ISSN 2229-5518

The Macroeconomic Determinants of Investment: Empirical Evidence from Bangladesh.

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Abstract- Economic wisdom of investment of economics enumerates that there has been a causal nexus between investment and other macroeconomic variables. This study draws on national accounts data to analyze movements in investment in Bangladesh from 1981- 2010 against GDP at constant price, Lending Interest Rate, Inflation and Foreign Exchange Rate. To check whether the series are integrated or not, the study relies on Augmented Dickey Fuller tests and Phillips- Perron test. This paper uses Engle-Granger tests and Johansen-Juselius test to check whether the series are cointegrated or not. It finds that there is a long-term relationship between them. To strengthen the study further, bivariate as well as multivariate analysis of the cointegration test has been applied. This paper also draws upon Error Correction Mechanism which states that there exists a stable relationship in Bangladesh in the short-run as well as in the long run.

Key Word: Investment, GDP, Lending Interest Rate, Error Correction.

1. Introduction

Since the time of Adam Smith and Karl Marx, investment has been deemed to be both the engine of economic activity and the primary cause of economic malaise. Since its initiation, the significance of investment for economic growth and development of a nation has been at the spirit of economists and policy makers. As capital is to put impetus to economic output, to embody new technology, and to balance human capital, **c**lassical economics stressed the importance of capital formation for economic growth. A new vision of the competitive environment and of the global trends can bring to invest in surprising directions. Funds for investment can be obtained from self-financing, cumulated past profits; injection of new financial capital from the owners; amortization, loans from banks and other financial institutions, long-term, short term credit at fixed or variable interest rate in domestic or foreign currency, etc. On the contrary at the macro level all these further depends on GDP at constant price, Lending Interest Rate, Inflation and Foreign Exchange Rate significantly.

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It is customary to define the variable from macroeconomic perspective. In macroeconomics investment is a technical jargon which maps the flow of spending that adds to the physical stock of capital. IMF defines Lending interest rate is the rate as the rate charged by banks on loans to prime customers. Inflation rate is the percentage of annual increase in general price level encompassing both food and non-food commodities. Exchange rate is defined as the price of one currency in terms of one another. In an economy, investment is mechanized by some major macroeconomic variables as mentioned above. The size of GDP is associated with the greater incidence of investment. Conventionally, banks lend firms so that they can purchase investment goods. The higher the lending interest rate for, the lower will be the borrowing. On the contrary, firms will want to borrow and invest more when interest rates are lower.

The above factors of investment are responsible for its various long term trends. For instance, according to Bangladesh Economic Review 2011, in FY 2002-03, In FY 2002-03, the rate of total investment was 23.41 percent of GDP in which the shares of public and private sector were 6.2 percent and 17.21 percent respectively. The rate of national investment gradually picked up to 24.65 percent of GDP in FY 2005-06 whereas there was a fluctuation of investment and in FY 2008-09 investment as percent of GDP declined to 24.37 percent. At the beginning of the nineties, the share of private investment in total investment was about 60 percent, which stood over 80 percent in FY 2009-10. The lending interest rate experienced a slight fall from 14.60 percent in FY 2008-09 to 12.37 percent in FY 2009-10. In FY 2009-10, Bangladesh feels the heat of inflation as it rose to 7.16 percent from 6.52 percent of previous FY. Of late, Bangladesh witness a dramatic depreciation in its foreign exchange rate as it rose to Taka 69.18 per dollar in FY 2009-10 compared to Taka 53.95 per dollar in FY 2000-01.

2. Literature Review

There is a reasonable amount of erudite literature available on the determinants of investment that covers the relationship between investment and other macro economic variables. The objective here is to review some of these studies to choose appropriate variables used in this study.

Neoclassical theory predicts that when interest rates rise, firms invest less because their cost of capital increases (Jorgensen, 1963). In a recent paper, however, Chetty (2007) shows that the investment demand function is a backward-bending function of the interest rate. When interest rates shoot up, so does the cost of capital, therefore investment become dearer. Robert Ferber (1967) argued that the demand function for investment goods is derived from the sum of the rate of change in the flow of capital services and of replacement needs. The demand function has a negative slope with respect to changes in the rate of interest, by assuming that changes in the rate of interest leave the price of capital services unchanged. Dornbusch & Fischer (1978) studied how investment depends on interest rates and income. The study figures out that investment spending is very volatile and responsible for much of the fluctuation of GDP across the business cycle. As per Bureau of Economic Analysis, during the period of 1959-2002, investment averages 14% of GDP in U.S., but it is relatively very volatile. Accordingly investment spending is primarily linked up with interest rates.

Doornik (1994) explored using conventional regression techniques (OLS) in order to try to identify long-run cointegrating relationships

and error correction mechanisms. The general equation includes lagged values of the dependent variable as well as current and lagged values of real GNP, real interest rates , real public investment and the change in the population aged 15 and over. All the variables are in logs except the interest rate and they are all integrated at order of trade flows, external debt, and black market activities also affect the rate of investment in sub-Saharan African economies. Levine and Renelt (1992) find that a positive relationship between investment and trade holds whether trade flows are measured by imports, exports or total trade. Harupara (1998) concludes that public investment, real output, credit to private sector and the depreciation of the exchange rate positively affect investment in the long run. Inflation and real interest rates affect investment negatively in the long run. In the short-run, private investment is an increasing function of public investment and output. In the short run inflation, real interest rates and the depreciation of the exchange rate affects investment negatively. Shimi and Kadhikwa's (1999) main findings are that interest rates and the ratio of government investment to GDP are significant determinants of investment in the long run. The ratio of government investment to GDP is highly significant in the short run. However the rate of interest rate and inflation are also significant, but with little impact in the long run. John M. Paleologos (1989) developed an investment functions where the interest rate has been introduced lagged once because they believe that the capital market in Greece is not responding immediately to changes in the interest rate. It included the gross investment variable in the proposed investment function, instead of the net investment. The cross country economic growth data that high investment-GDP ratio lead to high economic growth (Dornbusch , 2001). Guncavdi and Bleaney (2005) tested for shifts in aggregate private investment functions for Turkey as a consequence of financial liberalization in the early 1980s. Results for a neoclassical model in error correction form suggested that the short-run dynamics of investment were altered by financial liberalization. Okyay Ucan & Özlem Özturk (2011) investigated whether financial development has contributed to an increase in investment in Turkey. The study modeled investment function including real interest rate, GDP, inflation and Financial determinants which is estimated by utilizing the developments in the time series econometrics covering the period 1970-2009. the VAR approach is used with differencing all I(1) variables to make them stationary. The results mainly indicate a positive relationship between total domestic investment and four indicators.

Dr. Asma Salman & Fatima Jinnah (2011) argued that investments in any country have been linked with the growth terms of the host country. Using Pakistan's 24 year secondary data the study analyzed the impact of foreign private investments on the balance of trade, capital and financial account, and economic growth (GDP) in Pakistan. From the analysis it has been confirmed that the private investments affect the explained variables significantly. The model fits well, and the negative relation of Foreign Private Investment and Balance of Trade has come into lime light. The results are not extinctive and a positive relationship for Foreign Private Investment with the economic variables by Granger causality test could not be generated.

According to a survey "Twenty Years of National Accounting of Bangladesh, 1993', conducted by BBS, reports that investment – GDP ratio is still lower in Bangladesh as compared to the many Asian developing country like Singapore, Malaysia, Taiwan, Hong Kong and South Korea, where extraordinarily high rate investment of 35-40 percent of GDP are being maintained. However, investment / GDP ratio in Bangladesh rose to 23.23 percent in 2004. Md. Ezazul Islam & Mst. Nurnaher Begum (2005) explored the sensitivity of investment demand to interest rate in the context of Bangladesh. By using OLS method, a semi log

linear investment demand function has been estimated for the sample period of 1973-2004

which found that investment is more sensitive with GDP by 1.61 percent and less sensitive with interest rate (real lending rate) by 0.36 per cent. Shamim Ahmed & Md. Ezazul Islam (2005) had established an empirical assessment through the unrestricted vector auto-regressions investment spending at the aggregate level is non-responsive to interest rates. The findings claimed that investment spending at the disaggregate level is still not responsive to interest rates except for private sector investment category.

The shortcomings of the studies mentioned above is that, majority incorporates simple OLS regressions and unit root tests of stationarity including only ADF tests. They also do not run any test for cointegration to check the long run relationship among variables. This paper uses a more comprehensive econometric methodology. The uniqueness of the paper are, firstly, this study captures the stationarity of data sets on the basis of both ADF and PP tests of unit root. Secondly, it encompasses Engle-Granger test and Johansen Juselius test for cointegration. This study also extended these analysis to the multivariate setting to check the robustness of the bivariate outcome. Thridly, Error Correction Mechanism (ECM), a comparatively new dimension, has also been sorted out to illustrate the short run elasticities of respective variables unlike the earlier studies. Last but not the least, it appears that no other study in Bangladesh incorporated open-economy factors of investment determination which is smoothly incorporated by this study.

3. Data

This analysis is conducted using yearly data series for the period 1981 to 2010. The data for investment, GDP and exchange rate are gathered from Bangladesh Economic Review 2011 whereas the data for lending interest rate and exchange rate are submerged from the Economic Trend published by Bangladesh Bank.

4.Methodology and Results

4.1.Integration Tests

4.1.2. ADF Tests of Integration

Table 1 reports the results of the ADF tests. Panel A of the table presents the results for the levels of the data series, while panel B reports the results for their first differences.

The results from panel A constantly suggest that all time series considered contain unit roots. We fail to reject null hypothesis of a unit root even at 10% significance level in all cases except two. The exceptions are lending interest rate and inflation rate. From panel B, the null hypothesis for a second unit root is rejected in almost all cases. In particular, the evidence from the tests strongly supports the stationarity of the variables when they are first differenced. Thus, the evidence seems consistent to suggest the stationarity of the first differenced series. In other words, these variables can be characterized as *I(1)* variables.

Table 1: ADF Integration Test

Variables	Without Trend		With Trend	
	ADF Statistics	Optimum Lag Length	ADF Statistics	Optimum Lag Length
A. Levels				
INV	2.475954	0	-0.294907	0
GDP	0.713748	0	-2.930476	0
LINTR	-3.000189**	1	-2.469722	1
INF	2.371017**	0	-2.307474	0
EXRT	0.082188	2	-2.625681	1
B. First Differences				
INV	-4.843422*	0	-6.349742*	0
GDP	-5.514661*	0	-5.626939*	0
LINTR	-3.153288**	1	-3.478320***	1
INF	-5.922988*	1	-6.095981	1
EXRT	-4.626711*	1	-4.545121*	1

*Note: *, **, *** denotes refutation of null hypothesis at 1 percent, 5 percent and 10 percent level respectively.*

4.1.2. PP Tests of Integration

Table 2 represents the results of Phillips-Perron Tests. Likewise the ADF tests, Panel A and B of the table presents the results for levels and first differences of the data series.The results from panel A constantly suggest that all time series considered contain unit roots. We fail to reject null hypothesis of a unit root even at 10% significance level in all cases except one case. The exceptions is investment.

From panel B, the null hypothesis for a second unit root is rejected in all cases. The evidence from the PP tests also strongly supports the stationarity of the variables when they are first differenced, i.e., it seems consistent to suggest the stationarity of the first differenced series or *I(1).*

4.2.Cointegration Tests

4.2.1.Bivariate Analysis

Concluding that each of the series is stationary, its become routine task to investigate whether there exists a long-run equilibrium relationship between investment with each of the macroeconomic variable of interest.

Table 3 reports the results of both Engle-Granger (EG) and Johansen and Juselius tests (JJ). As Hall (1991) stated that cautions the JJ test results may be sensitive to the order of autoregressions.

Table 2: PP Integration Tests

Variables	Without Trend		With Trend	
	ADF Statistics	Bandwidth	ADF Statistics	Bandwidth
A. Levels				
INV	6.638132*	9	0.400748	4
GDP	1.617003	9	-2.811577	4
LINTR	-1.974867	4	-0.976206	5
INF	-2.371017	0	-2.271889	1
EXRT	-0.819826	4	-2.152622	2
B. First Differences				
INV	4.885646*	3	-6.855551*	5
GDP	-5.816548*	7	-6.447603	9
LINTR	-2.726281***	1	-2.219372**	9
INF	-7.079998*	6	-11.28540*	17
EXRT	-3.773113*	13	-3.530066**	12

*Note: *, **, *** denotes refutation of null hypothesis at 1 percent, 5 percent and 10 percent level respectively.*

The EG test indicates that cointegration between investment with GDP, lending interest rate, inflation rate and exchange rate as it rejects the null hypothesis of no cointegration at 5% significance level. The JJ test also produces similar results by refuting the hypothesis of no cointegration between investment and other macroeconomic variables at the same level of significance. So, both EG and JJ tests indicates that there is a bivariate cointegartion between investment and other macroeconomic variables of interest.

Table 3: Bivariate Cointegration Tests

Variables	**EG Tests**		**JJ Tests**			
	Lag	**Tau Statistic**	**Trace Test**		**Max Eigen Test**	
			r = 0	r = 1	r = 0	r = 1
INV & GDP	0	-3.570951*	14.98938*	0.001500	14.98788*	0.001500
INV & LINTR	0	-3.569008*	12.62308*	0.310360	12.31272*	0.310360
INV & INF	0	-3.745392*	15.87586*	2.333788	13.54207*	2.333788
INV & EXRT	0	-3.711847*	15.48068*	2.151066	13.32961*	2.151066

Note: * denotes refutation of hypothesis of no cointegration at 5% level.

4.2.2.Multivariate Analysis

The bivariate results may be counterfeit due to the possibility that relevant variables are being omitted from the regressions (Lutkephol, 1982).Therefore, to appraise the robustness of the previous results, the following section extends the analysis to multivariate settings. The analysis proceeds in a similar fashion to the bivariate analysis. The study relied on both EG test and JJ test.

The Engel-Granger Test for Multivariate Cointegration

In the test for stationarity same order of integration for all variables under study has been obtained. In this test OLS is applied on the levels of the variables and obtained the residuals. The Engel-Granger method requires that the linear combination of the non-stationary series be stationary, i.e., the residuals obtained should be integrated of order one [i.e., I(1)].The ADF test statistics the t-ratio on the term. The results of the Engel-Granger two step methods are represented in Table 4.

Table 4 : EG Tests for Multivariate Cointegration

Dependent Variable	Independent Variable					R^2	D-W	ADF Statistic
	C	GDP	Lending Interest Rate	Inflation	Exchange Rate			
INV	-52385.20 (-1.966888)	0.220893 (1.887500)	-2300.508 (-1.051665)	3691.207 (4.046873)	1665.25 (2.040712)	0.956880	1.255724	-4.315311*

Note: Number in parentheses show t statistics
** denotes significant at 1 % level .*

Since the computed ADF value (-4.315311) is much more negative than the 1 % ADF critical values (-3.75), our conclusion is the that residuals obtained from the regression of investment on GDP, lending interest rate, inflation and exchange rate I(1); that; that is , they are stationary. Hence, the series is cointegrated and this regression is not spurious.

Based on the estimated cointegrating equaiton, the long-run equilibrium exits as the coefficients of the cointegrating vector is plausible in magnitude, statistically significant and correctly signed based on economic theory. This means that increase GDP, lending interest rate, inflation and exchange rate will have impact on GDP.

Johansen-Juselius Test for Multivariate Cointegration

To check the existence of cointegration as well as determining the number of cointegrating equations or the rank of the cointegration vector the test developed by Johansen (1988) and

Juselius (1990) which is a system approach based on estimation of the full vector autoregression (VAR) is also conducted. The results of the Johansen's likelihood ratio test for the cointegrating rank of the system have been reported in Table 5. The table presents Eigen-Values in descending order. The corresponding likelihood ratio statistic (Only Trace Statistic is considered for simplicity) is used to test the null hypothesis of no cointegration (r = 0) against the alternative of at most one cointegrating equation (r ≤ 1) and one cointegrating equation (r = 1) against the alternative of less than two (r ≤ 2), and two cointegrating equation (r = 2) against the alternative of less than three (r ≤ 3), three cointegrating equation (r = 3) against the alternative of less than four (r ≤ 4).

Table 5: Johansen-Juselius Test for Multivariate Cointegration

No. of Cointegrating Equations	Series: INV, GDP, LINTR, INF & EXRT			
	Trace		Max-Eigen	
	Trace Statistic	Critical Values for Trace Test at 10% Level	Max-Eigen Statixtic	Critical Values for Max-Eigen Test at 10% Level
r = 0	63.19036*	56.28504	25.56893	27.91596
r ≤ 1	37.62143*	37.03536	18.12059	21.83670
r ≤ 2	19.50084	21.77716	13.49961	15.71741
r ≤ 3	6.001231	10.47457	5.315286	9.474804
r ≤ 4	0.685945	2.976163	0.685945	2.976163

*Note: * denotes rejection of the null hypothesis of no cointegration at the 10% significance level.*

The results summed in the above table suggest that, in the presence of deterministic trend in the data, the relationships among the variables considered are cointegrated; there exists a linear combination of I(1) variables that links them in a stable and long-run relationship. In fact, the data reported in the table shows the null hypothesis of no cointegrating vector can be rejected at least at 10 percent level in two cases.

Trace test indicates at least two cointegrating equations at the 0.10 level from which residuals can be obtained to measure the respective deviations between the current level of explanatory variables and the level based on the long run relationship.

4.3. Error Correction Models

Since the investment is cointegrated with other macroeconomic variables at first difference, i.e. *I(1)*, there is a long run relationship between the these variables.

The next step is estimation of short-run dynamic models for error correction.The error correction mechanism first used by Sargan and later popularized by Engle and Granger corrects for disequilibrium.

Table 6: Error-Correction Model for Investments, GDP, Lending Interest Rate, Inflation and Exchange Rate.

Error Correction	D(INV)	D(GDP)	D(LINTR)	D(INF)	D(EXRT)
CointEq1	*-1.256797*	*0.054553*	*-0.0000824*	*-0.000982*	*-0.000024*
	(-6.26237)	*(0.08820)*	*(-0.32285)*	*(-0.05486)*	*(-0.05486)*
D(INV(-1))	0.403135	-0.026002	-0.000198	0.000936	0.00011
	2.54540	-0.05327	-0.98206	1.75302	0.31842
D(GDP(-1))	-0.374625	-0.089107	-0.0000465	-0.000824	-0.000265
	-3.28687	-0.25368	-0.32085	-2.14456	-1.05472
D(LINTR(-1))	-3580.378	-3424.691	0.518429	-1.242466	-0.140222
	-1.62274	-0.50364	1.84822	-1.666992	-0.28803
D(INF(-1))	6723.292	1296.069	-0.091533	-0.951608	-0.142781
	-5.27004	0.32964	-0.56436	-2.21198	-0.50722
D(EXRT(-1))	-1836.752	4475.860	0.163567	0.509186	0.323421
	-1.21629	0.96171	0.85197	0.99989	0.97063
C	8869.739	11789.23	-0.042788	-1.668071	1.835801
	(2.72381)	(1.17471)	(-0.10335)	(-1.51905)	(2.55498)
R-squared	0.744760	0.112674	0.534400	0.508811	0.349090
Adj. R-squared	0.557585	-0.538032	0.192960	0.148606	-0.128244
F-statistic	3.978939	0.173157	1.565135	1.412558	0.731333
Log likelihood	20.78506	23.03616	2.844499	4.795494	3.947194
Akaike AIC	20.78506	23.03616	2.844499	4.795494	3.947194
Schwarz SC	21.36099	23.61209	3.420426	5.371421	4.523121

Note: Number in parentheses indicates t-statistic.

Therefore, Error Correction Models (ECM) are applied to explore the direction of causality The information provided by the tests can now be used to generate error correction models for each of the investment that capture the short and long-run behavior of the relationship. The changes in the relevant variables represent short-run elasticities, while the coefficient on the error-correction term indicates the speed of adjustment back to the long-run equilibrium relationship among the cointegrated variables. The error correction mechanism shows that there exist short run adjustments towards long run relationship among the considered variables implying that the GDP, lending interest rate, inflation rate and exchange rate as the significant determinants of investment for Bangladesh.

5. Conclusion

This paper investigates the relationship between investment and four macroeconomic variables for Bangladesh. The analysis will render special edge for the economic policy makers of Bangladesh. The results from the analyzed information suggest that, investment is reponsive with respect to GDP, lending interest rate, inflation and exchange rate in Bangladesh. The paper addresses the issue of the short run dynamics for the long run relationship among the considered variables. The study found that GDP at constant price, lending interest rate, inflation and foreign exchange rate are significant for macroeconomic determinants as well as their association is stable in both long run and short run.

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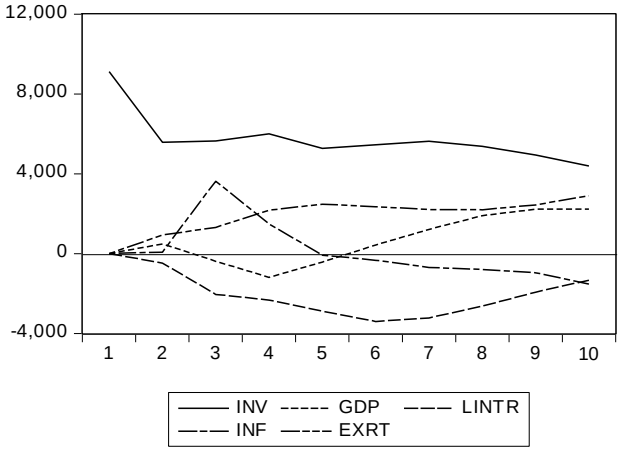
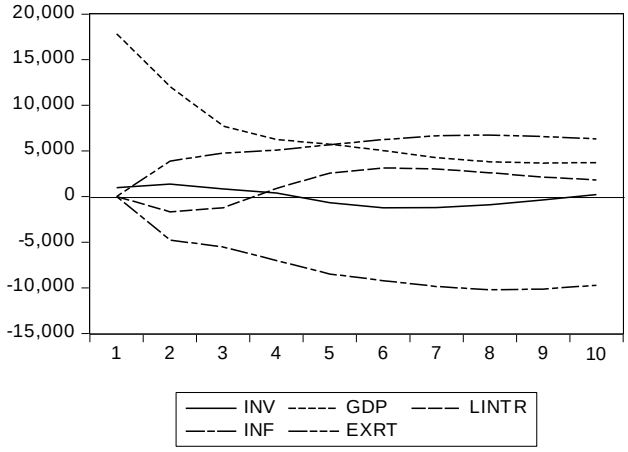
Response of INV to Cholesky
One S.D. Innovations



Response of GDP to Cholesky
One S.D. Innovations



Response of LINTR to Cholesky
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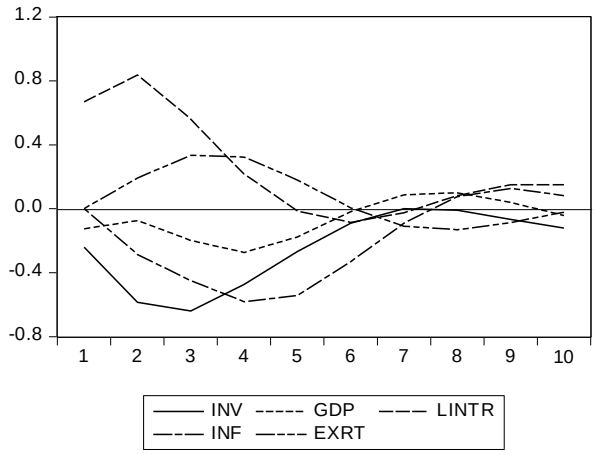

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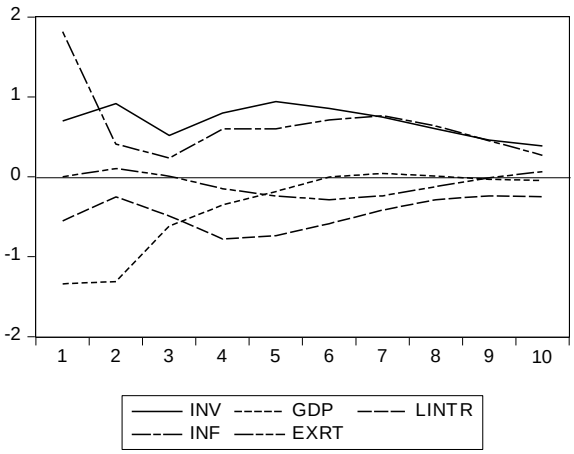
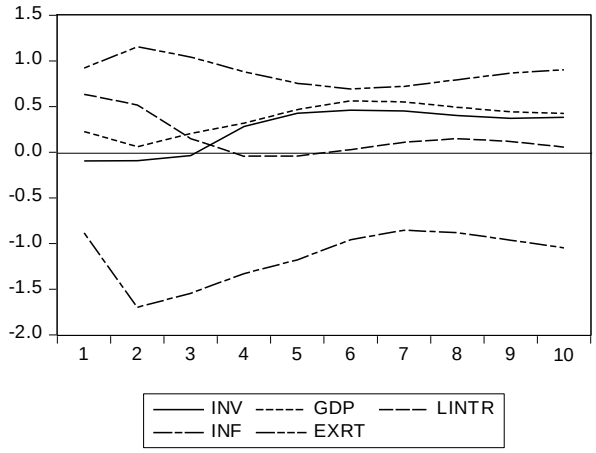
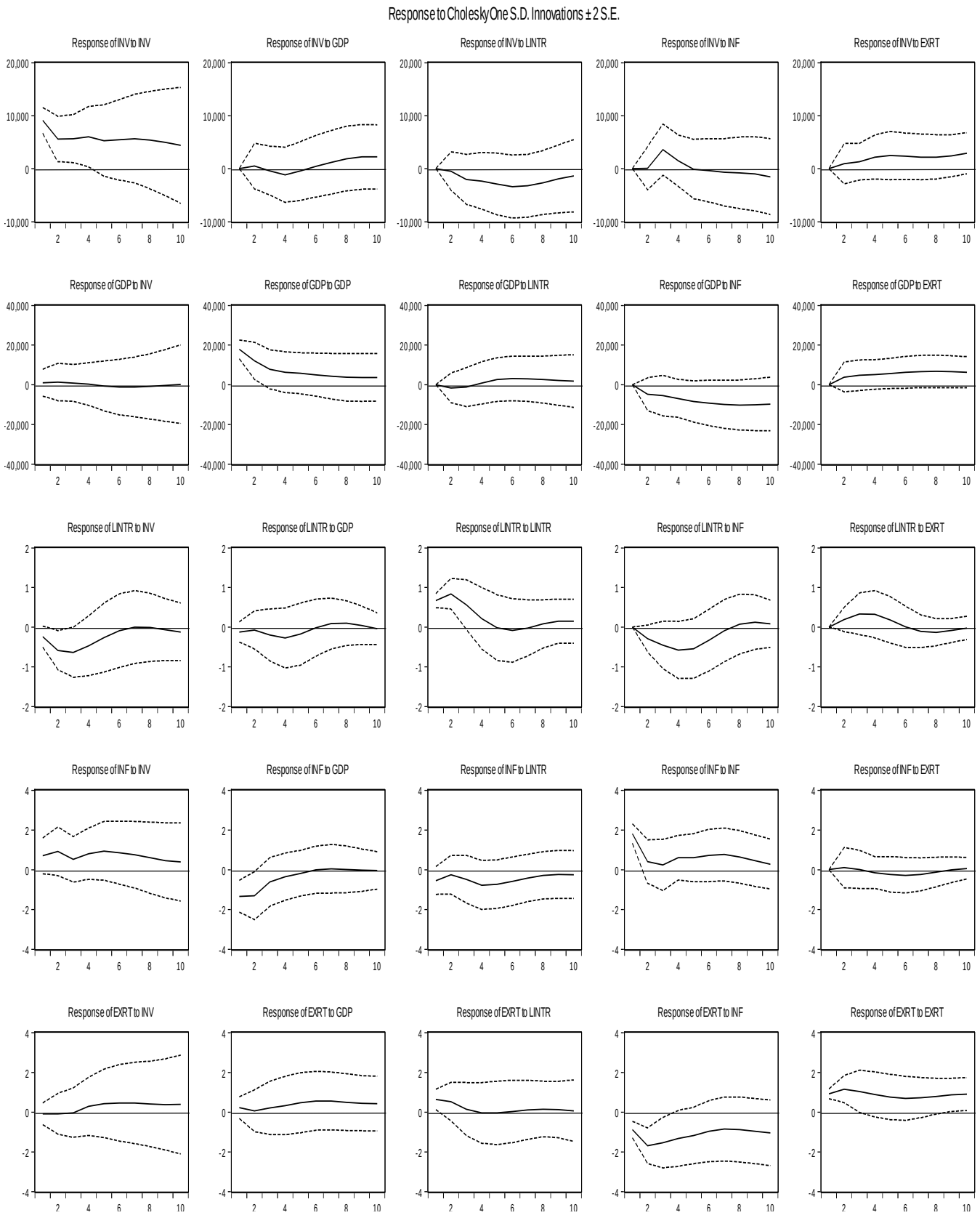


Response of EXRT to Cholesky
One S.D. Innovations




Response to Cholesky One S.D. Innovations ± 2 S.E.
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Response of INV to LINTR
Response of INV to INF
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Response of EXRT to EXRT