THE NEXUS BETWEEN INVESTMENT AND INTEREST RATE: NEW DIMENSIONS FOR PAKISTAN

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Abstract

The nexus between investment and interest rate is always considered essential to analyze the economic activity as these variables are important economic indicators in defining macroeconomic activity. However, the unchanged condition of investment in Pakistan has raised the cost of investment and crates uncertainty in investors. The paper investigates the link between rate of interest and investment to incorporate a new dimension of call money rate that may enhance the investment opportunities in Pakistan, employing time series analysis for the time span of 1973 - 2015. The ARDL Bound Testing Approach and ECM are employed to capture both the long and short-run dynamics of the variables in the model. The results of the study indicate that the call money rate has significant effect on investment and thus on economic growth. Therefore, the preparation and implementation of financial policies may increase the investment-friendly rate of interest to stimulate economic growth in Pakistan.

Keywords: Investment, Income, Interest rate, call money rate, ARDL

Introduction

Variations in interest rate can reveal the rudimentary economic situation specifically the macroeconomic activity. It affects GDP growth, inflation, employment, international payments, economic development etc. Hence, any alteration in interest rate is the significant factor to arbiter the condition of the economy. The study is an attempt to analyze the trend analysis of interest rate and to predict the macroscopic economic conditions in Pakistan.

Economists consider interest rate as an important factor to link the money market, total public savings and investment. It is the opportunity cost of investment that affects investment activities and determines the expected scale of investment to forecast the desired level of savings. However, an increment in the rate of interest surges the investment cost and lowers income of investors. This inevitably creates uncertainty among investors and sedates them to draw back from their area of investment, so that the investment demand declines in the economy. The bond market is also highly impulsive to the changes in the interest rate as there is inverse association between interest rate and bond prices

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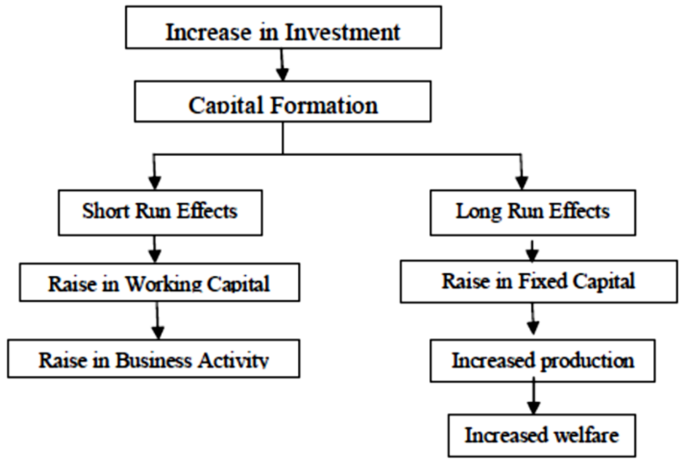
The following block diagram explains the flow of investment:



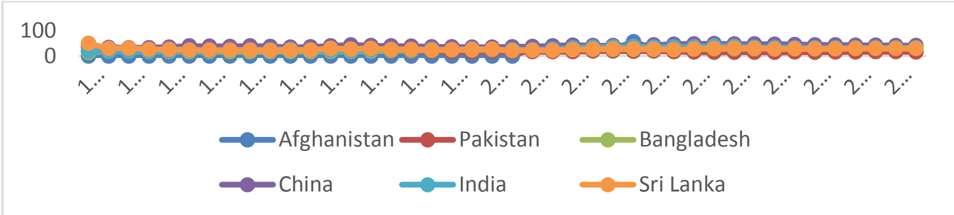
Source: Tabulated by Author

Investment in different sectors, ultimately, raise the capital formulation which is further analyzed in terms of its short and long run effects. In short run, increase in capital is associated with the increase in working capital that fosters the business activity. However, the long run effect implies an increase in fixed capital. Fixed capital is used to accelerate the production that later causes increase in the welfare of the economy. The rising trend in interest rate surges the cost of capital for the business sector that is invested in the working and business fixed capital. It also increases the cost of holding inventories.

The overall real economic growth of Pakistan on average was about 5.4 percent in the decade of 1970s and rose to 6.4 percent in the era of 1980s. The period of 1990s showed the average growth rate of only 5 percent at the time when technological changes were booming the world economy. The rate remained under 5 percent in the decade of 2000s and decelerated to the rate 3.7 in the last six fiscal years (2009-10 to 2014-15).[1]

[1] Facts and data in this section taken from Handbook of Statistics on Pakistan Economy 2015 published by State Bank of Pakistan. Analysis by authors.

Figure-1: Plot of Total investment Percent of GDP



Source: Haver Analytics/World Economic Outlook database

This declining trend in the growth of the economy can be attributed to the reduction in the overall investment level in Pakistan. From 1973 to 1979 the gross total investment as percentage of GDP was 16.9 and it raised to 19.15 percent in the period of 1980s. The rate took a hike in the decade of 1990s and grasped the average of 20.5 percent. However, it declined slightly by one percent in 2000s and now it is 15.77 percent of GDP for the year 2015. The decline in total investment portrays the instable condition of investment in Pakistan that affects the potential growth of the economy. Consequently, the economy is unable to match the growth of other Asian Countries as the total investment to GDP ratio of Pakistan is very low. Pakistan is at 151th rank for investment rate among 175 economies in 2015. Even the investment is well below from its neighboring economies like Bangladesh (40%), India (32%), and Sri Lanka (36%).[2]

The objective of this research is to consider the association among the variables in the model for the time span of 1973 to 2015 in the context of Pakistan. This may help to test the traditional economic theory of investment and interest rate. Contrary to our previous study we have selected this time period due to structural changes after 1973.Initially we checked the stationary of the data, through employing various unit root tests, and latterly analyzed the long and short run association among the variables of interest.

The study is further categorized in five sections. The next section critically evaluates the literature by incorporating various national and international work on this topic. Section 3 moots the methodology. Section 4 discusses empirical results to analyze the nexus between interest rate and investment. Section 5 concludes with some practically possible recommendations.

Literature Review

The nexus between interest rate and investment has being discussed by innumerable research work. These studies were empirical in nature and drew various inferences regarding the association between the rate of interest and investment.

According to the Baillie and McMahon (1981)[3] used Granger Causality tests as well as Box-Jenkins models to see the impact of three interest rate shocks, and GDP for Federal Republic of Germany during the time period 1960 to 1978 on investment. Results

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[2] www.sbp.org.pk/publications/staff-notes/SavingInvestmentStaffNote-Jan-16.pdf

[3] Baillie, Richard T., and P. C. McMahon. *Interest rates and investment in West Germany*. (Empirical Economics 6, no. 1 1981): 1-9.

indicated that the impact of rate of interest on investment is diverse in two different time periods because of the diverse policy. They determined that investment is inelastic regarding short-term nominal rate of interest and same results found in case of the real interest rate. Nevertheless, they also found long-term nominal interest rates influence investment. This result remains same even after government shifted their policies about regulating money supply instead of controlling interest rates.

Lanyi and Saracoglu[4] concluded that the correlation between investment and interest rate was a positive. They gathered the data of 21 developing countries, span from 1971 to 1980, and examine the real financial assets and the growth of real interest rates. They ended up with a direct association between the growth of real financial assets and real interest rates.

However, Ingersoll and Ross[5] replace discount rate by stochastic interest rate and found that the interest rate uncertainty had adverse impacts on investment.

Joshua and Delano[6] conducted a study on the causal factors of private investment in Less Developing Countries on 23 less developing countries for the span 1975 to 1985. They confirm the result that the real interest rate is inversely related to investment.

Alvareand and Koskef[7] observed the irretrievable investment with changes in interest rates. This modification in interest rate had direct and sometimes indirect effect on investment demand.

James and Larsen[8] studied the effect of rates of lending on real estate investment holding period return in the case of United State, they found that real estate investment has inversely related to interest rates.

Andrea Beccarini[9] used the discount factor to exemplify the investment and the Generalized Movement Method was employed to examine the association between interest rate and investment in an ambiguous environment, the outcome indicates that the correlation was positive between interest rate and investment. And the higher instability of the interest rate, the higher the positive correlation would be.

Bader and Malawi[10] investigated the effect of rate of interest on the investment in case of Jordan, A cointegration analysis. The results confirmed economic theory and various

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[4]Lanyi, Anthony, and Rüsdü Saracoglu. *The importance of interest rates in developing economies.* (Finance and Development 20, no. 2 1983): 20.

[5]Ingersoll Jr, Jonathan E., and Stephen A. Ross. *Waiting to invest: Investment and uncertainty.* (Journal of Business 1992): 1-29.

[6]Greene, Joshua, and Delano Villanueva. *Determinants of private investment in LDCs.* (Finance and Development 27, no. 4 1990): 40.

[7]Alvarez, Luis Hernan Radomiro, and Erkki Koskela. *Irreversible investment under interest* rate variability: new results. (Finland: Bank of Finland Discussion Papers 2003): 1-27

[8]Larsen, James E. *The impact of loan rates on direct real estate investment holding period return.* (Financial Services Review 13, no. 2 2004): 111.

[9]Beccarini, Andrea. *Investment sensitivity to interest rates in an uncertain context: is a positive relationship possible?.*(Economic Change and Restructuring 40, no. 3 2007): 223-234.

[10]Bader, Majed, and Ahmad Ibrahim Malawi. *The impact of interest rate on investment in Jordan: a cointegration analysis.*(Journal of King Abdulaziz University: Economics and Administration 24, no. 1 2010): 199-209.

studies that the real rate of interest and the investment are negatively related; by contrast, the income and investment are positively associated.

Luis H.R Alvarez (2010) used the diffusion model of short term interest rates and exhibited that ambiguity in interest rates may limit enterprise scale as well as the investment.

Whuyan et al. (2015)[11] examined the relationship between investment and interest rate in Jiangsu Province of China. This province is the largest according to investment. Johansen Co-integration test is employed for long run nexus. Whereas, for short run association VECM (vector error correction model) is employed, over the span from 2003 to 2012. The empirical outcomes indicated that investment and interest rate has long-term association. The association is negative in the long run however the relationship is positive in the short run. It can be concluded from the study that reducing the rate promoted investment. However concurrently, it is detected that the impact of interest rate on the investment is quite weak. Apart from the rate of interest, market size, economic development level, investment environmental and preferential policies also impact investment.

Few studies have centered on the economy of Pakistan in examining the causal factors of investment.

Sakr (1993)[12] has studied the determining factors of private investment in case of Pakistan and determined that the growth rate of GDP, growth of the private sector loans and public investment are significant factors that determine private investment in case of Pakistan.

Hyder and Ahmed (2003)[13] looked into the reasons that why private investment has reduced and how it can be fixed in case of Pakistan. They explored that increase in real interest dampens the investment level.

Ahmed (2001)[14] concluded that production, Public Sector Development Plan (PSDP) and interest rate influence net investment. He also established that the PSDP and interest rate are the most important factors of private investment in case of Pakistan.

Muhammad et al. (2013)[15] analyzed the impact of real interest rate and income on investment in case of Pakistan. Johansen cointegration test is employed to test the cointegration among the variables for the span of 1964 to 2012. The results confirmed the economic theory that investment has negative relationship with real rate of interest in Pakistan.

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[11]Wuhan, Li Suyuan, and Adnan Khurshid. *The effect of interest rate on investment; Empirical evidence of Jiangsu Province, China.* (Journal of International Studies Vol 8, no. 1 2015): 81-90.
[12]Sakr, Khaled. *Determinants of private investment in Pakistan.* (IMF Working Paper 1993): 1-20
[13]Hyder, Kalim, and Qazi Masood Ahmed. *Why private investment in Pakistan has collapsed and how it can be restored.* (The Lahore Journal of Economics, Vol.9, No.12003): 107-128.
[14]Ahmed, Qazi Masood. *The Influence of Tax Expenditures on Non-residential Investment,*(Journal of development economics 65, 2001): 477-489.
[15]Muhammad, D. Sulaiman, Rasool Lakhan, Saba Zafar, and Muhammad Noman. *Rate of Interest and its Impact on Investment to the Extent of Pakistan.* (Pakistan Journal of Commerce and Social Sciences 7, no. 1 2013): 91-99.

Jamil and Muhammad (2015)[16] investigated the impact of rate of interest on private investment as well as the economic growth of Pakistan. They used time series data span from 1980 to 2010. They as well used structural equation model to discover the associations among the said variables in the model. The outcomes showed that labor force, government expenditures, and private investment have positive and significant impact on GDP however, FDI has statistically significant and negative association with GDP. There as well exists a distinctive long term association between the growth of the economy and its factors, including rate of interest. The outcomes suggest that the behavior of the rate of interest is significant for the growth of the economy considering the associations between the rate of interest and investment and the growth of the economy.

Afta et al. (2016)[17] explored the long run as well as short run impact of rate of interest on the private sector credit in case of Pakistan during 1975 to 2011. ADF and PP test is used to analyze the Stationary of data. This article used ARDL model for the aim of examining long run as well as short run association. The outcomes confirmed the economic theory that there is significant negative association between rate of interest and private sector credit in the long term, as well as also in the short term. The outcomes moreover showed significant positive association between inflation and private sector credit in the long run as well as short run. But, exchange rate was detected to have no impact on the private sector credit.

On the basis of literature review above we can say that a persistently poor performance of the economic growth that also lower the investment levels is the crucial problem that unfavorably impact the economy of Pakistan for the last decade. An insightful examination of the key factors of investment that is rate of interest and income is rationally useful for Pakistan.

[16] Jamil, Naveed Iqbal Muhammad Farooq. *Interest Rates, Government and Private Investments and Pakistan Economy: An Analysis of Three Decades.* (International Journal of African and Asian Studies Vol.14, 2015): 161-166

[17] Afta, Nadeem, Khalil Jebran, Irfan Ullah, and Muhammad Awais. Impact of Interest Rate on Private Sector Credit; Evidence from Pakistan." (Jinnah Business Review, Vol.4, No.1, 2016): 47-52.

Methodology

The following functional form of investment function is used for analysis:

$$Inv = f\left(\underset{(-)}{R}, \underset{(+)}{Y}\right)$$

Gross total investment is employed as proxy variable for the investment level (Inv). Gross Domestic Product at factor cost is employed as proxy variable for the income level (Y), which has expected positive association with investment. Annual Call Money Rate is used as the proxy of rate of interest (R) which has expected negative association with investment.

The Data is taken from the Handbook of Statistics of Pakistan 2015[18] by the State Bank of Pakistan for the time period of 1973 to 2015.

The Phillips-Perron (PP) Test

The Stationarity of variables is checked by applying Unit Root test of Phillips and Perron test (1988).[19]Phillips and Perron (1988)[20]suggested a different method to test the unit root of a series and also tested serial correlation. The PP test estimates the non-ADF test equation which is as follow,

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \epsilon_t$$

The test modifies the t-ratio of the α coefficient so that the serial correlation does not affect the asymptotic distribution of the test statistic. The PP method is based on the following statistic:

$$t_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0 - \gamma_0)(se\left(\hat{\alpha}\right))}{2f_0^{1/2}s}$$

where $\hat{\alpha}$ is the estimate, and t_α is the t-ratio of α, $se\left(\hat{\alpha}\right)$ is coefficient standard error, and s is the standard error of the test regression. In the above equation, γ_0 is a consistent estimator of the error variance while the remaining term, f_0 is an estimator of the residual spectrum at frequency of zero. The asymptotic distribution of the PP test modifies t-ratio the same way as that of the ADF statistic.

[18]www.sbp.org.pk/departments/stats/PakEconomy_HandBook/index.htm

[19]Phillips, Peter CB, and Pierre Perron. *Testing for a unit root in time series regression.* (Biometrika 75, no. 2 1988): 335-346.

[20] *Ibid*

Autoregressive Distributed Lag (ARDL) Model

ARDL model is standard least squares regression that includes lags of both the dependent variable and explanatory variables as regressors (Greene, 2008).[21]The ARDL model by Pesaran and Shin (1998)[22] and Pesaran, Shin and Smith (2001)[23] has been used in econometrics. However, it has gained high acceptance in recent years as it examines the cointegration between variables.

ARDL Specification

ARDL model is a linear time series model in which both the dependent and independent variables are not only linked but are also distributed across their (lagged) values. If y_t is the dependent variable and$x_1, \ldots \ldots .., x_k$are k explanatory variables, a general ARDL$q, q_1, \ldots \ldots .., q_k$ model is given by:

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \varphi_i \, y_{t-i} + \sum_{j=1}^{k} \sum_{l_j=0}^{q_j} \beta_{j,l_i} x_{j,t-l_j} + \epsilon_t$$

Where ϵ_t is the usual innovation, α_0 is a constant term, and α_1, φ_i , and β_{j,l_i} are respectively the coefficients associated with the linear trend, lags of y_t, and lags of the k regressors $x_{j,t}$ for j=1, …, k.

The above formulation represents three alternative methods for parameter estimation. The first method is typically used for inter-temporal dynamic estimation while the second one is for the long run post-estimation. The third method reduces the above equation to the conditional error correction. This method is exemplified in the Pesaran, Shin and Smith (2001)[24] bounds test.

Conventionally, the cointegration tests of Engle-Granger (1987)[25], Phillips and Ouliaris (1990)[26], Park (1990)[27], or Johansen (1991)[28], Johansen (1995)[29], require all variables to be stationary at I(1) in the VAR. This property requires a pre-testing for the presence of a unit root in each of the variables under consideration and this creates the problem of

[21]Greene, William H. *The econometric approach to efficiency analysis.*(The measurement of productive efficiency and productivity growth 1 2008): 92-250.
[22]Pesaran, M. Hashem, and Yongcheol Shin. *An autoregressive distributed-lag modelling approach to cointegration analysis.* (Econometric Society Monographs 31 1998): 371-413.
[23]Pesaran, M. Hashem, Yongcheol Shin, and Richard J. Smith. *Bounds testing approaches to the analysis of level relationships.* (Journal of applied econometrics 16, no. 3 2001): 289-326.
[24]*ibid*
[25] Engle, Robert F., and Clive WJ Granger. *Co-integration and error correction: representation, estimation, and testing.* (Econometrica: journal of the Econometric Society 1987): 251-276.
[26]Phillips, Peter CB, and Sam Ouliaris. *Asymptotic properties of residual based tests for cointegration.* (Econometrica: Journal of the Econometric Society 1990): 165-193.
[27]Park, Joon Y. *Testing for unit roots and cointegration by variable addition.* (Advances in econometrics 8, no. 2 1990): 107-133.
[28]Johansen, Søren. *Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models.* (Econometrica: Journal of the Econometric Society 1991): 1551-1580.
[29]Soren, Johansen. *Likelihood-based inference in cointegrated vector autoregressive models.* (*OUP Catalogue* 1995).

misspecification. In contrast, Pesaran, Shin and Smith (2001)[30] proposed a robust test for cointegration. It explains that whether variables of interest are I(0), I(1), or mutually cointegrated. Incidentally, Pesaran, Shin and Smith (2001)[31] discussed a bounds test for cointegration to test the significance of cointegrated parameters. In other words, the test is a standard F or Wald test for the following null and alternative hypotheses:

$$H_0\colon \left(\varphi(1) \cap \{\beta_j(1)\}_{j=1}^{k}\right) = 0$$

$$H_A\colon \left(\varphi(1) \cap \{\beta_j(1)\}_{j=1}^{k}\right) \neq 0$$

Once the test statistic is computed, it is compared to the two asymptotic critical values corresponding to polar cases of all variables. These variables are either I(0) or I(1). When the test statistic is below the lower critical value, one fails to reject the null and concludes that cointegration doesn't exist. In contrast, when the test statistic is above the upper critical value, one rejects the null and concludes that there is cointegration. However, knowledge of the cointegrating rank is not required.

Alternatively, if the test statistic falls between the lower and upper critical values, it is inconclusive, and knowledge of the cointegrating rank is required to proceed further.

Error Correction Model (ECM)

ECM fits in the class of multivariate models and it is employed for time series data where the cointegrated variables show random trend and thus presents better long run association or cointegration. ECM is used for calculating both short and long run impacts of one series on another. The model deals with the concept that last-period deviates from its long-run equilibrium due to the shock or the error, which affects its short-term dynamics. Therefore, ECM instantly calculates the pace at which a regress and variable brings back to long run equilibrium after a shocks in other regressor variables.

Empirical Results and Analysis

To evaluate the order of integration of the variables PP Unit Root Test is used.

Table 1
Philips-Perron Unit Root Test

Variables	Calculated value	5% Tabulated value	10% Tabulated value	Prob.*
INV(4)	3.094215	-3.52079	-3.19128	1.0000
Δ(INV)(2)	-3.42625	-3.52362	-3.1929	0.0618***
Δ(INV,2)(2)	-12.6939	-3.52661	-3.19461	0.0000
R(2)	-3.05008	-2.93316	-2.60487	0.0384**
Δ(R)(1)	-6.00942	-2.935	-2.60584	0.0000
Δ(R,2)(12)	-17.332	-2.93694	-2.60686	0.0000

[30]Pesaran, M. Hashem, Yongcheol Shin, and Richard J. Smith. *Bounds testing approaches to the analysis of level relationships.* (Journal of applied econometrics 16, no. 3 2001): 289-326.
[31] *Ibid*

Y(4)	4.731493	-3.520787	-3.191277	1.0000
Δ(Y)(5)	-3.465816	-3.523623	-3.192902	0.0567***
Δ(Y,2)(3)	-14.21641	-3.526609	-3.194611	0.0000

Source: Summarized and Calculated by Authors

Note: *MacKinnon (1996) one-sided p-values., ** = 5% significance level and *** = 10% significance level. [Y: The Level form of the variable Y] [Δ (Y): The first change of the variable Y] [Δ (Y, 2): The second difference of the variable Y]

Above table 1 represent the result of the Philips-Perron Unit Root Test for all the selected variables. With the help of graphical analysis, it is observed investment and income have trend and intercept only interest rate has only intercept so Philips-Perron Unit Root Test estimate accordingly for all the three variables. Investment and income are stationary at the first difference at the 10 percent level of significance. Interest rate is stationary at levels. All the variables are integrated at level and order one, i.e., is I(0) & I(1), so it is justified to use Autoregressive Distributed Lag model F-statistic at the next stage to find whether the long run association among the chosen variables exists or not for the span of 1973-2015 in case of Pakistan. The result of the above mentioned Autoregressive Distributed Lag model is reported in table no. 2.

Table 2
The ARDL Cointegration Analysis

Estimated Model	$Inv = f(R, Y)$	
Optimal lags structure	(3, 2, 1)	
F-statistics	7.108539*	
Significant level	Critical values (T = 40)[#]	
	Lower bounds, $I(0)$	Upper bounds, $I(1)$
1%	4.13	5
2.5%	3.55	4.38
5%	3.1	3.87
10%	2.63	3.35
R^2 0.998083, $Adj-R^2$ 0.997588, F-statistics 2017.632***, DW Test 2.014121		
$\chi^2 NORMAL$ 3.19 (0.202) $\chi^2 SERIAL$ 1.82 (0.177) $\chi^2 ARCH$ 1.22 (0.27) $\chi^2 WHITE$ 9.41 (0.31)		

Source: Summarized and Calculated by Authors

The outcomes of the ARDL Cointegration Analysis specify that the calculated F-statistic which is 7.108539 is greater than upper critical bounds at the 1% level of significance once we used income and Interest rate are employed as explanatory variables. The outcomes confirm the presence of long run association or cointegration among the selected variables. This shows that there is a long run relationship between investments, income and interest rate for the span of 1973-2015 in case of Pakistan. This confirms the economic theory of investment. A description of how the interest rate impacts the investment in the economic system. Normally, higher rate of interest shrink investment, since higher rate of interest increase the borrowing cost and necessitate investment to have a higher return to be lucrative.

Additionally, this ARDL model bounds testing approach has fulfilled the assumptions of the Classical Linear Regression Model, for example the error term of this model follow a normal distribution. The ARDL model does not suffer from serial correlation between the error term and variables. There is no indication of autoregressive conditional heteroskedasticity or ARCH test and similar conclusion can be depicted for white heteroskedasticity test.

Table 3
Estimated Long Run Coefficients using the ARDL Approach

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R	-21986.21305	10469.17566	-2.10009	0.0440
Y	0.114528	0.012333	9.286608	0.0000
C	230062.6942	95568.14055	2.407316	0.0222

Source: Summarized and Tabulated by Authors

Table 3 explains that all selected variables have long run association. If there is a 1% increase in the interest rate the investments decrease by 21986.21305 million rupees and if income cost increase by 1 million the investments increase by 0.114528 million rupees.

Cointegration Equation = INV - (0.1145*Y -21986.2130*R + 230062.6942)

Above define equation explains the long run equilibrium association between the investments, interest rate and income. The sign of the coefficient is according to the economic theory. Investment has strong and positive association with income cost, while investment has strong and an inverse association with interest rate. All coefficients are significant at the 5% level.

Country like Pakistan needs investment to grow at a higher rate. These results are in line with the economic theory; if monetary authority controls the rate of interest it will be encouraging for the economy of Pakistan. It will also help in China, Pakistan Economic Corridor (CPEC) project.

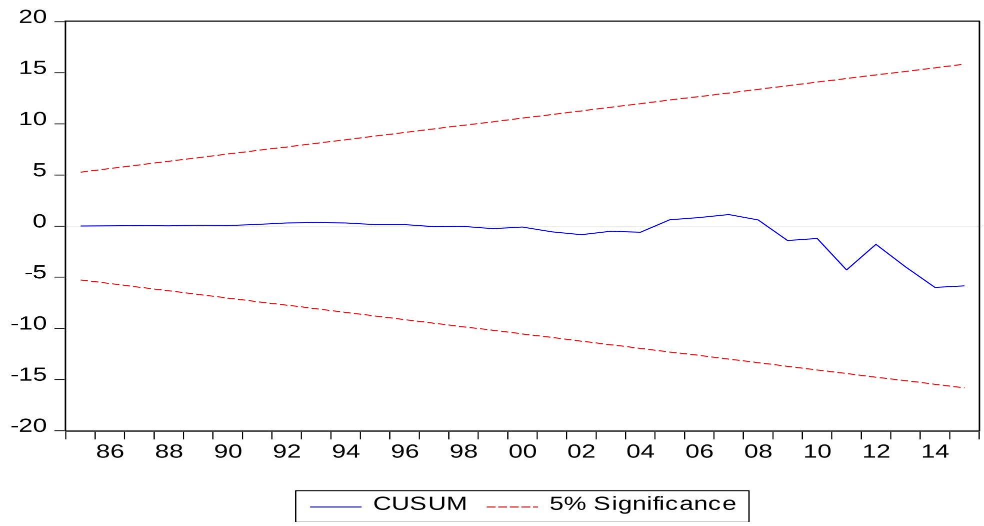
Table 4
Error Correction Representation for the Selected ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INV(-1))	0.744082	0.119328	6.235594	0.0000
D(INV(-2))	0.46634	0.160062	2.913489	0.0066
D(Y)	0.111931	0.026969	4.150364	0.0002
D(Y(-1))	0.115911	0.025149	4.608994	0.0001
D(R)	7783.81813	5001.83124	1.556194	0.1298
ECT_{t-1}	-0.566316	0.10141	-5.58443	0.0000

Source: Summarized and Tabulated by Authors

Error Correction Representation for the Selected ARDL Model clarify that the ECT_{t-1} is negative and significant at the 1% level. Error correction term explains model will converge to the equilibrium with time. The value of the error correction term is 0.566316 which shows that the disequilibrium is corrected 56.63% in one year and model will achieve equilibrium 1.77 years. The short run analysis shows that interest rate also impact the investment in case of Pakistan.

Figure-2
Plot of Cumulative Sum of Recursive Residuals



Source: Summarized and Tabulated by Authors from Eviews

The result of CUSUM is reported in Figures 1. The plot of the CUSUM test does not cross upper or lower critical limit so it can be concluded that this model is stable.

Conclusions and Recommendations

The purpose of this study is to elucidate the impact of income and the rate of interest on the investment to the extent of Pakistan. This study covers the span from 1973 to 2015. The proxy used for the study are call money rate for interest rate, GDP at factor cost for income, and gross total investment for investment. Additionally, PP Unit Root Test is used for checking the stationary of the data. Autoregressive Distributed Lag or (ARDL) Model is used to check the long run dynamics and ECM is used for short run analysis.

According to the Economic theory that there is an inverse association between investment and interest rate as well as there is a positive association between investment and income.

The analysis performed above confirmed that investment and Income cost are stationary at the first difference at the 10% level of significance. Interest rate is stationary at levels. All the variables are integrated at level and order one, i.e. is I(0) & I(1), so it was justified to use Autoregressive Distributed Lag Model.

The results of the Autoregressive Distributed Lag Model Cointegration Analysis determine that the estimated F-statistic which is 7.108539 is greater than upper critical bounds at the 1% level of significance. The results endorse the existence of cointegration among the selected variables for the span of 1973-2015 in case of Pakistan.

The short run dynamics explains that the ECM model will converge to the equilibrium with time because ECT is negative and statistically significant at the 1% level. The value of the error correction term is corrected 56.63% in one year and model will achieve equilibrium in less than two years.

A consistently declining in the policy rate encourages investment and economic growth in Pakistan that positively affect the economy of Pakistan for the last few years.[32] A complete and comprehensive analysis of the determining factors of private and public investment in different sectors of the economy of Pakistan is fairly encouraging in scheming there vitalization plan for the economy of Pakistan. Not only policy rate, however different factors like for example controlled law and order situation, war against terrorism, stable democratic government and other reasons to create a favorable environment for investment. CPEC is a milestone is this regard. To attract investment in Pakistan institution has to keep control the interest rate.

[32] https://tribune.com.pk/story/437339/monetary-policy-why-the-state-bank-will-keep-lowering-interest-rates/

APPENDICES

Annexure 1: Data used in the Study

Years	GTInv	GDPFC	CMR
1973	8647	61877	5.68
1974	11614	82307	8.48
1975	18218	104704	10.63
1976	22769	122728	9.4
1977	27421	141462	10.03
1978	29960	171979	11.2
1979	33355	192377	8.99
1980	41375	228537	8.97
1981	52208	270523	8.61
1982	62447	317502	9.86
1983	68462	367807	8.69
1984	76701	413944	8.1
1985	86525	463375	9.13
1986	96545	507678	7.26
1987	109540	551809	6.26
1988	121666	630120	6.27
1989	145570	711143	6.34
1990	162076	796751	6.77
1991	193446	932282	7.12
1992	244060	1090480	7.36
1993	277744	1210089	9.81
1994	305477	1416846	9.18
1995	346045	1686020	10.33
1996	402762	1922755	11.16
1997	435134	2207230	12.97
1998	474245	2456520	12.23
1999	457357	2710396	7.84
2000	659110	3514064	8.52
2001	715525	3868762	8.96
2002	738373	4169832	6.74
2003	817062	4686030	4.23
2004	935085	5375005	1.86
2005	1240240	6257029	4.34

2006	1687809	7715777	10.5
2007	1953388	8735766	10.27
2008	2258628	10355255	10.67
2009	2414749	12542265	13.38
2010	2431664	14248547	10.8
2011	2581000	17647553	13.1
2012	3022000	19361511	13.1
2013	3348000	21496680	9.5
2014	3756000	23903982	9
2015	4140000	25821943	7.4

Annexure 2: Table generated by Eviews Software
Phillips-Perron unit root Test

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

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		3.094215	1.0000
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	

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

Residual variance (no correction)	6.57E+09
HAC corrected variance (Bartlett kernel)	7.07E+09

Phillips-Perron Test Equation
Dependent Variable: D(GTINV)
Method: Least Squares
Date: 07/20/17 Time: 11:17
Sample (adjusted): 1974 2015
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GTINV(-1)	0.077072	0.023750	3.245147	0.0024
C	-24072.95	32152.63	-0.748709	0.4585
@TREND("1973")	2889.311	2022.652	1.428476	0.1611

R-squared	0.651417	Mean dependent var	98365.55
Adjusted R-squared	0.633541	S.D. dependent var	138982.5
S.E. of regression	84134.28	Akaike info criterion	25.58696
Sum squared resid	2.76E+11	Schwarz criterion	25.71108
Log likelihood	-534.3263	Hannan-Quinn criter.	25.63246
F-statistic	36.44076	Durbin-Watson stat	1.287179
Prob(F-statistic)	0.000000		

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

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.426251	0.0618
Test critical values:	1% level	-4.198503	

	5% level	-3.523623	
	10% level	-3.192902	

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

Residual variance (no correction)	6.14E+09
HAC corrected variance (Bartlett kernel)	6.29E+09

Phillips-Perron Test Equation
Dependent Variable: D(GTINV,2)
Method: Least Squares
Date: 07/20/17 Time: 11:17
Sample (adjusted): 1975 2015
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GTINV(-1))	-0.477155	0.140297	-3.401038	0.0016
C	-46875.38	29408.24	-1.593954	0.1192
@TREND("1973")	4535.467	1558.571	2.910017	0.0060

R-squared	0.239796	Mean dependent var	9293.488
Adjusted R-squared	0.199785	S.D. dependent var	91009.34
S.E. of regression	81412.17	Akaike info criterion	25.52279
Sum squared resid	2.52E+11	Schwarz criterion	25.64818
Log likelihood	-520.2173	Hannan-Quinn criter.	25.56845
F-statistic	5.993280	Durbin-Watson stat	1.892174
Prob(F-statistic)	0.005466		

Null Hypothesis: D(GTINV,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 14 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.69386	0.0000
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Residual variance (no correction)	7.97E+09
HAC corrected variance (Bartlett kernel)	9.88E+08

Phillips-Perron Test Equation
Dependent Variable: D(GTINV,3)
Method: Least Squares
Date: 07/20/17 Time: 11:16
Sample (adjusted): 1976 2015
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GTINV(-1),2)	-1.171825	0.162563	-7.208431	0.0000
C	-8592.739	32191.80	-0.266923	0.7910
@TREND("1973")	878.5561	1279.466	0.686659	0.4966

R-squared	0.584155	Mean dependent var	-690.9250
Adjusted R-squared	0.561676	S.D. dependent var	140209.7
S.E. of regression	92827.28	Akaike info criterion	25.78691
Sum squared resid	3.19E+11	Schwarz criterion	25.91357
Log likelihood	-512.7381	Hannan-Quinn criter.	25.83271
F-statistic	25.98768	Durbin-Watson stat	2.061309
Prob(F-statistic)	0.000000		

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

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.050077	0.0384
Test critical values:	1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

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

Residual variance (no correction)	3.124240
HAC corrected variance (Bartlett kernel)	3.767932

Phillips-Perron Test Equation
Dependent Variable: D(CMR)
Method: Least Squares
Date: 07/20/17 Time: 11:14
Sample (adjusted): 1974 2015
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

CMR(-1)	-0.325050	0.113193	-2.871632	0.0065
C	2.932656	1.045052	2.806229	0.0077

R-squared	0.170920	Mean dependent var	0.040952
Adjusted R-squared	0.150193	S.D. dependent var	1.964748
S.E. of regression	1.811202	Akaike info criterion	4.072306
Sum squared resid	131.2181	Schwarz criterion	4.155052
Log likelihood	-83.51843	Hannan-Quinn criter.	4.102636
F-statistic	8.246270	Durbin-Watson stat	1.601718
Prob(F-statistic)	0.006501		

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

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.009419	0.0000
Test critical values:	1% level	-3.600987	
	5% level	-2.935001	
	10% level	-2.605836	

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

Residual variance (no correction)	3.658832
HAC corrected variance (Bartlett kernel)	3.553258

Phillips-Perron Test Equation
Dependent Variable: D(CMR,2)
Method: Least Squares
Date: 07/20/17 Time: 11:14
Sample (adjusted): 1975 2015
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CMR(-1))	-0.945645	0.157272	-6.012816	0.0000
C	-0.030743	0.306559	-0.100284	0.9206

R-squared	0.481065	Mean dependent var	-0.107317
Adjusted R-squared	0.467759	S.D. dependent var	2.688294
S.E. of regression	1.961240	Akaike info criterion	4.232582
Sum squared resid	150.0121	Schwarz criterion	4.316171
Log likelihood	-84.76793	Hannan-Quinn criter.	4.263020
F-statistic	36.15396	Durbin-Watson stat	2.014426
Prob(F-statistic)	0.000000		

Null Hypothesis: D(CMR,2) has a unit root
Exogenous: Constant
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-17.33199	0.0000
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

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

Residual variance (no correction)	6.118612
HAC corrected variance (Bartlett kernel)	0.953456

Phillips-Perron Test Equation
Dependent Variable: D(CMR,3)
Method: Least Squares
Date: 07/20/17 Time: 11:15
Sample (adjusted): 1976 2015
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CMR(-1),2)	-1.390959	0.149526	-9.302427	0.0000

C	-0.126004	0.401458	-0.313866	0.7553

R-squared	0.694865	Mean dependent var	-0.011250
Adjusted R-squared	0.686835	S.D. dependent var	4.535011
S.E. of regression	2.537842	Akaike info criterion	4.749212
Sum squared resid	244.7445	Schwarz criterion	4.833656
Log likelihood	-92.98425	Hannan-Quinn criter.	4.779745
F-statistic	86.53516	Durbin-Watson stat	2.343327
Prob(F-statistic)	0.000000		

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

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		4.731493	1.0000
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	

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

Residual variance (no correction)	1.23E+11
HAC corrected variance (Bartlett kernel)	1.81E+11

Phillips-Perron Test Equation
Dependent Variable: D(GDPFC)
Method: Least Squares
Date: 07/20/17 Time: 11:06
Sample (adjusted): 1974 2015
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPFC(-1)	0.090413	0.015344	5.892231	0.0000
C	-164966.9	135145.8	-1.220659	0.2295
@TREND("1973")	17612.15	7984.163	2.205886	0.0334

R-squared	0.822111	Mean dependent var	613334.9
Adjusted R-squared	0.812989	S.D. dependent var	841987.0
S.E. of regression	364115.5	Akaike info criterion	28.51708
Sum squared resid	5.17E+12	Schwarz criterion	28.64120
Log likelihood	-595.8587	Hannan-Quinn criter.	28.56257

F-statistic	90.11912	Durbin-Watson stat	1.750282
Prob(F-statistic)	0.000000		

Null Hypothesis: D(GDPFC) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.465816	0.0567
Test critical values:	1% level	-4.198503	
	5% level	-3.523623	
	10% level	-3.192902	

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

Residual variance (no correction)	1.54E+11
HAC corrected variance (Bartlett kernel)	1.78E+11

Phillips-Perron Test Equation
Dependent Variable: D(GDPFC,2)
Method: Least Squares
Date: 07/20/17 Time: 11:08
Sample (adjusted): 1975 2015
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDPFC(-1))	-0.433961	0.130569	-3.323621	0.0020
C	-286961.2	157975.5	-1.816491	0.0772
@TREND("1973")	26618.04	9008.399	2.954803	0.0053

R-squared	0.228907	Mean dependent var	46281.24
Adjusted R-squared	0.188323	S.D. dependent var	452439.0
S.E. of regression	407616.4	Akaike info criterion	28.74440
Sum squared resid	6.31E+12	Schwarz criterion	28.86978
Log likelihood	-586.2601	Hannan-Quinn criter.	28.79005
F-statistic	5.640345	Durbin-Watson stat	2.596339
Prob(F-statistic)	0.007162		

Null Hypothesis: D(GDPFC,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-14.21641	0.0000
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Residual variance (no correction)	1.21E+11
HAC corrected variance (Bartlett kernel)	8.68E+10

Phillips-Perron Test Equation
Dependent Variable: D(GDPFC,3)
Method: Least Squares
Date: 07/20/17 Time: 11:10
Sample (adjusted): 1976 2015
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDPFC(-1),2)	-1.653627	0.129640	-12.75551	0.0000
C	-44402.88	125321.0	-0.354313	0.7251
@TREND("1973")	5813.116	4989.124	1.165158	0.2514

R-squared	0.814913	Mean dependent var	-12282.70
Adjusted R-squared	0.804908	S.D. dependent var	818034.3
S.E. of regression	361319.0	Akaike info criterion	28.50495
Sum squared resid	4.83E+12	Schwarz criterion	28.63161
Log likelihood	-567.0990	Hannan-Quinn criter.	28.55075
F-statistic	81.45303	Durbin-Watson stat	2.460604
Prob(F-statistic)	0.000000		

Autoregressive Distributed Lag (ARDL) Model

Dependent Variable: GTINV
Method: ARDL
Date: 07/20/17 Time: 11:24
Sample (adjusted): 1976 2015
Included observations: 40 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): GDPFC CMR
Fixed regressors: C
Number of models evalulated: 100
Selected Model: ARDL(3, 2, 1)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GTINV(-1)	1.177766	0.138666	8.493529	0.0000
GTINV(-2)	-0.277743	0.227353	-1.221634	0.2311
GTINV(-3)	-0.466340	0.210595	-2.214391	0.0343
GDPFC	0.111931	0.047637	2.349656	0.0253
GDPFC(-1)	0.068840	0.045690	1.506681	0.1420
GDPFC(-2)	-0.115911	0.042052	-2.756369	0.0097
CMR	7783.818	6908.784	1.126655	0.2685
CMR(-1)	-20234.96	6555.669	-3.086636	0.0042
C	130288.2	39244.05	3.319947	0.0023

R-squared	0.998083	Mean dependent var	924288.1
Adjusted R-squared	0.997588	S.D. dependent var	1170641.
S.E. of regression	57487.51	Akaike info criterion	24.95163
Sum squared resid	1.02E+11	Schwarz criterion	25.33163
Log likelihood	-490.0326	Hannan-Quinn criter.	25.08903
F-statistic	2017.632	Durbin-Watson stat	2.014121
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Bounds Test

ARDL Bounds Test
Date: 07/20/17 Time: 11:25
Sample: 1976 2015
Included observations: 40
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	7.108539	2

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.63	3.35
5%	3.1	3.87
2.5%	3.55	4.38
1%	4.13	5

Test Equation:
Dependent Variable: D(GTINV)
Method: Least Squares
Date: 07/20/17 Time: 11:25
Sample: 1976 2015
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GTINV(-1))	0.744082	0.174558	4.262670	0.0002
D(GTINV(-2))	0.466340	0.210595	2.214391	0.0343
D(GDPFC)	0.111931	0.047637	2.349656	0.0253
D(GDPFC(-1))	0.115911	0.042052	2.756369	0.0097
D(CMR)	7783.818	6908.784	1.126655	0.2685
C	130288.2	39244.05	3.319947	0.0023
GDPFC(-1)	0.064859	0.016957	3.824965	0.0006
CMR(-1)	-12451.14	4515.266	-2.757566	0.0097
GTINV(-1)	-0.566316	0.170439	-3.322690	0.0023

R-squared	0.867562	Mean dependent var	103044.5
Adjusted R-squared	0.833385	S.D. dependent var	140836.8
S.E. of regression	57487.51	Akaike info criterion	24.95163
Sum squared resid	1.02E+11	Schwarz criterion	25.33163
Log likelihood	-490.0326	Hannan-Quinn criter.	25.08903
F-statistic	25.38403	Durbin-Watson stat	2.014121
Prob(F-statistic)	0.000000		

ARDL Cointegrating and Long Run Form

ARDL Cointegrating And Long Run Form
Dependent Variable: GTINV
Selected Model: ARDL(3, 2, 1)
Date: 07/20/17 Time: 11:25
Sample: 1973 2015
Included observations: 40

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GTINV(-1))	0.744082	0.119328	6.235594	0.0000

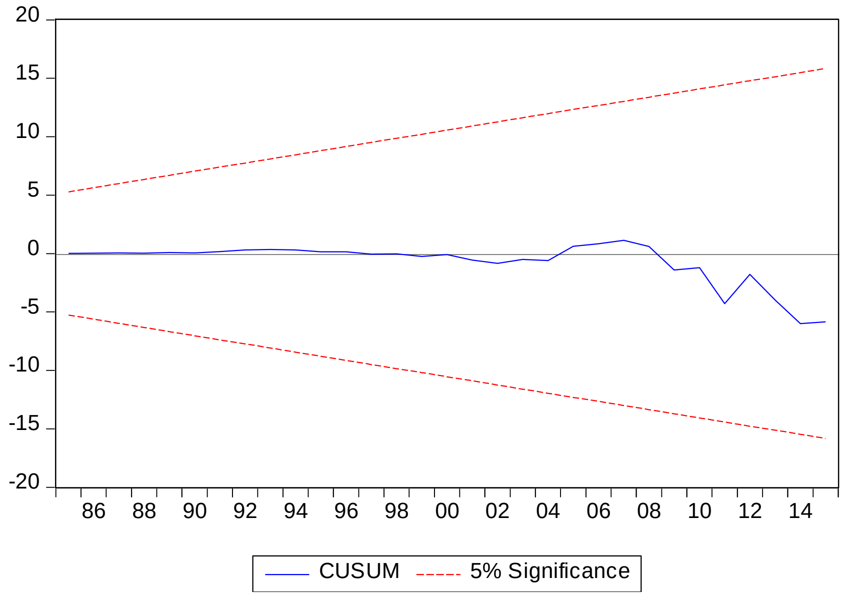
D(GTINV(-2))	0.466340	0.160062	2.913489	0.0066
D(GDPFC)	0.111931	0.026969	4.150364	0.0002
D(GDPFC(-1))	0.115911	0.025149	4.608994	0.0001
D(CMR)	7783.818128	5001.831238	1.556194	0.1298
CointEq(-1)	-0.566316	0.101410	-5.584429	0.0000

Cointeq = GTINV - (0.1145*GDPFC -21986.2130*CMR + 230062.6942)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPFC	0.114528	0.012333	9.286608	0.0000
CMR	-21986.2130	10469.175659	-2.100090	0.0440
C	230062.6942	95568.140547	2.407316	0.0222

Plot of Cumulative Sum of Recursive Residuals



Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.081078	Prob. F(2,29)	0.9223
Obs*R-squared	0.222419	Prob. Chi-Square(2)	0.8948

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 07/20/17 Time: 18:02
Sample: 1976 2015
Included observations: 40
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GTINV(-1)	-0.024804	0.231698	-0.107055	0.9155
GTINV(-2)	0.077253	0.409332	0.188730	0.8516
GTINV(-3)	-0.070531	0.310901	-0.226859	0.8221
CMR	4.060724	7168.522	0.000566	0.9996
CMR(-1)	-47.91866	6911.703	-0.006933	0.9945
GDPFC	-0.000148	0.050237	-0.002939	0.9977
GDPFC(-1)	0.007446	0.057434	0.129647	0.8977
GDPFC(-2)	-0.005854	0.046990	-0.124590	0.9017
C	56.06966	41310.79	0.001357	0.9989
RESID(-1)	0.016884	0.301357	0.056027	0.9557
RESID(-2)	-0.108604	0.273146	-0.397604	0.6938

R-squared	0.005560	Mean dependent var	-1.84E-11
Adjusted R-squared	-0.337350	S.D. dependent var	51253.32
S.E. of regression	59271.31	Akaike info criterion	25.04605
Sum squared resid	1.02E+11	Schwarz criterion	25.51050
Log likelihood	-489.9211	Hannan-Quinn criter.	25.21398
F-statistic	0.016216	Durbin-Watson stat	1.992990
Prob(F-statistic)	1.000000		

Heteroskedasticity Test: White

Heteroskedasticity Test: White

F-statistic	1.192679	Prob. F(8,31)	0.3351
Obs*R-squared	9.414007	Prob. Chi-Square(8)	0.3086
Scaled explained SS	6.653107	Prob. Chi-Square(8)	0.5745

Test Equation:
Dependent Variable: RESID^2

Method: Least Squares
Date: 07/20/17 Time: 18:05
Sample: 1976 2015
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.25E+09	1.64E+09	1.365135	0.1820
GTINV(-1)^2	-2.14E-05	0.002343	-0.009118	0.9928
GTINV(-2)^2	0.003824	0.003925	0.974416	0.3374
GTINV(-3)^2	-0.005090	0.003600	-1.414013	0.1673
CMR^2	-1604592.	23592795	-0.068012	0.9462
CMR(-1)^2	-4112018.	21200537	-0.193958	0.8475
GDPFC^2	8.35E-05	8.99E-05	0.929697	0.3597
GDPFC(-1)^2	6.23E-05	0.000101	0.613589	0.5440
GDPFC(-2)^2	-0.000193	0.000111	-1.736353	0.0924

R-squared	0.235350	Mean dependent var	2.56E+09
Adjusted R-squared	0.038021	S.D. dependent var	3.98E+09
S.E. of regression	3.90E+09	Akaike info criterion	47.20286
Sum squared resid	4.72E+20	Schwarz criterion	47.58286
Log likelihood	-935.0573	Hannan-Quinn criter.	47.34026
F-statistic	1.192679	Durbin-Watson stat	1.908723
Prob(F-statistic)	0.335117		

Heteroskedasticity Test: ARCH

Heteroskedasticity Test: ARCH

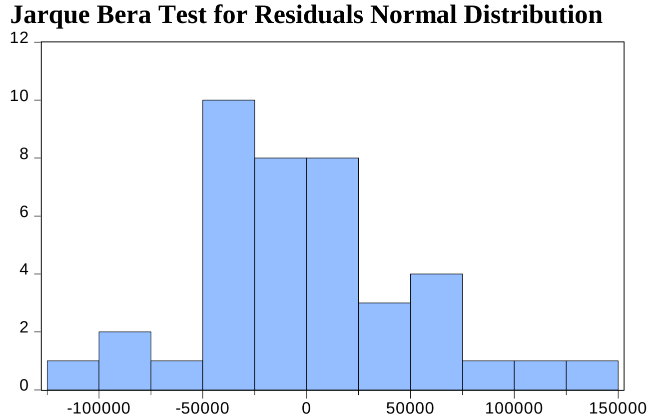
F-statistic	1.191418	Prob. F(1,37)	0.2821
Obs*R-squared	1.216642	Prob. Chi-Square(1)	0.2700

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 07/20/17 Time: 18:07
Sample (adjusted): 1977 2015
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.16E+09	7.69E+08	2.811057	0.0079
RESID^2(-1)	0.176658	0.161846	1.091521	0.2821

R-squared	0.031196	Mean dependent var	2.62E+09
Adjusted R-squared	0.005012	S.D. dependent var	4.01E+09
S.E. of regression	4.00E+09	Akaike info criterion	47.10709
Sum squared resid	5.92E+20	Schwarz criterion	47.19240
Log likelihood	-916.5883	Hannan-Quinn criter.	47.13770
F-statistic	1.191418	Durbin-Watson stat	2.101371
Prob(F-statistic)	0.282101		

Jarque Bera Test for Residuals Normal Distribution



Series: Residuals	
Sample 1976 2015	
Observations 40	
Mean	-1.84e-11
Median	-10530.28
Maximum	133524.3
Minimum	-100968.9
Std. Dev.	51253.32
Skewness	0.669006
Kurtosis	3.353296
Jarque-Bera	3.191827
Probability	0.202723