Sum of Sq.	Df	Mean Squares
Test SSR	0.003857	1	0.003857
Restricted SSR	0.166043	39	0.004258
Unrestricted SSR	0.162186	38	0.004268

LR test summary:

	Value
Restricted LogL	54.75965
Unrestricted LogL	55.24149

APPENDIX 2

Johensen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.846052	207.1421	95.75366	0.0000
At most 1 *	0.819986	139.7810	69.81889	0.0000
At most 2 *	0.644742	78.05108	47.85613	0.0000
At most 3 *	0.520577	40.79430	29.79707	0.0018
At most 4	0.260243	14.32813	15.49471	0.0744
At most 5	0.092054	3.476535	3.841466	0.0622

Trace test indicates 4 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

VEC Residual Serial Correlation LM TEST

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	26.13077	36	0.8868	0.597899	(36, 24.7)	0.9220
2	38.72458	36	0.3477	1.050560	(36, 24.7)	0.4565
3	43.50078	36	0.1823	1.261278	(36, 24.7)	0.2759
4	43.38861	36	0.1854	1.256047	(36, 24.7)	0.2796

ECM Diagnostic Tests
NORMALITY OF TEST