Time Series Analysis of Role of Infrastructure in Growth of FDI: The Case of Pakistan

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Abstract

Foreign Direct Investment (FDI) has its major contribution in economic development of a country. It has been clear from Literature that Foreign Direct Investment (FDI) not only facilitates in capital formation but also a source of new technology development in a country. This study has been conducted to ensure the impact of Infrastructure on FDI with the help of time series analysis by taking Pakistan as a case. The data of 30 years collected from two major sources; World Bank and Ministry of Finance for the time period 1980 to 2013. The variables used for this research are FDI (dependant variable) and Infrastructure (independent variable) also includes proxy variables with independent variable i-e; ((Real Government Expenditure per real GDP), Market size (Real GDP per capital), Openness (Real trade share (Import – export) per capital), Human Capital (total real education expenditure).

Time series analysis conducted to find out the relationship between FDI and Infrastructure. First step to start the time series analysis is to check, whether the data is stationary or not. The randomness of time series data is like a basic building block to go for further analysis. In this study, by applying ADF (unit root test) on Eviews it came to know that some of the variables are stationary at I(1) and some of them are stationary at I(2). After getting stationary data at 1st difference and 2nd difference, the ordinary least square (OLS) with White Heteroskedasticity employed to estimate the model. Findings showed the positive impact of Infrastructure on FDI, heteroskedasticity does not exist and also the regression is not spurious. The results can definitely be useful for policy makers to take decisions regarding economic growth and development of infrastructure.

Introduction

Background

Foreign direct investment (FDI) normally seen as an integral part for economic growth in the developing countries. The FDI proved to be helpful for technological advancement in country. Many studies have been conducted on the topic of, what affect the inflows of FDI in the country. The high level of contribution of FDI in the economic growth of the country has been well recognized throughout the world. The impact of FDI has been proven highly beneficial for the developing country than the developed countries (Root, 1979; Wheeler and Mody, 1992). Most of the developing countries normally have different economic deficiencies like lack of new technologies, and short of capital, which is automatically recovered by the FDI in the country (Kumar, 2001; Asiedu, 2002). In literature many researchers considered the importance of the FDI along with other determinants. The process of liberalization in the international trade in Pakistan was actually started from early 1980s. The market economic reforms and polices progressively open the doors for foreign investors in Pakistan (Sekkar and Veganzones-Varoudakis, 2004). The government has facilitated in tax concessions, tariff reduction, credit facilities and also softened foreign exchange controls (khan, 1999). Among the various factors of infrastructure, the most prominent are level of communications facilities, roadways, transportation, highways and ports (Kok and ersoy; 2009 and Khadaroo and Seetanah, 2010). It is considered that any country who has communication, ports and bridges they attract more FDI than any other country who don't have these infrastructure in a good form Coughin (1991).

Significance

Infrastructure and FDI

This study is related to Pakistan economy particularly. The two reasons to basically locate the FDI in a foreign country are discussed in the study of Shatz and Venables (2000).In their study they discussed about the Horizontal or base expansion which actually extends the economies of transportation costs, tariffs and access to a new market. The aim of this type on FDI is to enhance competitive position of the firm around the globe. The second reason is economics of production cost as lower labor, capital and the other inputs cost to maximize the profits. Such FDI is termed as vertical or minimizing production cost. Infrastructure is very useful in country it actually promotes both types of FDI, vertical FDI reduces

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operational costs. Khadaroo and Seetanah (2008) claim the gains are accomplished by infrastructure growth is associated with the greater accessibility and reduction in transportation costs. Public goods always reduced the cost of doing business of foreign enterprise, which actually leads to high profits. According to the literature, public goods have enormous impact on cost structure and output of private firms.

The poor infrastructure in any country causes increase in the transaction cost and it limits the access to both the local and the global market which discourages the FDI. (Iwanow and Kirkpatrick (2006)) argued about the major contribution of the quality infrastructure improvement in export performance also.

Not more researchers in Pakistan concentrated their studies on the relationship between infrastructure and FDI inflows which certainly leads to a research gap in this particular area.

Research Question

What are the significant determinants of FDI inflows in Pakistan with major focus on infrastructure facilities?

Research Objective

Following are the Research objectives of study

- To analyze the impact of infrastructure facilities on FDI inflows in Pakistan
- To investigate the impact of Real GDP per capita on FDI
- To examine the impact of real trade share per real GDP on FDI
- To check the impact of human capital on FDI

Data and Methodology

This study used the annual time series data from 1980 to 2013. Data collected from two major sources; World Bank and Ministry of Finance. These are the most authentic sources for data collection in Pakistan. FDI inflows in the country have been used as dependent variable. The data of transportation and energy has been used as the proxy for the infrastructure. The expenditure rate for transportation and energy may indicate the part of government expenditure invested for the infrastructure, thus a positive relationship is expected. The Real Gross Domestic Product Per Capita (GDPCAP) is used as a proxy as well but for the market demand and the market size of Pakistan. Schneider and Frey (1985) and Tsai (1994) also found that there is a positive relationship between real GDP per capita and FDI. As, Human capital plays an important role in country's growth or it is somehow part of FDI and infrastructure as well, therefore the data of Education total real expenditure has been used. Education has its significant impact for the development of human capital, as; the labor cost is one of the determinants of FDI inflows in country. Developing countries are supposed to pay more attention on skills of labor to ensure the foreign investors about optimal output. These entire things have been explained in the past by the Lucas (1993) and the Wheeler and Moody (1992). The next variable is trade openness, which can be measured by the Import + Export. In the past some studies conducted by different people like, (Edwards (1990), Hausmann and Fernandez-Arias (2000),Chakrabarti (2001), Asiedu 2002, showed a quiet positive relationship between the trade openness and the FDI.

Model Specification

Following is the specified model by using the variables discussed above in the methodology.

$$FDI = \beta_1 + \beta_2 INFR + \beta_3 OPEN + \beta_4 EDUEX + \beta_5 GDPCAP + \mu$$

FDI = Total Foreign Direct Investment in Malaysia

β = Constant

INFR = Infrastructure (Real government expenditure for Transportation + Energy)

GDPCAP= Market size (Real GDP per Capita)

OPEN = Openness (Real trade share (import + export) per real GDP)

EDUEX = Human Capital (Total real education expenditures)

μ = Error Term

Graphical representation of the data of variables is given below in Appendix I.

Empirical results

Unit Root Test

After specification of model, it is necessary to check the primary requirement of time series data i-e; whether it is stationary or not. ADF (Augmented Dickey-Fuller) Test used to check the Stationarity of the data. Following table shows orders of integration of all the variables after conducting ADF test on Eviews. It has been clear that all the variables are stationary at order of integration I(1) but FDI and Education are stationary at level I(0).

Variables	Null hypothesis	Order of Integration	Prob. at 10%
FDI	FDI has a unit root	I(0)	0.0925
Transportation	Transportation has a unit root	I(1)	0.00
GDP	GDP has a unit root	I(1)	0.0025
Imports	Imports has a unit root	I(1)	0.00
Exports	Exports has a unit root	I(1)	0.00
Education	Education has a unit root	I(0)	0.0618
Energy	Energy has a unit root	I(1)	0.00

After confirming the order of integration of variables, OLS regression was being used to check the linear relationship among variables. After applying OLS on Eviews, one of the violations of regression i-e; autocorrelation detected through Breusch-Godfrey Serial Correlation LM test. To remove the autocorrelation @trend series, AR (1) and MA (1) added in regression model as an independent variables. That addition resulted in elimination of autocorrelation (Breusch-Godfrey Serial Correlation LM Test, accepted the null hypothesis of no autocorrelation at Prob. (F-statistic) >0.05) and model is also fit at Prob. (F-statistic) < 0.05. To check that whether the error term of the model having constant variance or not, Breusch-Pagan-Godfrey, Heteroskedasticity test applied. The results accepted the null hypothesis of no heteroskedasticity at Prob. (F-statistic) > 0.05).

On the other hand, results of OLS showed different trend about casual relationship among dependent and independent variables. Except export, none of the variable showed significant relationship with FDI. It has been clear that in the case of Pakistan, only export has significant relationship with FDI. Export is one of the factors of trade and results showed that increase in trade leads to attract the FDI in country. Therefore, trade openness showed positive significant relationship with FDI which is similar to the study of Chakrabarti (2001), Asiedu (2002). Other variables, like energy, transportation, education and GDP does not have any good impact on FDI in case of Pakistan. These findings are totally inconsistent with the results of the studies by Wheeler and Moody (1992) and Loree and Guisinger (1995), these studies showed a strong positive relationship of FDI with the Infrastructure which the current study disagreed in case of Pakistan. The GDP value is 4259808 so it seems that our GDP is non-significant but they have positive relation with the FDI. So the results are similar to the study of Tsai (1994) and Schneider and Frey (1985).In these both studies, there is a positive but insignificant relationship between GDP and the FDI.

Dependent variable: FDI			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
C	-1.57	-3.056624	0.0056
EDUCATION	2.01	1.767355	0.0904
ENERGY	104760	1.353626	0.1890
EXPORTS	**7.00**	**2.767379**	**0.0110**
GDP	42598	0.103673	0.9183
IMPORTS	1.54	0.870361	0.3931
TRANSPRTATION	762137	0.374885	0.7112
TREND	-1.87	-0.979630	0.3375
AR(1)	-0.1780	-0.767500	0.4506
MA(1)	0.9999	4.453731	0.0002

Another important aspect of OLS is to check that whether the constructed model is spurious or having relevant relationship among variables. To ensure about relevant relationship of variables, values of R-square and Durbin-Watson statistic are being considered.

R-squared	**0.750606**
Durbin-Watson stat	**1.839765**

Above table showed that value of Durbin-Watson statistic is greater than R-square, which means that OLS model in not spurious.

Conclusion & Recommendations

The current study is about to check the impact of infrastructure on FDI, in case of Pakistan. Annual Time series data was used from the year 1980 to 2013. Variables used for the study are FDI, GDP, Trade Openness, Infrastructure, and Human Capital. Results found that except trade openness all the variables have insignificant relationship with FDI, in case of Pakistan. It has been clear that except trade, Pakistan is not good other fields to attract FDI. It is required to improve the infrastructure, human capital and energy sector of Pakistan, which will become a source of increase in GDP. A good physical infrastructure, like; development of highways, transportation, airports and energy sector can shorten the time for facility provision and may increase the efficiency of production. Therefore, it is highly recommended in case of Pakistan to work for strengthening the weak sectors, for the sake of attracting FDI and increase in GDP. Another thing which has been proved from conducted study, that the weakness of education sector and human capital of Pakistan. Skillfulness and education of human resource plays an important in attracting FDI in any country. Therefore it is necessary for Pakistan to pay special attention in improvement of education, efficiency and skillfulness of labor.

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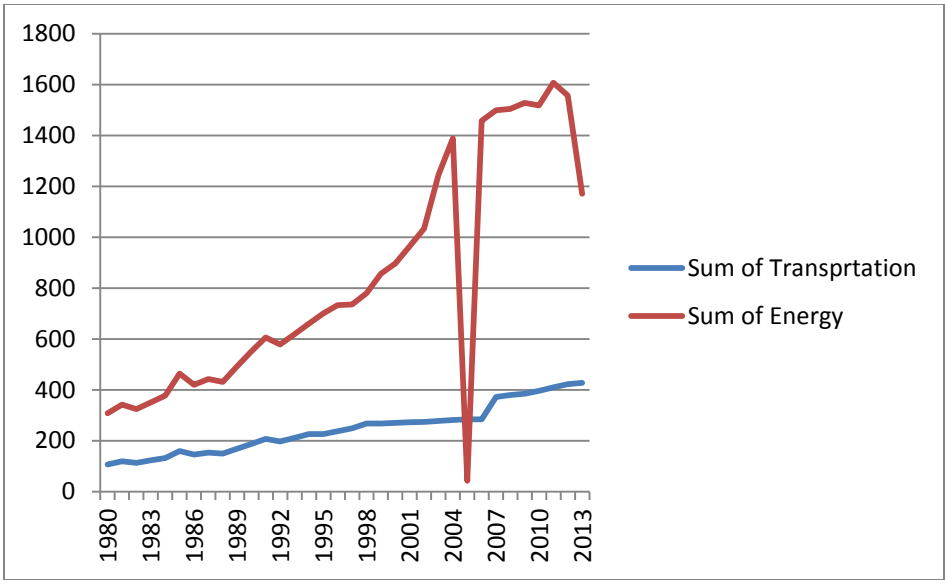
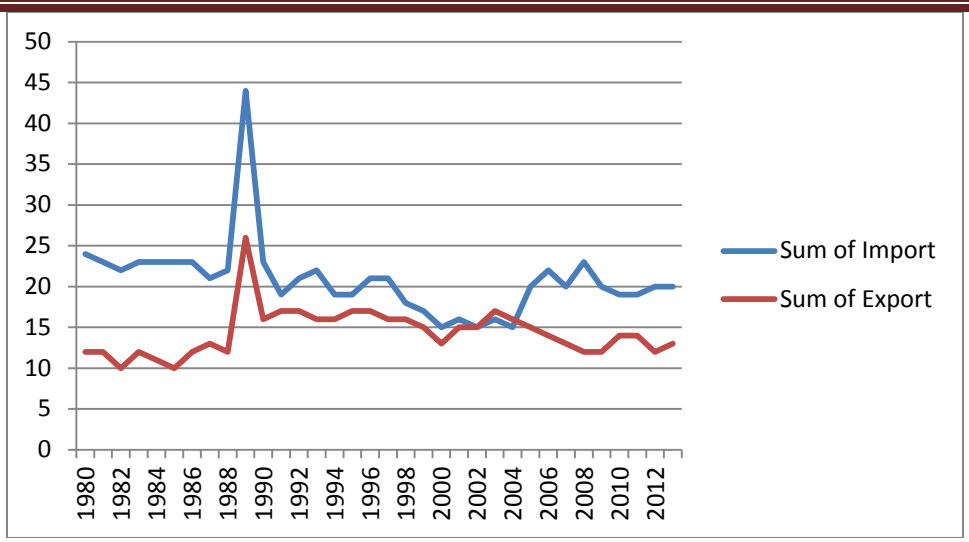
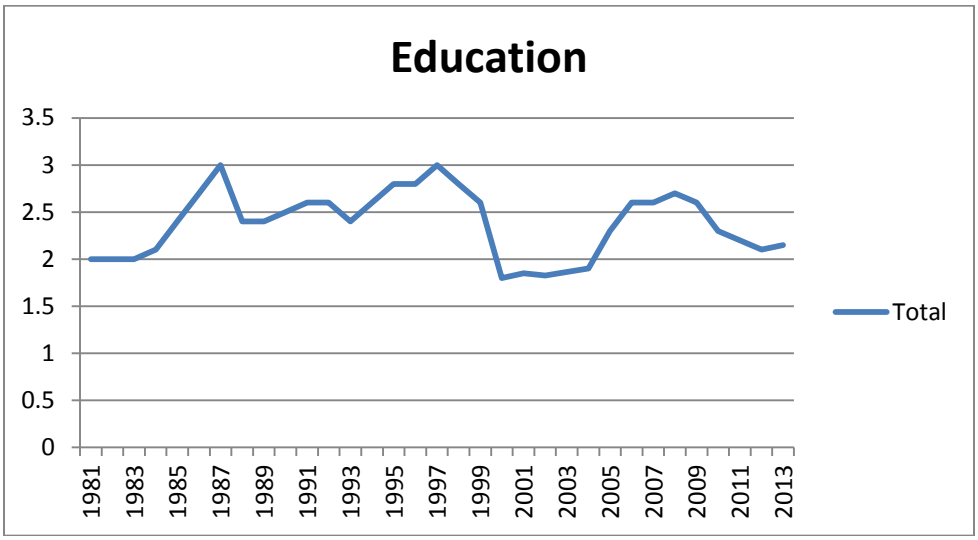
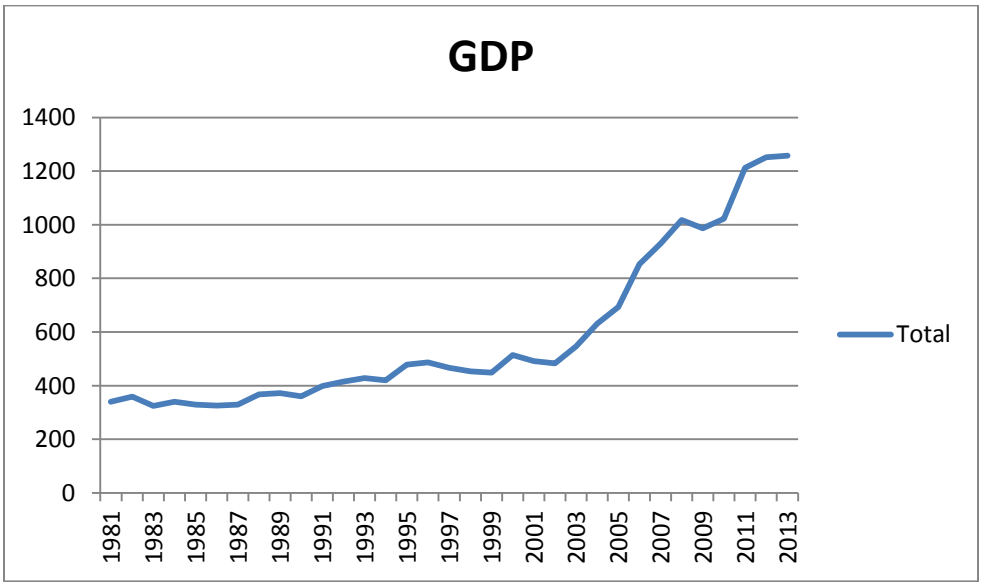
Appendix I




50
45
40
35
30
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Sum of Import
Sum of Export


Education
3.5
3
2.5
2
1.5
1
0.5
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Total


GDP
1400
1200
1000
800
600
400
200
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Total

Appendix II

Null Hypothesis: FDI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.657426	0.0925
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Null Hypothesis: EDUCATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.856732	0.0618
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Null Hypothesis: D(ENERGY) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.883354	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Null Hypothesis: D(EXPORTS) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.846655	0.0000
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.204853	0.0025
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Null Hypothesis: D(IMPORTS) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.965384	0.0000
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Null Hypothesis: D(TRANSPRTATION) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.249321	0.0000
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

OLS Results

Dependent Variable: FDI
Method: Least Squares
Date: 05/15/15 Time: 16:19
Sample (adjusted): 1981 2013
Included observations: 33 after adjustments
Failure to improve SSR after 20 iterations
MA Backcast: 1980

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.57E+11	5.15E+10	-3.056624	0.0056
EDUCATION	2.01E+10	1.14E+10	1.767355	0.0904
ENERGY	10476084	7739275.	1.353626	0.1890
EXPORTS	**7.00E+09**	**2.53E+09**	**2.767379**	**0.0110**
GDP	4259808.	41088723	0.103673	0.9183
IMPORTS	1.54E+09	1.77E+09	0.870361	0.3931
TRANSPRTATION	76213740	2.03E+08	0.374885	0.7112
TREND	-1.87E+09	1.91E+09	-0.979630	0.3375
AR(1)	-0.178039	0.231973	-0.767500	0.4506
MA(1)	0.999955	0.224521	4.453731	0.0002

R-squared	0.750606	Mean dependent var	1.60E+10
Adjusted R-squared	0.653018	S.D. dependent var	2.33E+10
S.E. of regression	1.37E+10	Akaike info criterion	49.76450
Sum squared resid	4.32E+21	Schwarz criterion	50.21798
Log likelihood	-811.1142	Hannan-Quinn criter.	49.91708
F-statistic	7.691520	Durbin-Watson stat	1.839765
Prob(F-statistic)	0.000038		

Inverted AR Roots	-.18
Inverted MA Roots	-1.00

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.629218	Prob. F(2,21)	0.2199
Obs*R-squared	4.432076	Prob. Chi-Square(2)	0.1090

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/15/15 Time: 16:20
Sample: 1981 2013
Included observations: 33
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.04E+10	5.00E+10	0.806978	0.4287
EDUCATION	2.52E+09	1.14E+10	0.220105	0.8279
ENERGY	-4600056.	8141187.	-0.565035	0.5780
EXPORTS	-2.32E+09	2.45E+09	-0.948644	0.3536
GDP	-4986547.	50748413	-0.098260	0.9227
IMPORTS	-4.36E+08	1.78E+09	-0.244979	0.8089
TRANSPRTATION	-64141578	2.07E+08	-0.309481	0.7600
TREND	9.56E+08	1.87E+09	0.510603	0.6150
AR(1)	-0.560508	0.891286	-0.628876	0.5362
MA(1)	-0.000340	0.000630	-0.539647	0.5951
RESID(-1)	0.686579	0.911074	0.753593	0.4595
RESID(-2)	-0.236834	0.286317	-0.827176	0.4174

R-squared	0.134305	Mean dependent var	-49827011
Adjusted R-squared	-0.319154	S.D. dependent var	1.16E+10
S.E. of regression	1.33E+10	Akaike info criterion	49.74147
Sum squared resid	3.74E+21	Schwarz criterion	50.28565
Log likelihood	-808.7342	Hannan-Quinn criter.	49.92457
F-statistic	0.296180	Durbin-Watson stat	1.796920
Prob(F-statistic)	0.979244		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.235753	Prob. F(7,25)	0.3210
Obs*R-squared	8.483111	Prob. Chi-Square(7)	0.2919
Scaled explained SS	7.866369	Prob. Chi-Square(7)	0.3445

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/15/15 Time: 16:22
Sample: 1981 2013
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.14E+20	8.41E+20	-0.611749	0.5462
EDUCATION	2.12E+20	1.84E+20	1.150546	0.2608
ENERGY	-4.88E+16	2.02E+17	-0.241688	0.8110
EXPORTS	3.81E+19	3.11E+19	1.225615	0.2318
GDP	-2.56E+16	7.66E+17	-0.033381	0.9736
IMPORTS	-2.16E+19	3.95E+19	-0.547963	0.5886
TRANSPRTATION	1.89E+18	3.23E+18	0.586908	0.5625
TREND	-2.11E+19	2.60E+19	-0.811107	0.4250

R-squared	0.257064	Mean dependent var	1.31E+20
Adjusted R-squared	0.049042	S.D. dependent var	2.60E+20
S.E. of regression	2.53E+20	Akaike info criterion	97.00639
Sum squared resid	1.60E+42	Schwarz criterion	97.36918
Log likelihood	-1592.605	Hannan-Quinn criter.	97.12846
F-statistic	1.235753	Durbin-Watson stat	2.522824
Prob(F-statistic)	0.321028		