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A VAR Approach**

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May 2006

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Interest Rate Responsiveness of Investment Spending in Bangladesh: A VAR Approach

Shamim Ahmed & Md. Ezazul Islam *

May 2006

Abstract

Bangladesh initiated the Financial Sector Reform Programs (FSRPs) at the beginning of the 1990s. One of the objectives of this comprehensive program was to provide better return on deposits and allocate credits efficiently in the financial market by moving towards a market based interest rate regime from an administered interest rate regime, thereby promoting economic growth through increased investment spending. In this connection, the paper empirically investigates whether interest rate liberalization pursued under the FSRP has been able to create a competitive environment in the financial market where investment spending at the aggregate level as well as in disaggregate terms is responsive to the respective lending rates. Using quarterly data set for the period of October-December 1979 to April-June 2005, an assessment of empirical evidence has been established through the unrestricted vector autoregressions (VARs) approach. The results of the empirical analysis suggest that investment spending at the aggregate level is non-responsive to interest rates. Besides, investment spending at the disaggregate level is still not responsive to interest rates except for *private sector investment* category which is only moderately responsive from the lenders' point of view in the short-run. These results have important policy implications for both domestic policy makers and the development partners in assessing the achievement of the objectives of the FSRP and taking further policy actions.

Keywords: Interest Rate, Investment, and Vector autoregressions (VARs).

JEL Classification: E43, E22, 023.

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1. Introduction

Economic theory often suggests that changes in either nominal or real interest rates transmit a direct effect on the level of investment spending which, in turn, affects the real economy.¹ In particular, the traditional Keynesian framework suggests that a decrease in the lending rate reduces the cost of investment, particularly, the cost of capital which in turn, increases the profit margin of investors. Therefore, investment spending increases since the investors react positively to this fall in lending rates and ultimately economic growth is accelerated.² On the other hand, to supply adequate funds to potential investors for spending, savings mobilization is necessary which mainly depends on deposit rates. In other words, increase in deposit rates encourages depositors i.e., savers to accumulate enough savings for financing investment spending in an economy and vice versa (e.g., Mckinnon (1973) and Shaw (1973)). Therefore, lower financial intermediation costs with reasonable lending and deposit rates are essential for counterbalancing ample savings mobilization, investment spending and finally, higher economic growth of a country.

In the above context, interest rate *spread* characterizes a critical feature of the financial intermediation process in the economy. It is basically the difference between lending and deposit rates, a crude measure of the cost of efficient resource intermediation in the financial system. Historically, least developed countries (LDCs) with financial market imperfections have been characterized by higher *spreads* due to factors such as absence of competition, burden of non-performing loans (NPLs), high administrative costs, etc. (Islam and Begum, 2004).

To reduce the financial intermediation cost and achieve higher economic growth through increased investment spending, the developing countries of Latin America (e.g., Argentina, Brazil, Columbia, Mexico, Uruguay, and Chile) and Asia (e.g., Malaysia, Indonesia, Philippines, South Korea, Thailand, India, Pakistan, and Sri Lanka) have implemented various Financial Sector Reform Programs (FSRPs) beginning from the mid-1970s. In this connection, Bangladesh is not an exception which initiated the FSRP at the beginning of the 1990s. One of the objectives of this comprehensive program was to provide better return on deposits and allocate credits efficiently in the financial market by moving towards a market based interest rate regime from an administered interest rate regime, thereby promoting economic growth (Islam and Begum, 2004).³ In this backdrop, it is timely that one investigates the lending interest rate responsiveness of investment spending in the country in

¹ Investment is a spending devoted to enhancing or maintaining the existing stock of capital consisting of factories, machinery and equipments, offices, and other durable products used in the process of production (Dornbusch and Fischer, 2001). Besides these, capital stock includes residential housing as well as inventories held by the firms.

² The theory of investment suggests an inverse relationship between lending rates and investment spending from the borrower's point of view.

³ The other objectives were institutional reforms which included the revision of legal structure, strengthening Bangladesh Bank's supervision, introduction of new policies for loan classification, implementation of capital adequacy requirement of commercial banks, development of capital market, etc.

a comprehensive way. Particularly, it is important to evaluate whether interest rate liberalization pursued under the FSRP has been able to create a competitive environment in the financial market where investment spending at the aggregate level as well as in disaggregate terms is responsive to the respective lending rates. Besides, high lending rates in Bangladesh have recently been claimed to impede the financing of investment spending, a major debatable issue for policy purposes requiring careful investigation.

Until recently, there has hardly been any empirical study that attempted to investigate the relationship between investment spending and lending interest rate in Bangladesh, especially, the extent to which lending rates affect investment spending. What has been done so far mostly address the issue of high lending interest rates (e.g., Coats and Alam (2003), Choudhury (2003), and Mahmud (2004)). In this regard, Islam and Begum (2005) have attempted to explore whether investment spending in aggregate level is sensitive to the lending rate in Bangladesh. Using annual data set for the period between 1973 to 2004 and employing ordinary least squares (OLS) method, they find that investment spending is weakly sensitive (i.e., -0.36 percent) to lending rates.

However, in the context of developing countries, several empirical studies explore the interest rate responsiveness of investment spending. Morisset (1991) investigates the effect of interest rate policies on *private sector investment* spending in Argentina. Using 3-stage least squares (3SLS) technique over the period between 1961 to 1982, he finds a very weak effect (i.e., -0.047 percent) of changes in interest rates on *private sector investment*, although the total impact is perhaps stronger on the quality of investment than on the quantity. A related empirical study has been carried out by Emran et al (2003) where they estimate investment function for India by following the autoregressive distributive lag (ARDL) approach covering data for the period of 1953 to 1999. They found that the response of aggregate private investment with respect to the relative cost of capital increased at least 4.6 times after the dismantling of all pervasive interventionist policy regimes, the so-called *License Raj*.

The purpose of this paper is to empirically investigate the interest rate (i.e., lending rate) responsiveness of investment spending at the aggregate level (i.e. total investment spending) as well as the disaggregate level i.e., specific categories: *private sector*, *residential*, and *business fixed investment*. This has been motivated by the recent work of Islam and Begum (2005). Unlike Islam and Begum (2005), all empirical analysis presented in the paper has been conducted by a sophisticated macro-econometric framework namely, unrestricted vector autoregressions (VARs) approach using quarterly data set for the period of October-December 1979 to April-June 2005. The results of the empirical analysis suggest that although the country adopted the FSRP in the 1990s, particularly, interest rate liberalization, investment spending at the aggregate level is non-responsive to interest rates. Besides, investment spending at the disaggregate level is still not responsive to interest rates except for *private sector investment* category which is only moderately responsive from the lenders' point of view in the short-run. Finally, the results provide guidance for both domestic policy makers and development partners in assessing the achievement of the objectives of the FSRP in the 1990s and taking further policy actions.

The remainder of the paper is organized as follows: Section 2 provides some basic features of the financial system, the evolution of interest rate policy, and the investment spending in Bangladesh. Section 3 discusses the respective unrestricted VAR models and methodology used to obtain the empirical findings reported in the paper. Section 4 provides data specification and estimated results on lending interest rate responsiveness of investment

spending, and finally, section 5 presents a summary of the main conclusions and policy implications, limitations of the paper, and discusses a possible future extension.

2. Financial System, Interest Rate Policy, and Investment Spending in Bangladesh

2.1 Financial System in Bangladesh

The financial system of Bangladesh comprises of 4 nationalized commercial banks (NCBs), 5 government owned specialized banks (SpBs), 30 domestic private commercial banks (PCBs) including 6 Islamic banks (IBs), 9 foreign banks (FCBs), 28 non-bank financial institutions (NBFIs), and a large number of microfinance institutions (e.g., Bangladesh Rural Advancement Committee (BRAC), Grameen Bank, Proshika, and Association of Social Advancement (ASA)) and 62 insurance companies (e.g., Jiban Bima Corporation, Shadharan Bima Corporation, and American Life Insurance Company (ALICO)). Besides, the financial system includes 2 stock exchanges (i.e., Dhaka and Chittagong) and a number of co-operative banks. Out of the 5 SpBs, Bangladesh Krishi Bank (BKB) and Rajshahi Krishi Unnayan Bank (RAKUB) have been launched in order to meet the credit demands of the agricultural sector, while Bangladesh Shilpa Bank (BSB) and Bangladesh Shilpa Rin Sangtha (BSRS) are for extending term loans to the industrial sector, and finally, Bangladesh Small Industries and Commerce (BASIC) Bank Limited provides loans to the small scale and cottage industries of the economy.

Table 1 reveals that PCBs (including IBs) dominate the banking system in terms of total deposits by holding 46.47 percent at the end of December 2005.⁴ In this connection, it is important to mention that, although NCBs' share in total deposits has been dominant since 1970s, it has been declining continuously in recent years. Even as late as December 2002, NCBs held 50.32 percent of total deposits. Moreover, if credit (i.e., sum of advances and bills) of individual bank groups as a share of total credit is considered, it can be observed that PCBs (including IBs) has the highest share, 54.11 percent, at the end of December 2005. Again, it is notable that although NCBs' share of total credit has declined in recent years, it had the highest share of 41.41 percent at the end of September 2003. This in turn, demonstrates increasing domination of PCBs (including IBs) in the financial market.

Table 1: Position of Deposits and Credits in the Banking System

Bank Groups	Deposits	% of Total Deposits	Credits (Advances & Bills)	% of Total Credits	Credit-Deposit Ratio
NCBs	627.74	40.52	493.67	32.91	0.79
SpBs	92.41	5.97	111.55	7.44	1.21
PCBs	719.83	46.47	811.79	54.11	1.13
FCBs	109.09	7.04	83.15	5.54	0.76
Total	1549.06	100.00	1500.16	100.00	0.97

- Notes: 1. All figures regarding deposits and credits are in billion BDT (outstanding amounts) at the end of December 2005.
2. PCBs also include IBs.

Source: Banking Statistics Division, Statistics Department, BB, Head Office, Dhaka and authors' calculation.

⁴ The scheduled banking system governed by the BB is a major segment of the financial system which comprises NCBs, SpBs, PCBs (including IBs), and FCBs.

2.2 The Evolution of Interest Rate Policy ⁵

Shortly after independence in 1971, Bangladesh Bank (BB) implemented a controlled interest rate policy which continued up to the end of the 1980s. The objective of this comprehensive policy of controls on the level as well as the structure of interest rates was to limit the costs of financial intermediation and thus enforcing reasonable lending and deposit rates in general as well as for the priority sectors. In particular, BB deliberately fixed both lending and deposit rates where rates were generally kept at a low level in the 1970s (Table 2). Besides, rates on term deposits (except for FY76 and FY77) were below the rates of inflation. As a result, the real rates of return on term deposits were negative in most of the years during this decade. Considering this fact, the BB, in October 1980, revised the nominal rates on term deposits upward in order to provide positive real rates of return to the depositors. In this regard, it is important to mention that although nominal rates on term deposits were kept at a high level in the 1980s, the rate increase was not fully in line with changes in inflation rates, thereby causing real rates to be negative again in most of the years (except for FY89) during this decade (Table 2).

Similarly, more and more exceptions were introduced or special lending categories were identified for *directed credits* in the 1980s. Therefore, the structure of lending rates remained highly complex in nature where lending to selected prioritized sectors at different subsidized rates gave rise to proliferation of rates along with varied degree of subsidization among the sectors (Jahan, 2005). This was done in the belief that credit can be best allocated by the government's dictates (Mahmud, 2004). However, the regime of *directed credit* stimulated the shifting of investable funds from one use to another, distorting the use of resources (Jahan, 2005). Therefore, the interest rate as well as the credit structure was distorted and competition was totally absent, thereby allocation of resources was inefficient in the banking system.

The complexity and rigidity of controlled interest rates destabilized the role of interest rates in mobilizing savings to supply adequate funds for investment spending, and finally, allocating credits efficiently. Moreover, as the government attempt to provide positive returns to depositors failed due to its failure to effectively control inflation as the resulting negative and volatile real yield on deposits hurt the incentives to mobilize savings. Therefore, to overcome the above shortcomings, a market oriented interest rate policy was introduced in January 1990 as part of the FSRP of the 1990s. This was done in the belief that the new interest rate liberalization policy would encourage competition among scheduled banks and enable them to mobilize savings as well as allocate credits at rates of interest allowing for an appropriate *spread*.⁶ Besides, in the early 1980s the government allowed the setting up of commercial banks in the private sector.

Initially, interest rate bands were established for 11 exhaustive categories determined by the BB and scheduled banks were allowed to set their rates (both lending and deposit) freely as long as they remain within the prescribed bands.⁷ Particularly, interest rates on deposits were freed except that a floor and a ceiling for savings and fixed deposits were established. In addition, BB initiated a rediscount window essentially for lending to the scheduled banks at a

⁵ This section draws heavily from Ahmed and Islam (2006).

⁶ In this paper, *spread* has been interpreted as the difference between weighted average lending and deposit rates which is different from *net interest margin* (NIM). See Ahmed and Islam (2006).

⁷ The categories include agriculture, industrial term lending, jute working capital, other working capital, jute exports, other exports, jute trading, other commercial lending, special programs-small industry term lending and other special programs, urban housing, and others (BB, 1989).

uniform rate (Islam and Begum, 2004). Subsequently in 1992, the prescribed bands for lending rates were removed from all but three prioritized sectors: agriculture, export, and cottage industries. As a result, scheduled banks were allowed to set their lending rates along the lines of market conditions. Besides, ceiling on savings and fixed deposits were removed but floors were continued which were eventually removed in 1997. Finally, in August 1999, interest bands on credits to agriculture and cottage industries were removed. It is worth mentioning here that interest rate liberalization has effectively reduced the extent of direct control of BB on interest rates as well as providing greater flexibility to scheduled banks of the country (Islam and Begum, 2004).

Table 2: Interest Rates Structure in Bangladesh (weighted average in percent)

Year	Nominal Interest Rates			Real Interest Rates	
	Deposit	Lending	Inflation	Lending	Deposit
1974-75	3.51	11.28	67.17	-55.89	-63.66
1975-76	4.23	11.62	-8.36	19.98	12.59
1976-77	4.32	11.03	2.42	8.61	1.90
1977-78	4.22	10.66	12.62	-1.96	-8.40
1978-79	4.27	11.12	8.24	2.88	-3.97
1979-80	4.31	11.04	18.46	-7.42	-14.15
Average (1974-75 to 1979-80)	4.14	11.13	16.76	-5.63	-12.62
1980-81	6.98	13.07	12.54	0.53	-5.56
1981-82	7.29	13.53	16.29	-2.76	-9.00
1982-83	7.36	13.55	9.93	3.62	-2.57
1983-84	8.11	13.75	9.67	4.08	-1.56
1984-85	8.13	14.50	10.94	3.56	-2.81
1985-86	8.54	14.66	9.95	4.71	-1.41
1986-87	8.59	14.70	10.35	4.35	-1.76
1987-88	8.69	14.66	11.42	3.24	-2.73
1988-89	8.88	14.68	8.00	6.68	0.88
1989-90	9.06	14.83	9.30	5.53	-0.24
Average (1980-81 to 1989-90)	8.16	14.19	10.84	3.35	-2.68
1990-91	9.11	14.99	8.31	6.68	0.80
1991-92	8.11	15.12	4.56	10.56	3.55
1992-93	6.51	14.39	2.73	11.66	3.78
1993-94	5.34	12.78	3.28	9.50	2.06
1994-95	4.86	12.22	8.87	3.35	-4.01
1995-96	6.11	13.41	6.65	6.76	-0.54
1996-97	6.67	13.69	2.52	11.17	4.15
1997-98	7.07	14.02	6.99	7.03	0.08
1998-99	7.28	14.16	8.91	5.25	-1.63
1999-00	7.21	13.86	3.41	10.45	3.80
Average (1990-91 to 1999-00)	6.83	13.86	5.62	8.24	1.20
2000-01	7.03	13.75	1.58	12.17	5.45
2001-02	6.74	13.16	2.36	10.80	4.38
2002-03	6.29	12.78	5.14	7.64	1.15
Average (2000-01 to 2002-03)	6.69	13.23	3.03	10.20	3.66

Note: Real interest rates have been calculated by subtracting inflation (12-month moving average) from the respective nominal rates.

Source: *Economic Trends* (various issues), BB and authors' calculation.

Although most of the restrictions on interest rates have been gradually removed since the 1990s, state control remains significant even after the government's strong commitment to reduce serious financial disorder in the NCBs and SpBs. It is also notable that the *spread* in the banking sector has been persistently high over the years (Table 3), which basically indicates the high cost of intermediation in the banking industry of Bangladesh.⁸ In this connection, Mahmud (2004) mentions that the resulting high cost of borrowing not only tends to discourage private investment but also puts strains on the government by increasing the cost of servicing public borrowing.

Table 3: Interest Rate Spread based on Weighted Average Lending and Deposit Rates (in percent)

Quarter	All Banks	NCBs	SpBs	PCBs	FCBs
June '03	6.48	6.14	6.00	6.63	7.61
September '03	6.23	5.90	5.67	6.45	7.43
December '03	6.11	5.77	4.71	6.55	7.32
March '04	5.40	4.79	4.29	5.89	6.94
June '04	5.36	4.88	3.64	5.85	7.22
September '04	5.22	4.70	3.66	5.67	7.36
December '04	5.27	4.87	3.70	5.54	7.46
March '05	5.16	4.80	3.66	5.29	7.82
June '05	5.31	5.14	3.58	5.25	7.93
September '05	5.24	5.08	3.56	5.10	8.34
December '05	5.38	5.42	3.66	5.08	7.87

Note: IBs are included in PCBs group.

Source: *BB Quarterly* (various issues) and authors' calculation.

2.3 Investment Spending in Bangladesh⁹

The Bangladesh economy embarked on a path of robust economic growth in the early 1990s from the backdrop of deep macro-economic crisis of the period since independence (Bhattacharaya, 2004). Particularly, the country has experienced remarkable economic growth on average i.e., around 5.13 percent during the period between 2001 to 2004 in comparison with 2.82 percent in the 1970s, and 3.85 percent and 4.73 percent in the 1980s and 1990s, respectively. The principal factor determining the rate of economic growth in Bangladesh is the rate at which the nation's capital stock is augmented, i.e., the rate of investment spending (GOB, 2005). It is notable that the investment-GDP ratio in Bangladesh compares poorly with that of the faster growing countries of South East Asia (e.g., Singapore, Malaysia, Hong Kong, and South Korea) where investment as a percentage of GDP is maintained within the range of 35 to 40 percent per annum (Islam and Begum, 2005). However, investment as a percentage of GDP at current prices in Bangladesh has steadily risen to 24.43 percent in FY05 as compared to 16.90 percent in FY91 (Table 4). Besides,

⁸ Ahmed and Islam (2006) analyze in detail the issue of the lack of competition in the financial sector and the possible sources of the high *spread*.

⁹ This section is based on Islam and Begum (2005).

public sector investment as a percentage of GDP remained within the range of 5 to 7 percent since the 1970s.¹⁰ Conversely, *private sector investment* at current prices has increased gradually to 18.53 percent in FY05 from 10.26 percent in FY91. It would thus appear that the private sector has taken the lead following the liberalization policies.

Table 4: Investment as percent of GDP at Current and Constant (base: 1995-96) Prices

Fiscal Year	Constant Prices			Current Prices		
	Total	Private	Public	Total	Private	Public
1990-91	16.62	10.12	6.5	16.90	10.26	6.63
1995-96	19.99	13.58	6.42	19.99	13.58	6.42
1999-2000	23.81	16.01	7.80	23.02	15.61	7.41
2001-02	24.78	17.97	6.82	23.15	16.78	6.37
2003-04	26.09	19.11	6.98	24.02	17.83	6.19
2004-05	27.04	20.22	6.82	24.43	18.53	5.90

Note: Figures for constant prices are constructed using sectoral implicit deflators: 1995-96 base (e.g., construction material price index, machinery equipment, transport equipment, and other capital goods).

Source: BBS (2005).

Even though current investment spending in Bangladesh is considerably higher than earlier (Table 5), it is not enough to attain and maintain an economic growth of 8 to 9 percent per annum as would be consistent with the goals of poverty reduction.¹¹ Therefore, the major challenge for Bangladesh is to raise investment to at least 30 percent of GDP.¹² Although this might appear as a reasonable proposition, it could be difficult because there are various implications of additional investment financing from both domestic savings and foreign sources (Islam and Begum, 2005). In this regard, banks and financial institutions are, still, the major sources of financing investment spending in the country due to narrow based capital market as well as weak financial system. Besides, a survey report prepared by the *World Bank and Bangladesh Enterprise Institute* (WB & BEI) reveals that firms in Bangladesh, on average, collect around 55 percent and 60 percent of their working capital and investment capital respectively from their retained earnings, while about 30 percent of working and investment capital from scheduled banks and other financial institutions (Table 6). The survey report also indicated that many firms appear to have exhausted the bank credit available to them, while financing is primarily short term, and its cost is high where real borrowing rates have sometimes exceeded 10 percent in the past decade.

¹⁰ Mahmud (2004) mentions that a short-lived episode of investment boom existed in the country from the late 1970s to the beginning of the 1980s where investment in both public and private sector grew at nearly 15 percent annually in real terms. He also added that it was made possible by depending on increased foreign aid and adopting privatization policy based on lavish dispensation of *directed cheap credit* and provision of other incentives such as highly protected markets for domestic industries.

¹¹ According to the Poverty Reduction Strategy Paper (PRSP) document, an enhanced economic growth rate of 8 to 9 percent per annum is required to achieve the poverty reduction targets set by the Millennium Development Goals (MDGs) in Bangladesh (GOB, 2005).

¹² Authors' own estimation by the well known capital-output (k/Y) ratio in the Harrod-Domar framework. This framework has been used extensively in developing countries like Bangladesh to examine the relationship between economic growth and capital requirement i.e., investment spending (Perkins et al., 2001).

Table 5: Composition of Investment (BDT in billions) at Constant (base: 1995-96) Prices

Year	Construction	Plant and Machinery	Transport Equipment	Others	Total Investment
1999-2000	356.87	75.47	53.38	1.64	487.36
2000-01	388.93	86.70	36.92	1.93	514.48
2001-02	423.52	89.59	33.09	1.22	547.42
2002-03	458.79	99.56	41.05	1.29	600.69
2003-04	498.36	132.47	40.71	1.51	673.05
2004-05	537.15	144.16	40.71	1.73	723.75

Note: Figures at constant prices are constructed using sectoral implicit deflators: 1995-96 base (e.g., construction material price index, machinery equipment, transport equipment, and other capital goods).

Source: BBS (2000, 2001, 2005) and authors' calculation.

Table 6: Sources of Finance (in percent) by Type of Firms in Bangladesh

	Bangladesh	Small	Medium Size	Large	Exporter	Non-exporter	Domestic	Foreign
Sources for Working Capital								
Retained Earnings	56.6	63.9	55.5	52.2	53.9	56.8	55.8	50.3
Banks and Financial Institutions	33.5	25.8	35.5	35.7	33.3	33.5	33.2	43
Trade Credit	4.2	2	3.9	5.2	5.3	3.4	4.2	4
Equity	0.5	0.3	0.3	0.7	0.7	0.4	0.4	0.7
Informal Sources	0.5	1.1	0.2	0.3	0.3	0.6	0.5	0.1
All others	5.8	6.9	4.5	5.8	6.5	5.3	5.9	1.9
Sources for New Investments								
Retained Earnings	59.9	68	61.2	55.9	55.5	62.9	59.6	62.8
Banks and Financial Institutions	29.7	20	30.1	33.6	33	27.4	29.8	30.7
Trade Credit	2.6	2.7	2.1	2.8	3	2.4	2.7	1.1
Equity	0.4	0.2	0.2	0.5	0.6	0.2	0.3	0
Informal Sources	0.3	1.1	0.2	0.1	0.2	0.5	0.4	0
All others	7.1	8.1	6.1	7.1	7.7	6.7	7.3	5.5

Source: The World Bank and Bangladesh Enterprise Institute (2003).

Despite recent efforts, major factors continue to discourage investment spending in the country (GOB, 2005).¹³ The banking system characterized by 4 poorly functioning NCBs

¹³ To enhance overall investment, the government offers generous opportunities under its liberalised Industrial Policy and export-oriented private sector-led growth strategy. In particular, all but four sectors: (i) arms and ammunition and other defence equipment and machinery; (ii) forest plantation and mechanised extraction within the bounds of reserved forests; (iii) production of nuclear energy; and (iv) security printing and mining are open for private (both domestic and foreign) investment in Bangladesh. In this regard, the Board of Investment (BOI)

along with 5 SpBs, which together still account for nearly half of all deposits in the system, creates instability and stifles competition, thus, has become the *Achilles heel* of the financial system. Access to financing and costs of financing is the most significant constraint to potential investors. Apart from these constraints, the factors that discourage investment spending in Bangladesh are the lack of adequate and reliable supply of electricity and gas, poor transportation network, inadequate telecommunication services, poor port facilities, official harassment, delays and corruption, collection of illegal protection money, an inadequate legal system, and finally, frequent political agitations (GOB, 2005).¹⁴

3. The Model and the Methodology

Macro-econometric models, in general, perform two basic tasks: providing macroeconomic forecasts and delivering structural inferences as well as guidance for appropriate policy prescriptions. In the early 1970s, these tasks were basically performed using diverse macro-econometric techniques ranging from large scale models to single-equation models which focused on interactions of a few variables to simple univariate time series models. Following the ground breaking *Lucas critique* (1976), almost all of these approaches appeared to be less reliable, especially in making forecasts with large non-structural models.¹⁵ In this connection, Sims (1972, 1980) pioneered a new macro-econometric framework known as vector autoregressions (VARs), which provides a simple and systematic way to capture the rich dynamics that exist in the univariate or multivariate time series models engaged in forecasting and policy analysis. In general, an n -equation VAR is an n -variable linear system in which each variable is in turn explained by its own lagged values and past values of the remaining $n-1$ variables. Furthermore, in an n -variable unrestricted VAR, each and every concerned variable in the system is assumed to be endogenous and no a priori restrictions are imposed (Enders, 1995).

Considering advantages of the VAR approach, the paper basically employs unrestricted VARs to comprehensively investigate the interest rate responsiveness of investment spending (i.e., investment demand) in Bangladesh. In general, investment spending can be disaggregated into three broad categories. The first one is the *business fixed investment* which is the spending on equipment, machinery, and structures such as factories. The second category is *residential investment*, consisting largely of investment in housing and finally, the third category is *inventory investment*, consisting of additions to the stock of inventories of firms. Therefore, the paper has attempted to explore the interest rate responsiveness of investment spending at the aggregate level (i.e., total investment spending) as well as disaggregate levels (i.e., specific categories): *private sector*, *residential*, and *business fixed*

provides institutional support services to intending investors. The general facilities/incentives include: (i) tax holiday for 5 or 7 years depending on the location of the industrial enterprise; (ii) tax exemption on royalties, technical know-how fees received by any foreign collaborator, firm, company and expert; (iii) exemption of income tax up to 3 years for foreign technicians employed in industries specified in the relevant schedule of the income tax ordinance; (iv) tax exemption on income of the private sector power generation company for 15 years from the date of commercial production; (v) tax exemption on capital gains from the transfer of shares of public limited companies listed with a stock exchange; and (vi) concessionary duty on imported capital machinery. For an elaboration, visit www.bangladeshbank.bd.org.

¹⁴ Mahmud (2004) points that apart from the resource constraints on investment growth, the *desire to invest* factors may have become important in the 1970s and 1980s because of the withdrawal of public sector investment from directly productive sectors.

¹⁵ The *Lucas critique* points out not only that conventional econometric models cannot be used for policy evaluation, but also that the public's expectations about a policy will influence the response to that policy (Miskin: 2004, p. 660).

investment. In this connection, it is important to mention that the *inventory investment*, an important category of investment spending has been excluded from the empirical analysis because of non-availability of relevant data in Bangladesh.

Before employing the data in the estimation of VARs, time series properties of all concerned macroeconomic variables have been identified by four most popular techniques: the Dicky-Fuller (DF, 1979) test, the Augmented Dickey-Fuller (ADF, 1981) test, the Phillips-Perron (PP, 1988) test, and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992) test. All of these tests have been performed in the levels. The paper has estimated all of the unrestricted VAR models in levels; even though, some of the concerned time series variables in the respective models are likely to be non-stationary and contain unit roots, I(1). The motivation behind this originates from a considerable number of empirical literature (e.g., Sims (1980), Eichenbaum (1992), etc.) on unrestricted VARs that have been employed in levels. In particular, Sims (1980) argues that since the objective of VAR analysis is to explore the interrelationships that exist among the time series variables, first differencing the variables purges away relevant information concerning the comovements in the data even if the variables contain a unit root, I(1). Analogous to Sims' (1980) argument, Disyatat and Vongsinsirikul (2003) also mention that since economic theory is mostly based on the relationship between variables in levels; therefore, a VAR in first difference fails to capture such dynamics. The following unrestricted VAR models regarding the interest rate responsiveness of investment spending have been estimated in the paper with the order of given variables:

- Total Investment Spending: $RAIN, RTA, RGDP$ ¹⁶
- Private Sector Investment Spending: $RAIN, RPSA, RGDP$
- Residential Investment Spending: $RHIN, RHA, RGDP$
- Business Fixed Investment Spending: $RINDIN, RINA, RGDP$

where

$RGDP$ = real GDP;

RTA = real total advances (i.e., sum of advances in the public and private sectors);

$RPSA$ = real private sector advance;

RHA = real housing advance;

$RINA$ = real industrial advance;

$RAIN$ = real interest rate on advances;

$RHIN$ = real interest rate on housing advance; and

$RINDIN$ = real interest rate on industrial advance.

In all of the above specific 3-variable VAR models, investment spending at the aggregate level as well as disaggregate levels: *private sector*, *residential*, and *business fixed investment* have been proxied by the outstanding advances (in real terms) in the respective categories by

¹⁶ The system of equations of the VAR model regarding total investment spending can be represented as

$$RAIN_t = \varphi_{10} + \sum_{j=1}^s \varphi_{11j} RAIN_{t-j} + \sum_{i=1}^q \varphi_{12i} RTA_{t-i} + \sum_{k=1}^l \varphi_{13k} RGDP_{t-k} + e_{1t}$$

$$RTA_t = \varphi_{20} + \sum_{j=1}^s \varphi_{21j} RAIN_{t-j} + \sum_{i=1}^q \varphi_{22i} RTA_{t-i} + \sum_{k=1}^l \varphi_{23k} RGDP_{t-k} + e_{2t}$$

$$RGDP_t = \varphi_{30} + \sum_{j=1}^s \varphi_{31j} RAIN_{t-j} + \sum_{i=1}^q \varphi_{32i} RTA_{t-i} + \sum_{k=1}^l \varphi_{33k} RGDP_{t-k} + e_{3t}$$

where e_{1t}, e_{2t}, e_{3t} are the random disturbance terms, and $s, q,$ and l are the number of lag lengths.

all scheduled banks of the country. In this connection, it is important to mention that industrial advance (outstanding amount) has been used as a proxy for *business fixed investment* spending. These have been used as proxies for the whole sample period since the quarterly data set on investment at the aggregate level as well as specific categories is unavailable in the country. Besides, advances at the aggregate level as well as disaggregate levels comprise a significant portion of total credit (i.e., sum of advances and bills) and credit in the specific categories respectively (Annex Table 1). Finally, as there is no separate interest rate available for private sector advance, real interest rate on advances (*RAIN*) has been used as a proxy for real rate in the *private sector investment* spending. An elaborate description of all time series variables has been provided in the section ahead.

The VAR models in the paper have been identified using a Choleski decomposition, which isolates the structural errors by recursive orthogonalization. A Choleski decomposition requires that the concerned variables be placed on the basis of the speed at which the variables act in response to shocks. In particular, the variables placed higher in the ordering have contemporaneous impact on the variables lower in the ordering, but the variables placed lower in the ordering do not have contemporaneous impact on the variables higher in the ordering (Rahman, 2005). Since the main objective of the paper is to empirically investigate the relative impact of interest rates on investment spending at aggregate level as well as disaggregate levels, policy variable, i.e., real interest rates on different categories of advances have been placed in the first place of all the corresponding VAR models and the variable, real advances in the respective categories has been placed in the second position. As aggregate output, i.e., real GDP is influenced by the level of investment spending in the economy, the variable *RGDP* has been placed in the last position in the ordering of all the 3-variable VAR models.

Finally, variance decompositions (VDCs) and impulse response functions (IRFs) derived from VARs estimation has been used to look at the relative impact of interest rates on different categories of investment spending in the country.¹⁷ Basically, the IRFs show the response of each concerned variable in the linear system to a shock from system variables and the VDCs show the portion of the variance in the forecast error for each variable due to innovations to all variables in the system (Enders, 1995).

4. Data and Empirical Evidence

4.1 Data Specification

The VAR models in the paper have used quarterly data set on GDP, total advances, private sector advance, industrial advance other than working capital financing, housing advance; interest rates on advances, industrial advance, and housing advance in real terms for the period of October-December 1979 to April-June 2005 retrieved from the Bangladesh Bureau of Statistics (BBS) and the Banking Statistics Division, Statistics Department, BB. In particular, the VAR model regarding interest rate responsiveness of: (i) total investment spending has used quarterly data set on real GDP (*RGDP*), real total advances (*RTA*), and real interest rate on advances (*RAIN*), (ii) *private sector investment* spending has used *RGDP*, real private sector advance (*RPSA*), and *RAIN*, (iii) *residential investment* spending has used *RGDP*, real housing advance (*RHA*), and real interest rate on housing advance (*RHIN*); and (iv) *business fixed investment* spending has used *RGDP*, real industrial advance (*RINA*), and

¹⁷ Enders (1995) mentions that IRF analysis and VDCs together known as *innovation accounting* is a useful tool to investigate the relationships among macroeconomic variables.

real interest rate on industrial advance (*RINDIN*). All the above mentioned time series variables have been adjusted for seasonality and used in log form, except for the interest rates for different types of advances.¹⁸ The detailed definitions of all the macroeconomic variables used in the empirical analysis are as follows:

Real GDP (*RGDP*):

Until now GDP in Bangladesh has been calculated only on a yearly basis by the BBS. However, to investigate the issue of whether investment spending is responsive to interest rates in Bangladesh, quarterly data set on GDP is required in order to get a parsimonious result. Therefore, quarterly GDP at producer prices has been calculated both in real and in nominal terms from the available annual data where *RGDP* has been calculated at constant producer prices (base year: 1995-96).¹⁹ Since GDP in Bangladesh comprises of agriculture, industry, and services, quarterly contributions of these sectors have been estimated where seasonal factors are taken into accounts to reflect the agricultural as well as industrial production cycles. For the service sector, since there is very little seasonality in annual output, and therefore, it has been distributed equally into four quarters of each year in order to construct the quarterly GDP series of Bangladesh for the period of October-December 1979 to April-June 2005.²⁰

Real Total Advances (*RTA*):

Data on quarterly *RTA* has been calculated from nominal total advances (outstanding amounts at the end of each quarter) of all scheduled banks of the country using the constructed quarterly GDP deflator (1995-96 = 100). It includes outstanding advances both to public and private sectors.

Real Private Sector Advance (*RPSA*):

RPSA has been estimated from quarterly nominal private sector advances (outstanding amounts at the end of each quarter) of all scheduled banks using the constructed quarterly GDP deflator.

Real Housing Advance (*RHA*):

Quarterly data on *RHA* has been estimated from nominal advances for construction purposes (outstanding amounts at the end of each quarter) of all scheduled banks which include advances to housing societies/companies, urban and rural housing.²¹ Data before July-September 1998 includes outstanding advances to housing societies/companies and individual housing. Then the constructed quarterly GDP deflator has been employed to get quarterly data on *RHA*.

¹⁸ The seasonal adjustment has been done using *Census X12* procedure in *Econometric Views 4* package. This procedure has been developed by the U.S Census Bureau.

¹⁹ Quarterly nominal GDP at producer prices has been estimated in order to construct the quarterly GDP deflator where the base year is 1995-96, i.e., 1995-96 = 100. This has been used to construct the different types of advances in real terms from their respective nominal terms.

²⁰ Details on the quarterly GDP estimation procedure are available from the authors on request.

²¹ Outstanding amounts by NBFIs (e.g., Delta Brac Housing (DBH) and Finance Corporation Limited) and microfinance institutions (MFIs) for housing purposes have not been included in the empirical analysis due to the unavailability of a quarterly data set in the country.

Real Industrial Advance (*RINA*):

Data on *RINA* has been constructed from quarterly nominal industrial advances (outstanding amounts at the end of each quarter) of all scheduled banks using quarterly GDP deflator. It excludes outstanding advances for working capital financing purposes.

Real Interest Rate on Advances (*RAIN*):

RAIN has been estimated from quarterly weighted average nominal interest rates on advances of all scheduled banks after adjusting for inflation measured by the Consumer Price Index (CPI, 12-month moving average) at the preceding quarter end.²²

Real Interest Rate on Housing Advance (*RHIN*):

RHIN has been estimated from quarterly weighted average nominal interest rates of all scheduled banks on construction advances after adjusting for inflation measured by the CPI (12-month moving average) at the previous quarter end. Data before July-September 1992 are the quarterly inflation (i.e., previous quarter end) adjusted mid-points of the interest rate bands on construction purposes prescribed by the BB. Moreover, data from October-December 1992 to April-June 1996 are the quarterly inflation (i.e., preceding quarter end) adjusted simple average of 4 NCBs, i.e., Sonali, Rupali, Agrani, and Janata.

Real Interest Rate on Industrial Advance (*RINDIN*):

RINDIN has been calculated from quarterly weighted average nominal interest rates of all scheduled banks on industrial advances other than working capital financing after adjusting for inflation measured by the CPI (12-month moving average) at the preceding quarter end. Similar to *RHIN*, data before July-September 1992 are the quarterly inflation (i.e., previous quarter end) adjusted mid-points of the interest rate bands on large and medium scale manufacturing industries prescribed by the BB. In addition, data from October-December 1992 to April-June 1996 are the quarterly inflation (i.e., preceding quarter end) adjusted simple average of 4 NCBs because of non-availability of data on quarterly weighted average nominal interest rates for this economic purpose.

4.2 Empirical Evidence

The results of the unit root tests on the relevant macroeconomic variables have been reported in Table 7. The tests show that the variables, *RTA*, *RHA*, *RINA*, *RGDP* are non-stationary and contain unit roots $I(1)$ based on DF, ADF, PP, and KPSS tests and in case of *RPSA*, DF, PP, and KPSS tests succeed although the ADF test fails. Since the PP and KPSS tests are preferable to ADF it can be concluded that *RPSA* is also non-stationary, $I(1)$. Conversely, the unit root tests suggest that the variables, *RAIN*, *RHIN*, and *RINDIN* are integrated of order zero based on the DF, ADF, PP, and KPSS tests. Therefore, they are stationary, $I(0)$. Finally,

²² In estimating the real rates on different types of advances for the period of October-December 1979 to April-June 2005, CPI of any particular (single) base year has been avoided because of several methodological issues in the data. In particular, till now there are three CPI base years, i.e., 1974-75=100, 1985-86=100, and 1995-96=100, where the commodities and income groups included in each CPI basket of particular base year are considerably different from the others. Therefore, using a single CPI base year for the whole sample period generates negative real rates for a considerable number of observations and in some cases would be misleading. To avoid this problem, all real rates have been estimated by adjusting for inflation measured by the CPI (12-month moving average) at the preceding quarter end.

the estimated results of all the 3-variable VAR models in terms of VDCs and IRFs have been presented in the next section.

Table 7: Unit Root Tests

Variables (in log levels)	DF		ADF		PP		KPSS		Decision
	Without trend	With trend	Without trend	With trend	Without trend	With trend	Without trend	With trend	
<i>RTA</i>	I(1)***	I(1)	I(1)	I(1)	I(1)	I(1)***	I(1)	I(1)	I(1)
<i>RPSA</i>	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)
<i>RHA</i>	I(1)***	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
<i>RINA</i>	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
<i>RGDP</i>	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
<i>RAIN*</i>	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)***	I(0)	I(0)
<i>RHIN*</i>	I(0)	I(0)	I(0)	I(0)	I(0)**	I(0)	I(1)	I(0)	I(0)
<i>RINDIN*</i>	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)***	I(0)	I(0)

Notes: 1. * means the series without log, *** and ** means significant at 1-percent and 10 percent levels, respectively.

2. Lag length for ADF tests have been decided on the basis of *Akaike's Information Criteria* (AIC).
3. Maximum Bandwidth for PP and KPSS tests have been decided on the basis of *Newey-West* (1994).
4. All tests have been performed on the basis of 5-percent significance level using *Econometric Views 4* Package.
5. The DF, ADF and PP tests are based on the null hypothesis of unit roots while the KPSS test assumes the null hypothesis of stationarity.

4.2.1 Total Investment Spending

The VAR model regarding the interest rate responsiveness of total investment spending has been estimated at the optimal lag of 12 that makes all the residuals of the model white noise, i.e., zero mean, constant variances, and individually serially uncorrelated (Annex 1.1).²³ Estimated VDCs have been reported in Table 8 and IRFs in Figure 1 where each IRF has been reported with a two-standard-deviation confidence interval (i.e., 95 percent confidence interval) level. In this connection, it is important to mention that a response is considered to be significant if it does not contain the zero line within its confidence bands (i.e., ± 2 s. e.).

VDCs presented in Table 8 for each variable at forecast horizons of 1 quarter through 12 quarters, i.e., 3 years, give the share of fluctuations in a given variable that are caused by shocks in other concerned variables as well as itself. The columns give the percentage of forecast error variance due to each shock, with each row adding up to 100 percent. The results indicate that, *RGDP* shock accounts for about 15 percent of the fluctuations in *RAIN* after 3 years, with its own shock accounting for most of the rest. This suggests that real output innovation is a relatively weak determinant of fluctuations in real rate on advances. Besides, after 3 years, the shock in *RAIN* account for about 12 percent of the fluctuations in

²³ Although, AIC and *Likelihood Ratio* (LR) tests indicate 13 and 12 lags respectively as the optimal lag length, 12 lags have been considered in the estimation that makes the residuals of the VAR model white noise. Besides, recursive residuals suggest stability in the parameters of the equations in the model (Annex 1.5).

RTA, again with its own shock accounting for most of the rest. This indicates that real rate innovation is a relatively weak determinant of fluctuations in total advances in real terms i.e., total investment spending. Finally, the shock in *RAIN* accounts for 38.42 percent of the fluctuations in *RGDP* after 3 years, suggesting that innovation in real rates on advances is a moderately strong determinant of fluctuations in real output.

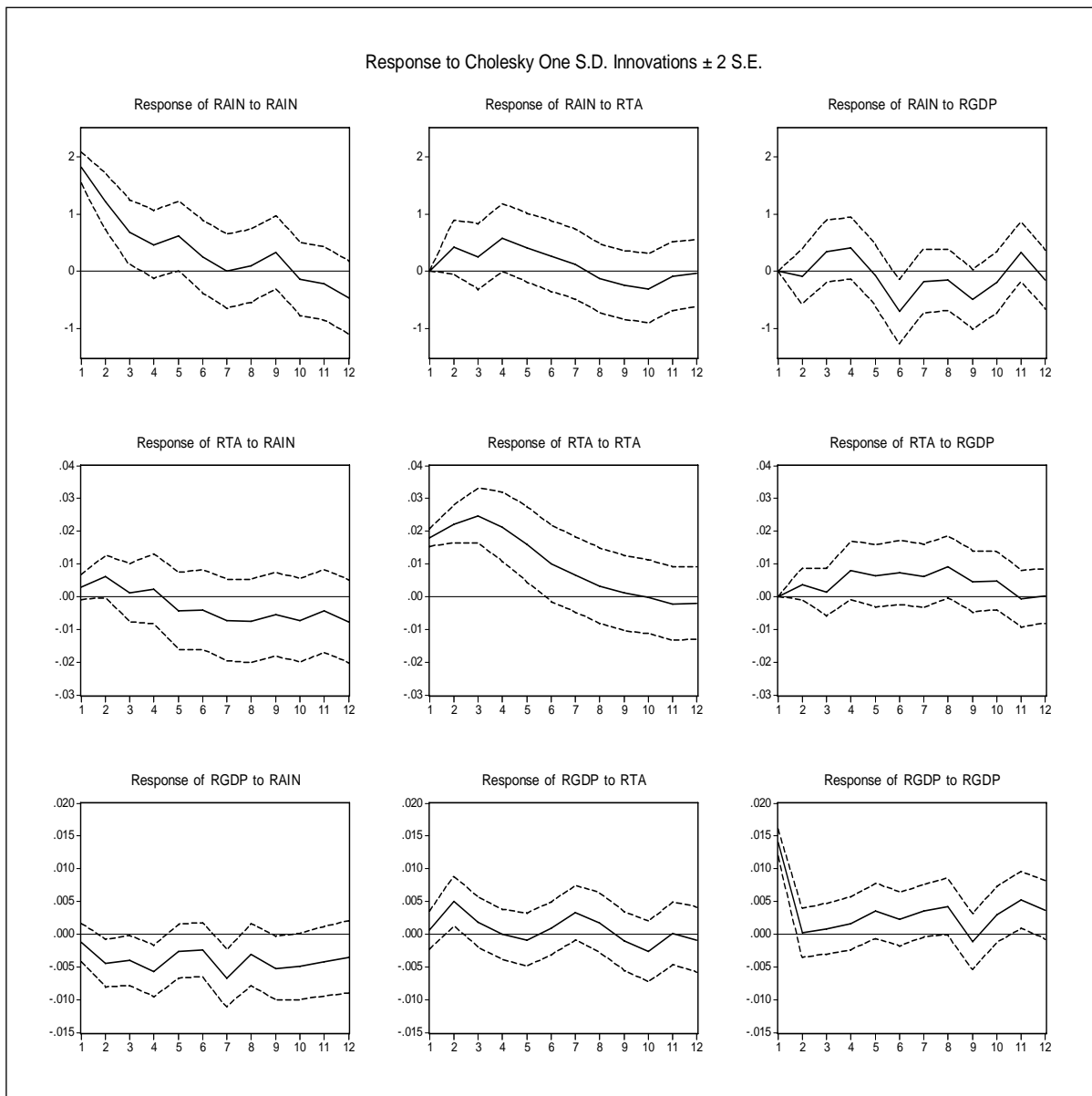
Table 8: Variance Decompositions-Total Investment Spending

Variance Decomposition of <i>RAIN</i>				
Quarter	S.E.	<i>RAIN</i>	<i>RTA</i>	<i>RGDP</i>
1	1.809	100.00	0.00	0.00
4	2.509	86.16	9.16	4.68
8	2.749	77.65	11.22	11.13
12	2.918	73.47	11.87	14.66
Variance Decomposition of <i>RTA</i>				
1	0.018	2.62	97.38	0.00
4	0.045	2.58	93.45	3.97
8	0.053	7.09	82.33	10.57
12	0.055	11.97	76.74	11.28
Variance Decomposition of <i>RGDP</i>				
1	0.014	0.86	0.19	98.94
4	0.017	23.32	9.74	66.95
8	0.021	31.98	10.27	57.74
12	0.024	38.42	9.29	52.29
Cholesky Ordering: <i>RAIN RTA RGDP</i>				

The estimated IRFs presented in Figure 1 show that the shock in *RTA* has a significant and positive impact on *RAIN* only in the 1st quarter and then dissipates indicating a very short-run positive influence on *RAIN* (top middle panel). It appears that real rates have risen in order to offset the excess demand in the credit market, a demand side phenomenon (from the borrowers' side) of interest rate responsiveness of investment spending at the aggregate level. Thus, real rate is responsive to total investment spending from borrowers' (i.e., potential investors, entrepreneurs, etc.) perspective in the very short-run. From the top right corner panel of Figure 1, it is observable that the shock in *RGDP* has a significant and negative impact on *RAIN* only in the 6th quarter indicating a supply side phenomenon of aggregate output in that quarter. It is also noticeable that the shock in the policy variable, *RAIN*, has no influence on *RTA* (middle left corner panel of Figure 1). That is, total investment spending is not responsive to real rates either from the lenders' (i.e., scheduled banks) or from the borrowers' perspective. Since the combined share of NCBs and SpBs in total credit (i.e., sum of advances and bills) is significant yet declining in recent years (Annex Table 1) where much of the credits have been as *directed credit* at a *concessional rate*, especially, in the public sector, total investment spending becomes non-responsive to real rates. Therefore, it can be concluded that investment spending at the aggregate level is not responsive to real interest rates in Bangladesh.²⁴

²⁴ The results regarding the interest rate responsiveness of investment spending at the aggregate level remain the same as those of alternative ordering of the relevant variables including some radical ones such as, completely reversing the order as well as a VAR model with all variables in nominal terms.

Figure 1: Impulse Response: Total Investment Spending



Typically from the borrower perspective, an inverse relationship between interest rates and investment spending is expected to exist in an economy. The BB in this regard has been pursuing market based interest rate policy under the FSRP of the 1990s. Nevertheless, the impact of interest rate liberalization on investment spending has not been reflected in the empirical analysis. The probable reasons could be: (i) the use of a quarterly data set of weighted average interest rates is not able to reflect the actual situation in the market; (ii) the channels of monetary transmission mechanism in the economy is still not strong enough to capture such dynamics; and (iii) a substantial amount of *directed credit* at a *concessional rate* mainly in the public sector as already explained above.²⁵

²⁵ Inclusion of lending rates of NCBs and SpBs in weighted average lending rates purges away actual situation of the lending rate structure at the aggregate level as well specific categories.

The middle right corner panel of Figure 1 points out that *RTA* is non-responsive to *RGDP* shock. From the bottom left corner panel of Figure 1, it is visible that the response of *RGDP* to *RAIN* shock is insignificant in the 1st quarter and then turns negative and significant for a short while (up to the 4th quarter) and then becomes insignificant. It again revives in the 7th quarter and then the 9th quarter which remains significant up to the 10th quarter. This supports the inverse relationship between interest rates and aggregate output in an economy from the aggregate demand side perspective. Finally, the bottom middle panel of Figure 1 reveals that the response of *RGDP* to *RTA* shock is initially insignificant and then turns positive and significant in the 2nd quarter, which again dissipates indicating a very short-run positive influence on *RGDP*. This confirms the traditional theory of investment that increases in investment spending raise aggregate output.

4.2.2 Private Sector Investment Spending

In order to analyze the interest rate responsiveness of *private sector investment* spending, the VAR model has been estimated at the optimal lag of 12 that makes all the residuals white noise (Annex 1.2).²⁶ Computed VDCs have been presented in Table 9 for each variable at forecast horizons of 1 quarter through 12 quarters i.e., 3 years. The results indicate that after 3 years, the shock in *RAIN* accounts for 15.28 percent of the fluctuations in *RPSA*, with its own shock accounting for most of the rest. Thus, real rate innovation is a relatively feeble determinant of fluctuations in private sector advances in real terms i.e., *private sector investment* spending.

Table 9: Variance Decompositions-Private Sector Investment Spending

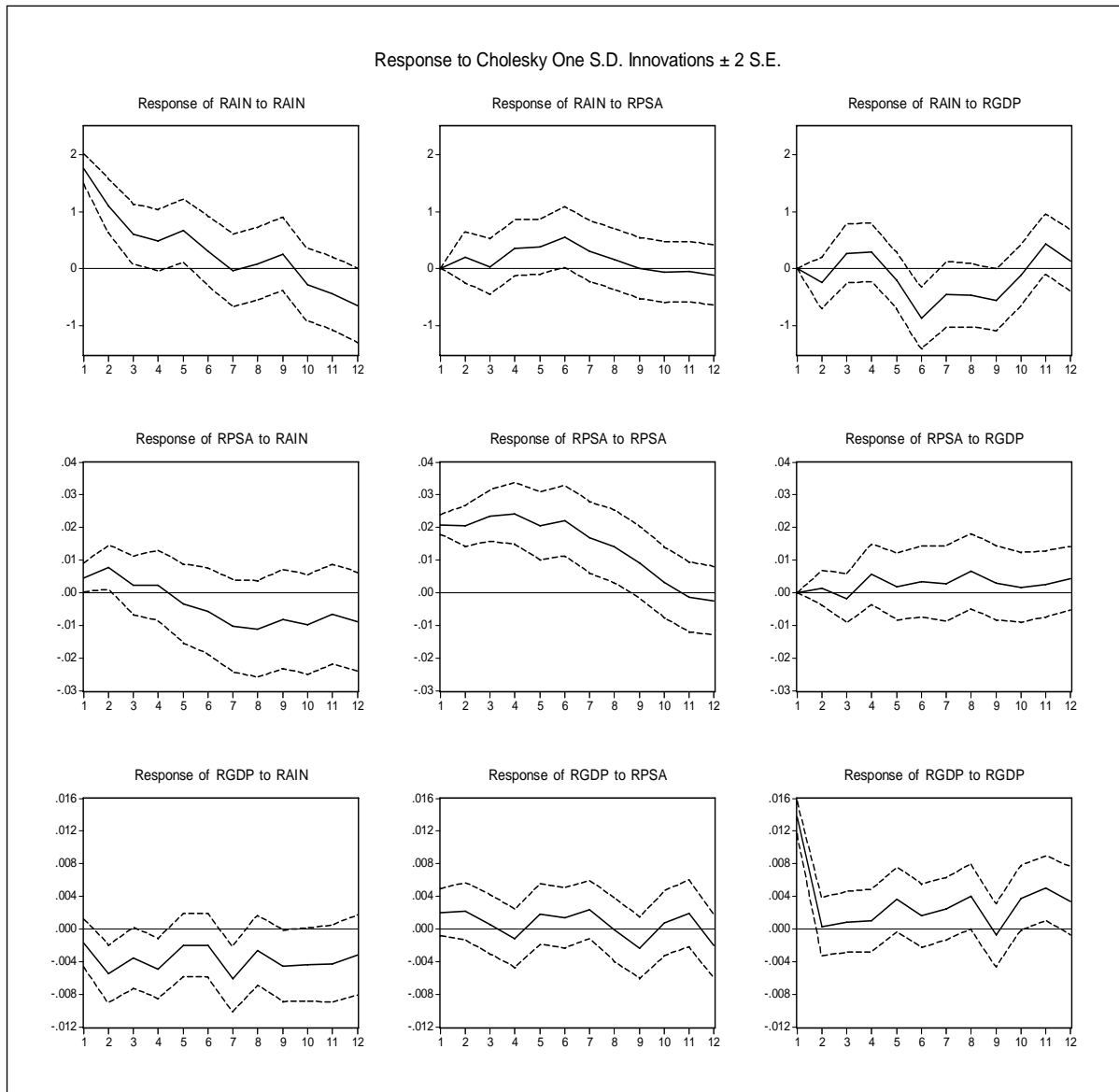
Variance Decomposition of <i>RAIN</i>				
Quarter	S.E.	<i>RAIN</i>	<i>RPSA</i>	<i>RGDP</i>
1	1.755	100.00	0.00	0.00
4	2.297	92.72	3.27	4.01
8	2.758	71.52	9.75	18.73
12	2.983	69.59	8.56	21.85
Variance Decomposition of <i>RPSA</i>				
1	0.021	4.78	95.22	0.00
4	0.046	4.31	93.96	1.72
8	0.062	9.45	87.92	2.63
12	0.065	15.28	81.49	3.23
Variance Decomposition of <i>RGDP</i>				
1	0.014	1.60	2.15	96.24
4	0.016	25.99	3.89	70.12
8	0.019	33.07	5.73	61.20
12	0.022	37.97	6.94	55.09
Cholesky Ordering: <i>RAIN RPSA RGDP</i>				

IRFs have been presented in Figure 2 where the top middle panel shows that the shock in *RPSA* has no real impact on *RAIN* up to the 5th quarter and then becomes positive and significant in the 6th quarter which again dissipates indicating a very short-run positive

²⁶ Although, AIC and *Likelihood Ratio* (LR) tests indicate 16 and 11 lags respectively as the optimal lag length, 12 lags have been considered in the estimation that makes the residuals of the VAR model almost white noise. In addition, recursive residuals suggest stability in the parameters of the equations in the model (Annex 1.6).

influence on *RAIN*. Primarily, it is a demand side phenomenon of interest rate responsiveness of *private sector investment* spending. That is, in the face of increased demand for *private sector investment*, real rates have risen in order to neutralize the excess demand in the credit market. Besides, financial institutions, mainly NCBs and SpBs, have been following a conservative approach to disburse loans in the private sector since 1990s as a result of high NPL ratios. However, in recent years this ratio is declining reflecting an improved regulatory framework and supervision system of the BB.

Figure 2: Impulse Response: Private Sector Investment Spending



From the top right corner panel of Figure 2, it is again observable that the shock in *RGDP* has a significant and negative impact on *RAIN* only in the 6th quarter. It is also noticeable that the shock in *RAIN* has a positive and significant influence on the *RPSA* up to the 2nd quarter and then dissipates in the rest of the periods (middle left corner panel of Figure 2). This suggests a short-run positive impact of *RAIN* on *RPSA*. It seems that the supply side phenomenon (i.e., from lenders' side) of interest rate responsiveness of *private sector investment* spending

exists in the country. That is, increase in real rates generate responses by scheduled banks, especially PCBs (including IBs) of the country to disburse more advances for *private sector investment* spending in order to earn more interest income.²⁷ Therefore, it can be concluded that *private sector investment* in Bangladesh is moderately responsive to real interest rates in the short-run from the lenders' perspective.²⁸ Similar to investment spending at the aggregate level, the impact of interest rate liberalization pursued by the BB has not been reflected in the empirical analysis (from the borrowers' perspective) due to reasons already mentioned in the preceding section.

Further, the response of *RPSA* to shocks in *RGDP* is insignificant (middle right corner panel of Figure 2). It is quite an unusual phenomenon that *RPSA*, i.e., *private sector investment* spending is non-responsive to *RGDP*. Since the private sector has been growing faster due to the privatization policy adopted by the government of Bangladesh (GOB) from the late 1980s, a positive and significant relationship between *private sector investment* and *RGDP* is expected to exist. Therefore, it again indirectly confirms the existence of a weak transmission mechanism in the real economy through the bank lending channel.²⁹

The response of *RGDP* to *RAIN* shock is insignificant in the 1st quarter and then turns negative and significant in the 2nd quarter and then becomes insignificant (bottom left corner panel of Figure 2). It again revives in the 4th quarter and then the 7th and 9th quarters, therefore, confirming an inverse relationship between interest rates and aggregate output in the economy from the aggregate demand side perspective. It also matches the overall policies (i.e., fiscal and monetary) adopted to achieve higher economic growth through accelerated investment spending. Lastly, the bottom middle panel of Figure 2 reveals that the response of *RGDP* to *RPSA* shock is insignificant.

4.2.3 Residential Investment Spending

The interest rate responsiveness of *residential investment* spending in Bangladesh has been investigated in the VAR approach with an optimal lag of 12 that makes all the residuals white noise (Annex 1.3).³⁰ Estimated VDCs have been presented in Table 10 where the results indicate that, after 3 years, the shock in *RGDP* accounts for about 20 percent of the fluctuations in *RHIN*, with its own shock accounting for most of the rest. This suggests that real output innovation is a relatively weak determinant of fluctuations in real rate on housing

²⁷ Recently, PCBs (including IBs) as a group has the highest share in credit in terms of volume which is close to 50 percent (Annex Table 1). Moreover, their lending and deposit rates are comparatively higher than those of NCBs and SpBs as well as the weighted average lending and deposit rates of the whole banking system (Annex Table 2).

²⁸ The results regarding the interest rate responsiveness of *private sector investment* spending remain the same regardless the ordering of the relevant variables as well as a VAR model with all variables in nominal terms.

²⁹ The bank lending channel of monetary transmission is based on the view that banks play a special role in the financial system. Because of the banks' special role, certain borrowers will not have access to the credit markets unless they borrow from the banks. Therefore, as long as there is no perfect substitution between retail bank deposits and other sources of funds, the bank lending channel operates as follows. For instance, a contractionary monetary policy reduces bank reserves as well as bank deposits, which in turn decreases the quality of bank loans available to the consumers and producers in the economy. This decrease in loans will further cause investment (and possible consumer) spending and subsequent aggregate output to fall (Mishkin, 1996). Schematically, the monetary policy effect is:

$$M \downarrow \Rightarrow \text{Deposits} \downarrow \Rightarrow \text{Loans} \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$$

³⁰ Although, AIC and LR tests indicate 6 and 11 lags respectively as the optimal lag length, 12 lags have been considered in the estimation of VARs that make the residuals almost white noise. Moreover, recursive residuals suggest stability in the parameters of the equations in the model (Annex 1.7).

advances. Besides, *RHIN* shock accounts for only 2.09 percent of the fluctuations in *RHA* after 3 years, indicating that innovation in real rates on housing advances is a very weak determinant of fluctuations in advances on housing in real terms i.e., *residential investment* spending. Lastly, the shock in *RHIN* accounts for around 18 percent of the fluctuations in *RGDP* after 3 years, again with its own shock accounting for most of the rest. This suggests that innovation in real rates on housing advances is a comparatively weak determinant of fluctuations in real output.

Table 10: Variance Decompositions-Residential Investment Spending

Variance Decomposition of <i>RHIN</i>				
Quarter	S.E.	<i>RHIN</i>	<i>RHA</i>	<i>RGDP</i>
1	1.527	100.00	0.00	0.00
4	2.171	83.76	10.44	5.81
8	2.581	66.52	19.38	14.09
12	2.767	63.12	17.31	19.57
Variance Decomposition of <i>RHA</i>				
1	0.067	0.50	99.49	0.00
4	0.109	1.62	85.78	12.59
8	0.137	1.89	84.45	13.66
12	0.149	2.09	85.67	12.25
Variance Decomposition of <i>RGDP</i>				
1	0.016	0.00	0.64	99.35
4	0.019	11.28	5.28	83.44
8	0.022	15.79	9.32	74.88
12	0.025	17.51	12.33	70.16
Cholesky Ordering: <i>RHIN RHA RGDP</i>				

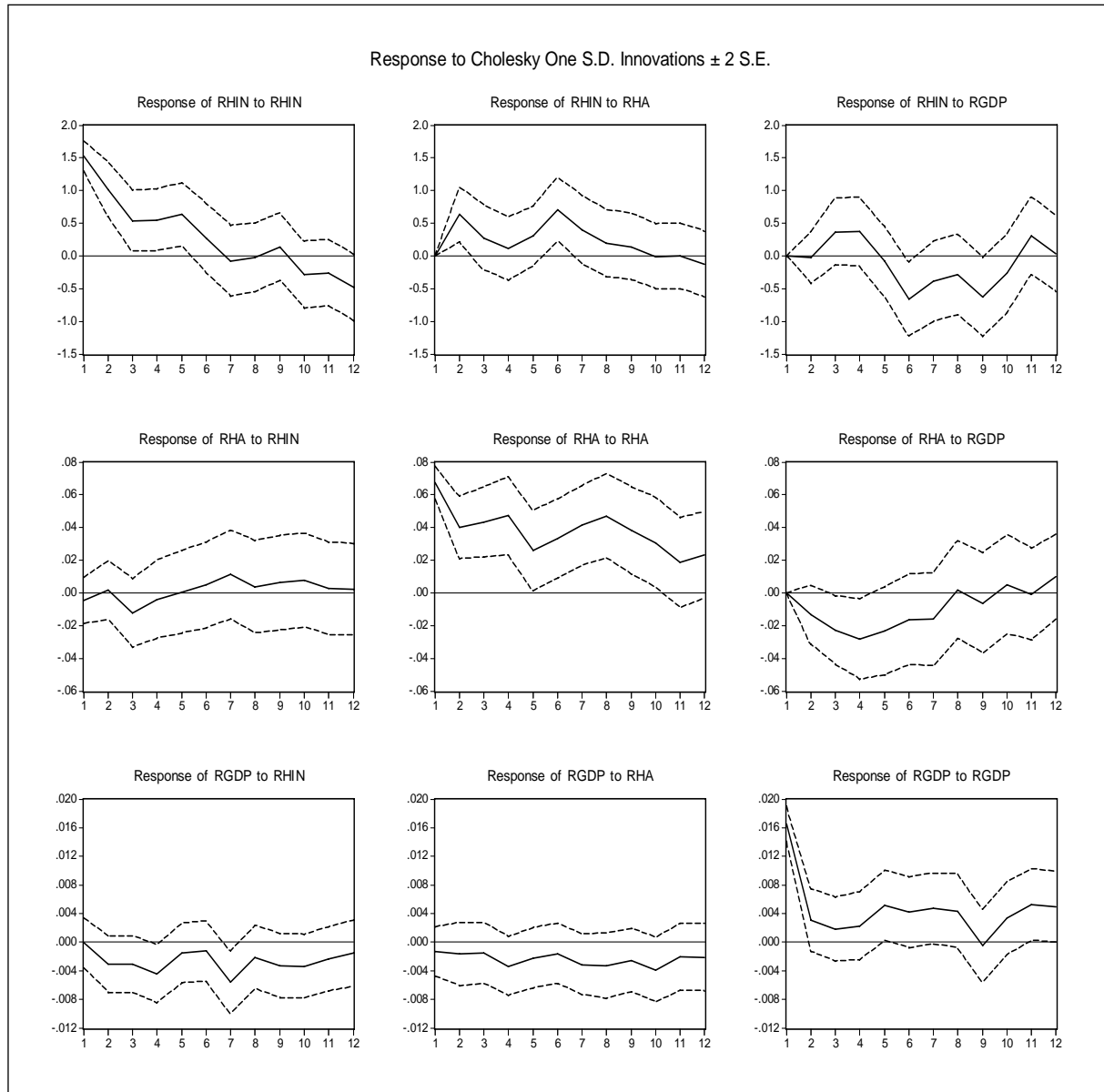
The computed IRFs have been presented in Figure 3. The top middle panel reveals that the shock in *RHA* has a significant and positive impact on *RHIN* up to the 2nd quarter and then becomes insignificant, which again revives in the 6th quarter indicating a short-run positive impact on *RHIN*. Alike *private sector investment* spending, this suggests the existence of a demand side phenomenon (i.e., from the borrowers' side) of interest rate responsiveness of *residential investment* spending. In other words, real rates on housing advances have risen in order to offset the excess demand for *residential investment*. Thus, it can be concluded that real rates on housing advances is somewhat responsive to *residential investment* spending in Bangladesh in the short-run from the borrowers' point of view. The top right corner panel of Figure 3 is similar to the interest rate responsiveness of *private sector investment* spending which has already been discussed in the previous section. In particular, *RGDP* shock has a negative and significant impact on *RHIN* only in the 6th quarter and then becomes insignificant.

The shock in *RHIN* has no real impact on *RHA* (middle left corner panel of Figure 3). Thus, it can be concluded that *residential investment* spending in Bangladesh is responsive to real rates on housing advances in the short-run neither from the borrower nor from the lender point of view.³¹ This may be due to the exclusion of data for NBFIs as well as housing

³¹ The results regarding the interest rate responsiveness of *residential investment* spending remain the same regardless the ordering of the concerned variables as well as a VAR model with all variables in nominal terms.

financed by MFIs, mostly in rural areas, in the empirical analysis.³² Moreover, self-financed (e.g., remittances, savings, etc.) housing both in rural and urban areas could be a probable reason. Again, the impact of BB's interest rate liberalization has not been reflected in the empirical analysis (from the borrowers' perspective) for this particular category of investment spending.

Figure 3: Impulse Response: Residential Investment Spending



The middle right corner panel of Figure 3 points that the response of *RHA* to *RGDP* shock becomes negative and significant between the 3rd and 4th quarter and then dissipates indicating a short-run negative impact on *RHA*. This contradicts that increases in aggregate output increases *residential investment* spending in the country, quite an unusual phenomenon. Although, the housing sector in the country is growing faster over the years, the

³² For example, in 2004, Grammen Bank disbursed BDT 1.14 billion (outstanding amounts at the end of December) for housing purposes (CDF, 2004, p. 225).

empirical analysis has not been able to capture this development probably due to reasons already explained above. The response of *RGDP* to *RHIN* shock is insignificant up to the 3rd quarter and then turns negative and significant in the 4th quarter which again becomes insignificant (bottom left corner panel of Figure 3). It again turns significant in the 7th quarter. Thus, an inverse relationship between real rates on housing advances and aggregate output exists in the economy from the aggregate demand side perspective. Finally, the bottom middle panel of Figure 3 reveals that the response of *RGDP* to *RHA* shock is not significant at all.

4.2.4 Business Fixed Investment Spending

To assess the interest rate responsiveness of *business fixed investment* spending, an optimal lag of 9 has been considered in the VARs approach that makes all the residuals white noise (Annex 1.4).³³ Computed VDCs have been presented in Table 11 for each variable at forecast horizons of 1 through 12 quarters. The results indicate that, after 3 years, *RGDP* shock accounts for about 17 percent of the fluctuations in *RINDIN*, with its own shock accounting for most of the rest. This suggests that real output innovation is a relatively weak determinant of fluctuations in real rate on industrial advances.

Besides, the shock in *RINDIN* accounts for only 3-percent of the fluctuations in *RINA* after 3 years, indicating that innovation in real rate on industrial advances is a very weak determinant of fluctuations in industrial advances in real terms, i.e., *business fixed investment* spending. The shock in *RINDIN* accounts for about 18 percent of the fluctuations in *RGDP* after 3, again with its own shock accounting for most of the rest. This in turn, suggests that innovation in real rates on industrial advances is a relatively weak determinant of fluctuations in real output.

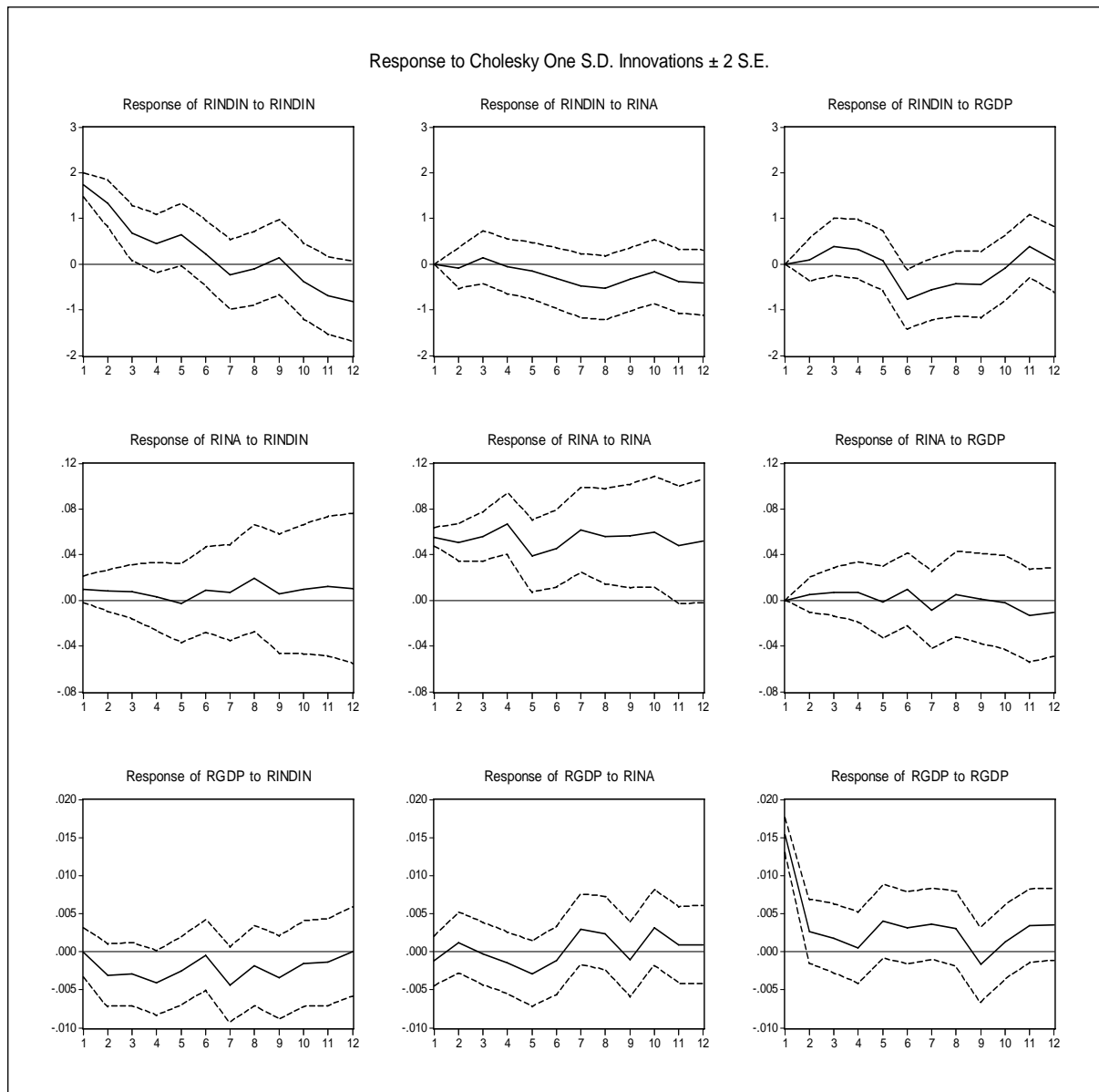
Table 11: Variance Decompositions-Business Fixed Investment Spending

Variance Decomposition of <i>RINDIN</i>				
Quarter	S.E.	<i>RINDIN</i>	<i>RINA</i>	<i>RGDP</i>
1	1.745	100.00	0.00	0.00
4	2.401	95.04	0.55	4.41
8	2.832	74.99	8.25	16.76
12	3.188	72.11	11.02	16.87
Variance Decomposition of <i>RINA</i>				
1	0.056	2.88	97.12	0.00
4	0.117	1.64	97.41	0.95
8	0.157	2.95	95.74	1.30
12	0.193	2.99	95.34	1.66
Variance Decomposition of <i>RGDP</i>				
1	0.015	0.00	0.61	99.39
4	0.017	12.41	1.78	85.80
8	0.019	16.63	7.53	75.84
12	0.021	18.10	9.43	72.47
Cholesky Ordering: <i>RINDIN RINA RGDP</i>				

³³ AIC and LR tests have been used to determine the optimal lag length of 13 that makes the residuals of the VAR model white noise. Besides, recursive residuals suggest stability in the parameters of the equations in the model (Annex 1.8).

IRFs presented in Figure 4 reveals that the shock in *RINA* has no real impact on *RINDIN* (top middle panel). This indicates that the real rate is non-responsive to *business fixed investment* spending either from the lenders' or borrowers' perspective. The shock in *RGDP* has no impact on *RINDIN* except in the 6th quarter, indicating a very short-run negative impact on *RINDIN* which is basically an aggregate supply side phenomenon in the economy (top right corner panel of Figure 4). Moreover, shock in the policy variable i.e., *RINDIN* has no influence at all on *RINA* (middle left corner panel of Figure 4). This is perhaps due to: (i) mounting amount of *directed credits at concessional rates*, particularly, by NCBs and SpBs; (ii) unequal access of potential borrowers to the credit market; (iii) exhaustion of available bank credit by many firms; and (iv) exclusion of data for NBFIs as well as data related to small and medium enterprises (SMEs) financed by MFIs in the country. Hence, it can be concluded that *business fixed investment* spending in Bangladesh is responsive to real rates in the short-run neither from the lenders' nor from the borrowers' perspective.³⁴

Figure 4: Impulse Response: Business Fixed Investment Spending



³⁴ The results of interest rate responsiveness of *business fixed investment* spending remain the same regardless

This supports the findings of the WB & BEI that firms in Bangladesh collect most (i.e., more than 50 percent) of their working capital and investment capital from their retained earnings (Table 6). Thus, in this category of investment spending, the impact of BB's interest rate liberalization has not been reflected in the empirical analysis (from the borrowers' perspective). The middle right corner panel of Figure 3 points that the response of *RINA* to *RGDP* shock remains insignificant for the whole sample period. The response of *RGDP* to *RINDIN* shock is insignificant (bottom left corner panel of Figure 4). Finally, the bottom middle panel of Figure 4 again reveals that the response of *RGDP* to *RINA* shock is not significant at all.

5. Conclusion

In view of changes in interest rate policy regimes as well as policy debate on interest rates in Bangladesh, the paper is an attempt to empirically investigate the interest rate responsiveness of investment spending at the aggregate level as well as disaggregate level, particularly, *private sector*, *residential*, and *business fixed investment*. An assessment of the empirical evidence has been performed through a sophisticated macro-econometric framework, namely, the unrestricted VARs approach using a quarterly data set of the relevant time series variables. Major findings about the interest rate responsiveness of investment spending in Bangladesh are summarized as follows:

- Real interest rates on advances respond positively to total advances in real terms only in the 1st quarter and then disappear. It suggests a demand side phenomenon of interest rate responsiveness of investment spending at the aggregate level in the very short-run. Conversely, total advance in real terms is not responsive to real interest rates in the country. This observation is more or less consistent with the empirical evidence of Islam and Begum (2005), that is, investment spending is weakly sensitive to lending rates in Bangladesh.
- Real rate on advances reacts positively to private sector advances in real terms only in the 6th quarter, which dissipates afterwards. It indicates a demand side phenomenon of the interest rate responsiveness of *private sector investment* spending. On the other hand, private sector advances in real terms respond positively to the respective real rates up to the 2nd quarter and then dissipates in the rest of the periods, indicating a supply side phenomenon of interest rate responsiveness. That is, *private sector investment* spending in Bangladesh is only moderately responsive to real rates in the short-run from the lenders' perspective.
- Real rates on housing advances respond positively to housing advances in real terms for a short period i.e., up to the 2nd quarter, suggesting the existence of a demand side phenomenon of interest rate responsiveness of *residential investment* spending. On the contrary, housing advances in real terms is non-responsive to real rates on housing advances. In other words, *residential investment* spending in the country is not responsive to real rates on housing advances.
- Real rate on industrial advances is non-responsive to industrial advances in real terms either from the lenders' or borrowers' perspective. Similarly, industrial advances in real terms are also non-responsive to real rate on industrial advances. Hence, *business*

the ordering of the relevant variables as well as a VAR model with all variables in nominal terms.

fixed investment spending in Bangladesh is responsive to the respective real rates neither from the lenders' nor from the borrowers' perspective.

The results of the empirical analysis suggest that although the GOB along with the BB adopted the FSRP in the 1990s, particularly, interest rate liberalization, investment spending at the aggregate level is non-responsive to interest rates. Moreover, investment spending at the disaggregate level is still not responsive to interest rates except for *private sector investment* category which is only moderately responsive from the lenders' perspective in the short-run.

Several reasons could be responsible for the findings obtained in the paper. Firstly, the use of proxies like advances in the respective categories in the empirical analysis due to the unavailability of quarterly data set on total investment as well as specific categories. Secondly, the coverage of the data period in the empirical analysis. Although the data set includes observations during the period between October-December 1979 to April-June 2005, most of the reforms were fully in effect only from the late 1990s. Therefore, the channels of monetary transmission mechanism are still not strong enough to capture the actual scenario regarding interest rate responsiveness of investment spending in the paper. Thirdly, the inclusion of suppressed lending rates of NCBs and SpBs compared to PCBs (including IBs) and FCBs in the weighted average lending rates purges away the actual situation of the lending rate structure in the banking system. Moreover, although declining in recent years, the existence and continuation of *directed credits* at *concessional rates* in NCBs and SpBs are causing investors to become non-responsive to interest rates. Fourthly, interest rate responsiveness under the monetary transmission mechanism is perhaps weak due to the absence of a bond market and the existence of a narrow based capital market in the financial system of Bangladesh. Fifthly, according to the survey report by the WB & BEI, firms in the country are mostly (i.e., more than 50 percent) financed by retained earnings; therefore, interest rate responsiveness to investment spending is likely to become non-existent or insignificant. Finally, apart from access to and a constraint on adequate supply of resources i.e., credits, the cost of operating a business is considerably higher due to several non economic factors (e.g., weak governance and infrastructure as cited above) other than interest rate cost, thereby, discouraging investment in the country (GOB, 2005).

The empirical findings of the paper suggest that the recent policy debate on higher lending rates due to tight monetary policy is futile. However, the BB has broader objectives (i.e., price and macroeconomic stability) in conducting both tight and easy monetary policies through both direct and indirect instruments (e.g. bank rate, statutory liquidity ratio (SLR), cash reserve requirement (CRR), repo and reverse repo, etc.). For instance, to contain inflationary pressures and stabilize exchange rates in the country, the BB has been pursuing tight monetary policy since the early 2005.

Some caveats are in order. For example, in the context of Bangladesh, the empirical results provided in the paper do not address the following important issues:

1. It does not estimate the interest rate responsiveness of investment spending at the aggregate as well as disaggregate level for the pre and post-interest liberalization periods separately.
2. Whether the policies regarding fiscal (mainly taxes) incentives have an impact on investment decision of firms.

Future research should extend in the above directions in order to derive firm policy relevant conclusions.

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Annex Table 1: Scheduled Banks Credit (BDT in billions)

Year	NCBs		SpBs		FCBs		PCBs (including IBs)		IBs		All Banks
	Advance	Bills	Advance	Bills	Advance	Bills	Advance	Bills	Advance	Bills	
1999	278.66	8.22	97.37	0.54	30.27	2.85	157.69	8.76	32.85	2.28	584.35
2000	297.95	14.00	102.06	0.69	35.03	1.70	196.68	12.50	42.97	1.76	660.61
2001	327.73	13.65	108.28	0.77	37.77	3.36	253.72	14.79	56.24	1.54	760.05
2002	355.86	20.85	109.22	0.74	50.92	2.10	314.31	15.18	73.19	2.45	869.17
2003	361.68	22.94	99.63	0.54	61.64	2.20	372.42	20.27	92.04	4.19	941.31
2004	381.09	23.61	107.95	1.40	69.05	2.44	466.27	26.17	137.32	7.71	1077.99
2005	423.86	69.81	110.41	1.14	78.80	4.36	589.41	42.61	171.41	8.37	1500.17

Note: All figures are outstanding amounts at the period end.

Source: Banking Statistics Division, Statistics Department, BB, Head Office, Dhaka

Annex Table 2: Lending and Deposit Rates (weighted average in percent)

Quarter	Lending Rate					Deposit Rate				
	All Banks	NCBs	SpBs	PCBs	FCBs	All Banks	NCBs	SpBs	PCBs	FCBs
June '03	12.78	11.93	12.80	13.81	12.10	6.30	5.79	6.75	7.18	4.49
September '03	12.59	11.80	12.10	13.61	12.14	6.36	5.90	6.41	7.16	4.71
December '03	12.36	11.59	10.90	13.54	12.10	6.25	5.82	6.22	6.99	4.78
March '04	11.32	9.96	10.40	12.82	11.52	5.92	5.17	6.15	6.93	4.58
June '04	11.01	9.76	9.37	12.51	11.64	5.65	4.88	5.73	6.66	4.42
September '04	10.90	9.72	9.23	12.24	11.62	5.68	5.02	5.57	6.57	4.26
December '04	10.83	9.76	9.19	11.99	11.46	5.56	4.88	5.49	6.47	4.00
March '05	10.74	9.74	9.16	11.78	11.45	5.58	4.94	5.49	6.48	3.62
June '05	10.93	9.77	12.10	11.68	9.03	5.62	4.63	6.83	3.75	5.45
September '05	11.14	9.89	9.05	12.33	12.11	5.90	4.81	5.49	7.23	3.77
December '05	11.25	10.01	9.07	12.48	11.83	5.90	4.59	5.41	7.40	3.96

Source: Banking Statistics Division, Statistics Department, BB, Head Office, Dhaka.

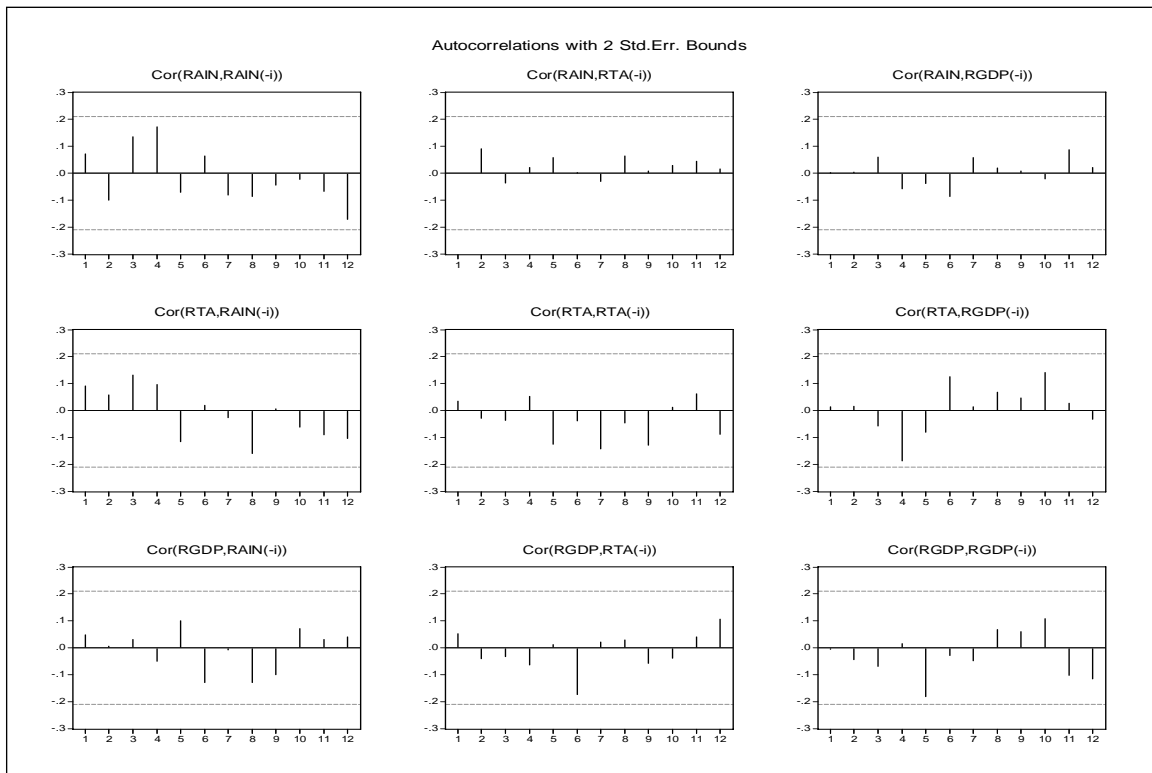
Annex Table 3: Scheduled Banks Outstanding Advances (BDT in billions) and Nominal Interest Rates on Advances (weighted average in percent)

Year	Private Sector Advance	Total Advance (Public +Private)	Interest Rate on Advance	Housing Advance	Interest Rate on Housing Advance	Industrial Advance	Interest Rate on Industrial Advance
1980	15.67	30.50	13.16	0.40	16.00	12.52	14.00
1985	76.68	101.49	14.58	1.47	16.00	22.99	14.50
1990	170.98	210.46	14.91	5.23	13.50	55.82	14.50
1995	309.75	348.69	12.50	12.54	12.12	98.39	13.50
2000	581.01	631.72	13.75	26.19	12.88	167.33	13.98
2001	676.07	727.49	13.42	27.83	12.71	180.40	13.57
2002	765.17	830.31	13.09	40.95	11.78	170.13	12.86
2003	841.07	895.37	12.36	43.24	10.88	174.72	11.83
2004	986.27	1024.37	10.83	48.12	9.67	190.48	10.61
2005	1048.46	1117.32	10.93	50.31	9.84	199.52	10.61

- Notes: 1. Figures for advances in 2005 are at the end of June (outstanding amounts).
2. Weighted average interest rates on different types of advances are as of each year's October-December quarter's end nominal rates.
3. Industrial advance excludes advance on working capital financing.
4. Interest rates on housing and Industrial advances in 1995 are the average of 4 NCBs and before that were the mid points of the range determined by the BB.
5. Interest rates on housing advance have been taken from the rates on construction advance.

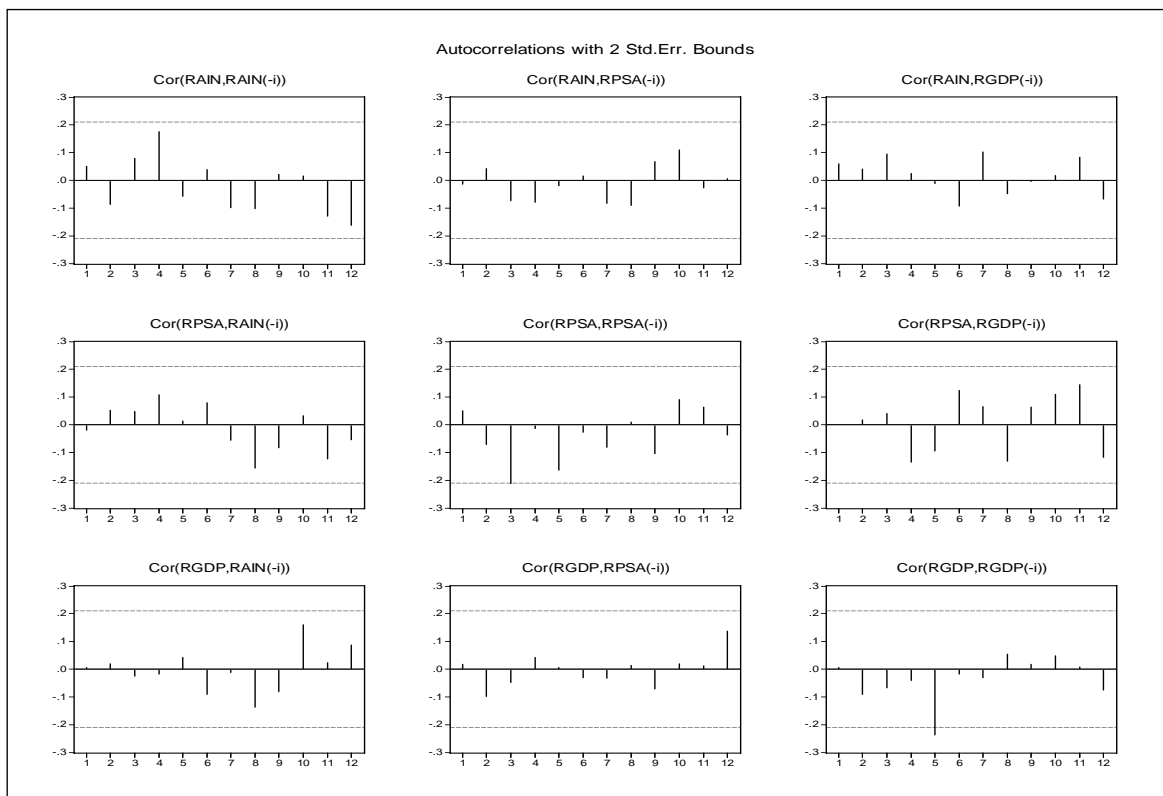
Source: Banking Statistics Division, Statistics Department, BB, Head Office, Dhaka.

Annex 1.1: Correlogram of Residuals (Total Investment Spending)



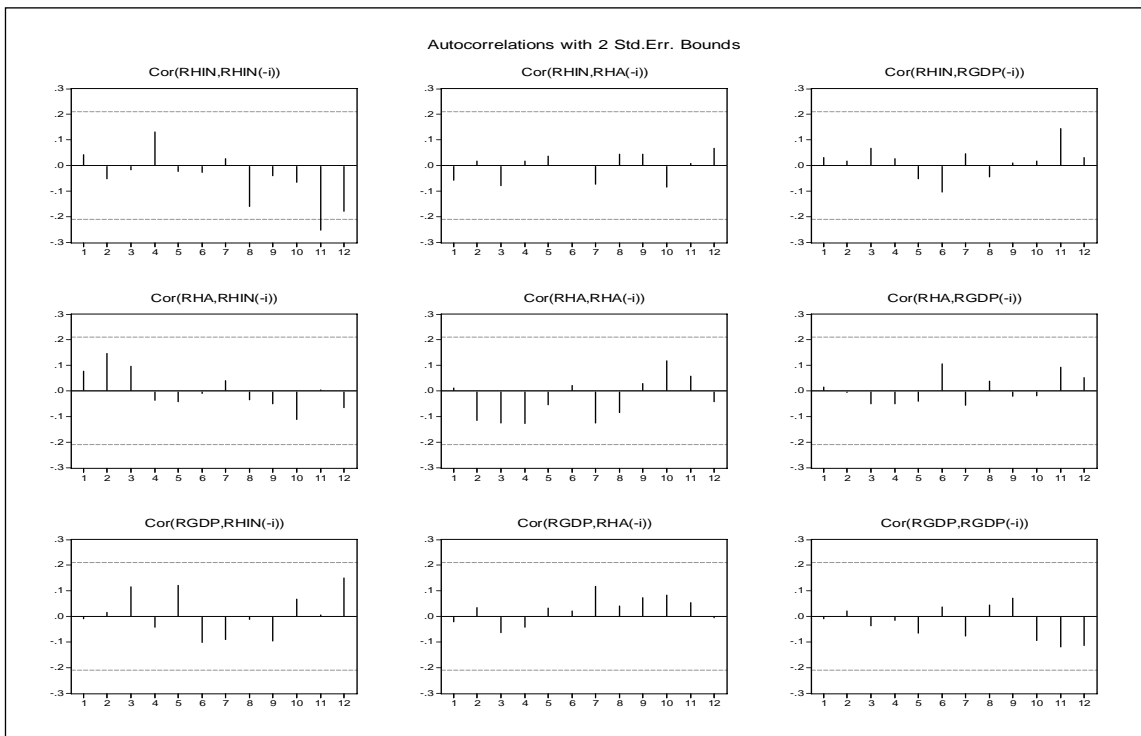
Note: Optimal lag length 12 has been used to make the residuals white noise.

Annex 1.2: Correlogram of Residuals (Private Sector Investment Spending)



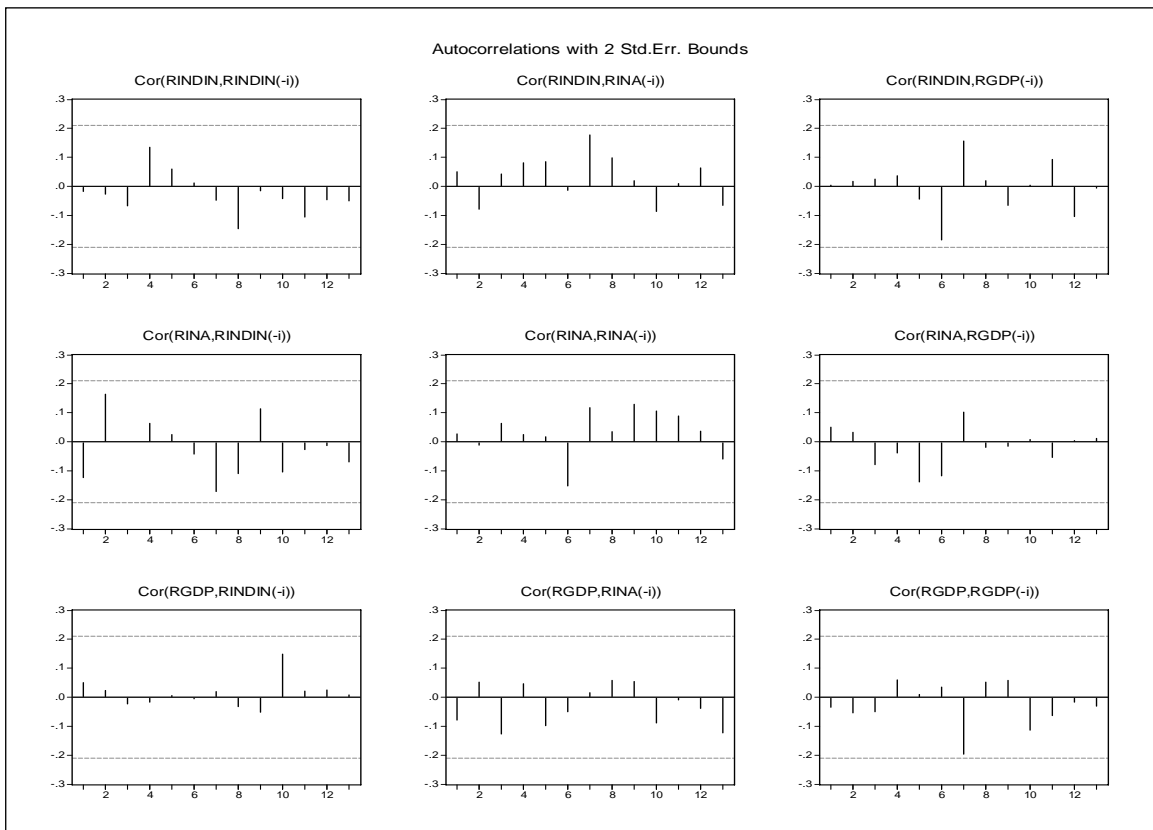
Note: Optimal lag length 12 has been used to make the residuals almost white noise.

Annex 1.3: Correlogram of Residuals (Residential Investment Spending)



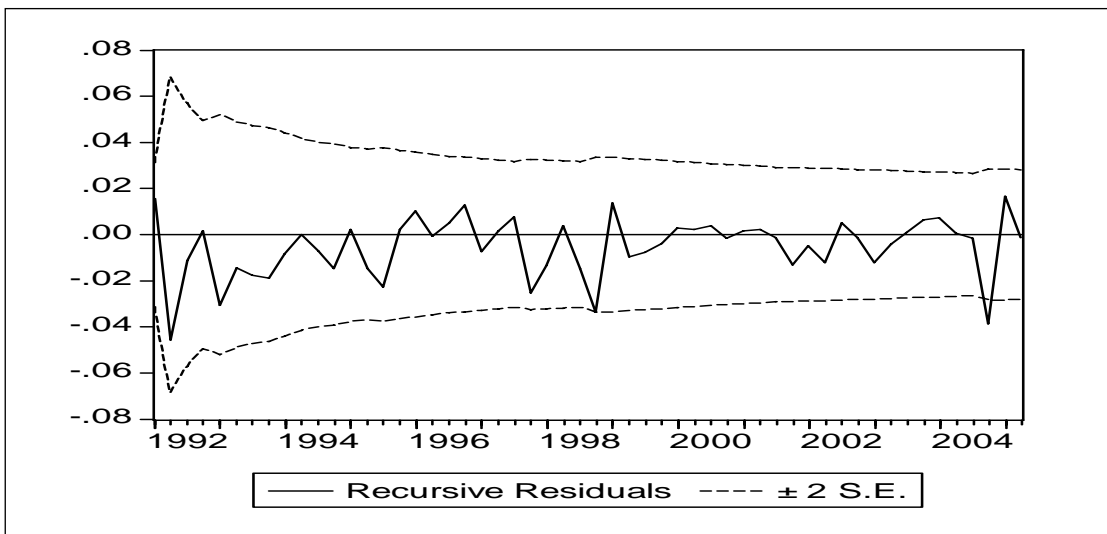
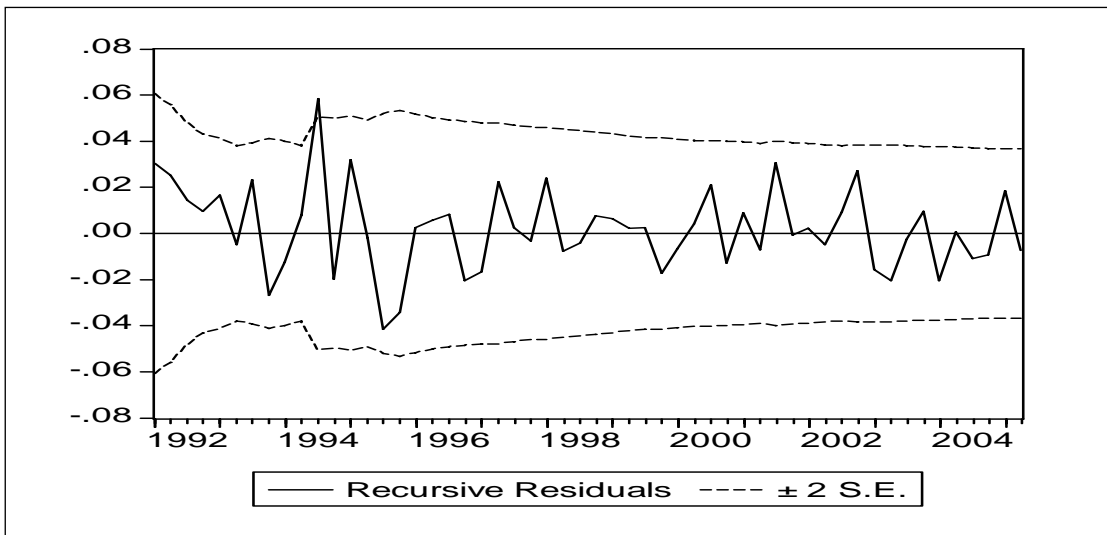
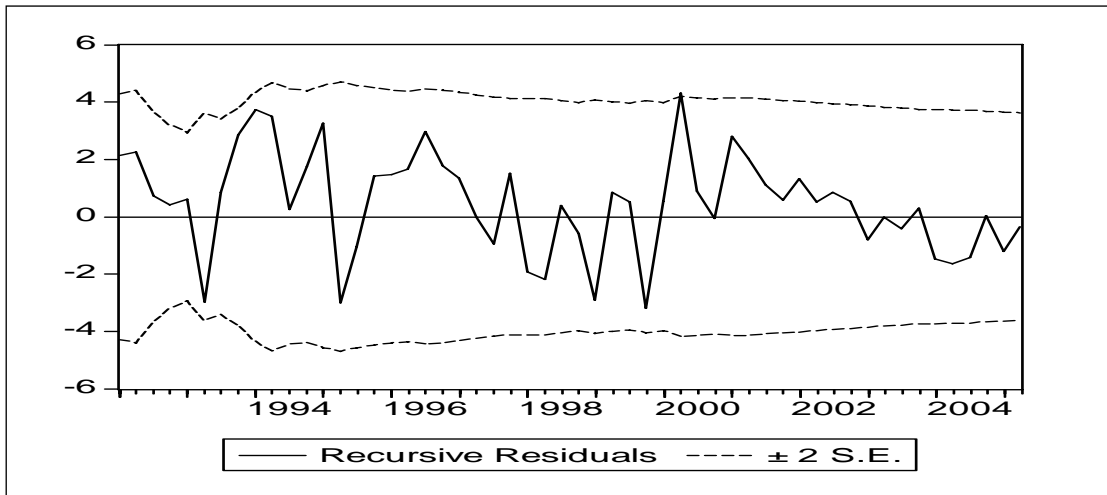
Note: Optimal lag length 12 has been used to make the residuals almost white noise.

Annex 1.4: Correlogram of Residuals (Business Fixed Investment Spending)



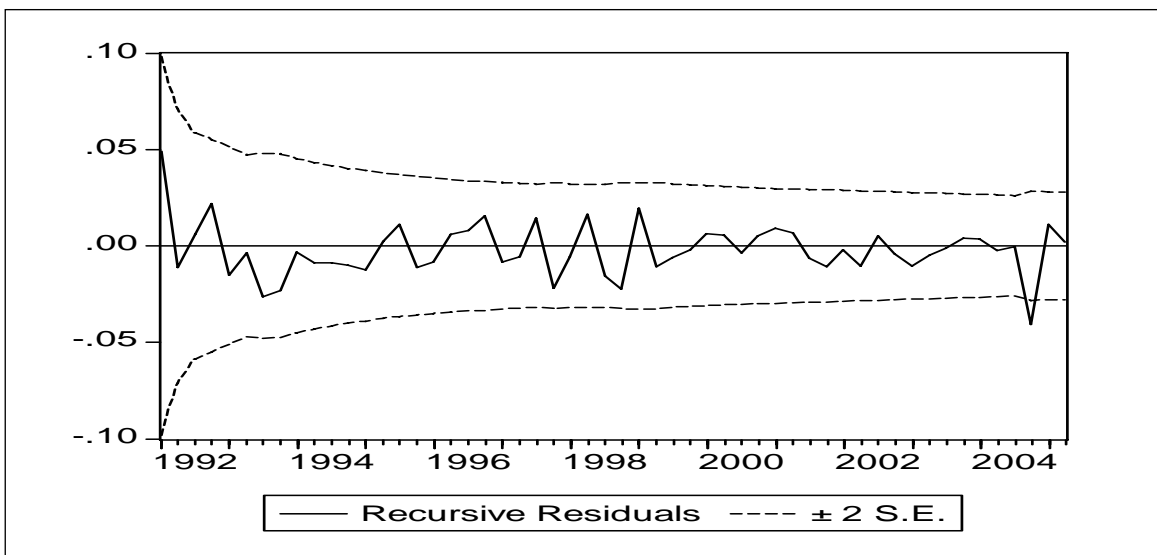
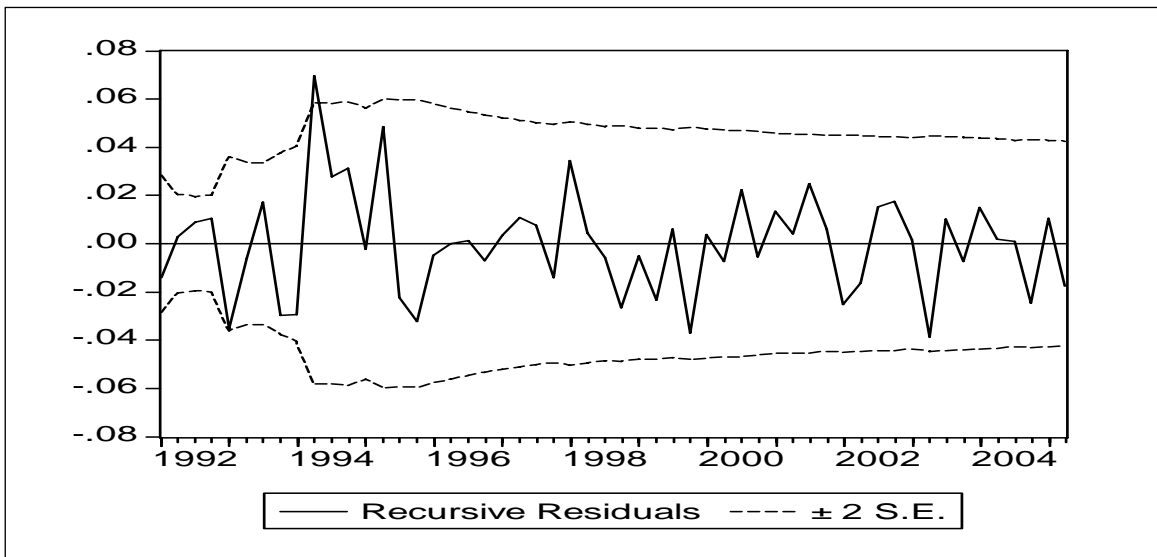
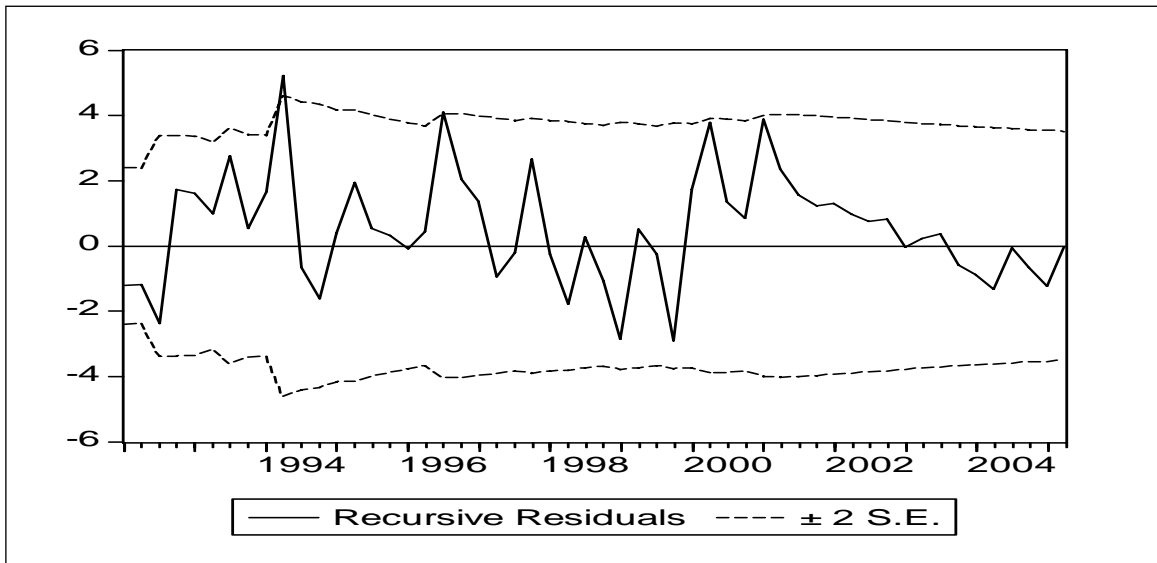
Note: Optimal lag length 13 has been used to make the residuals white noise.

Annex 1.5: Stability Test-Recursive Residuals (Total Investment Spending)

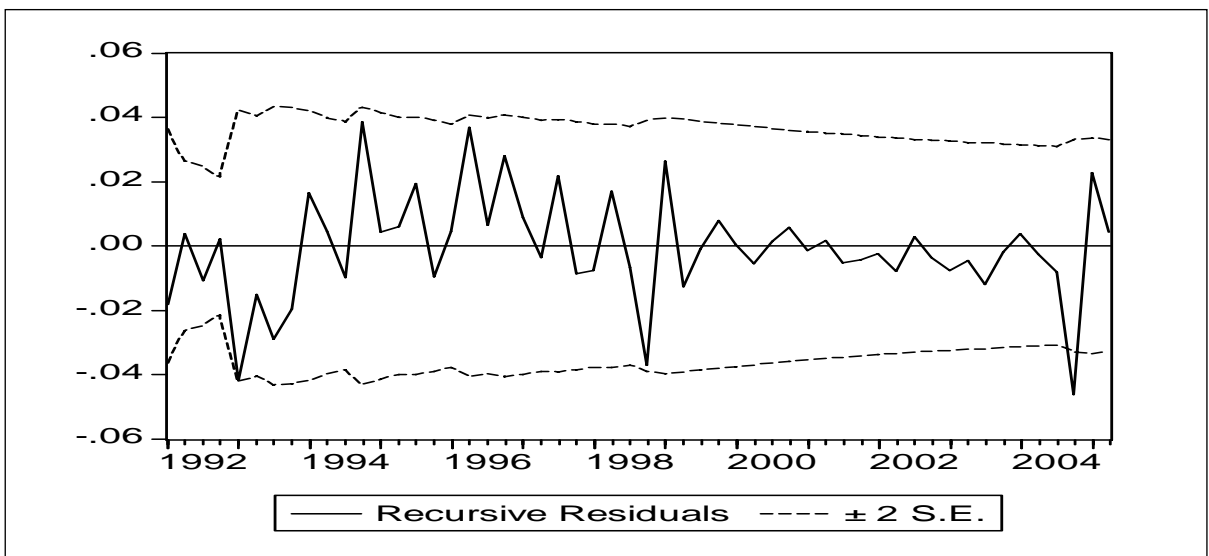
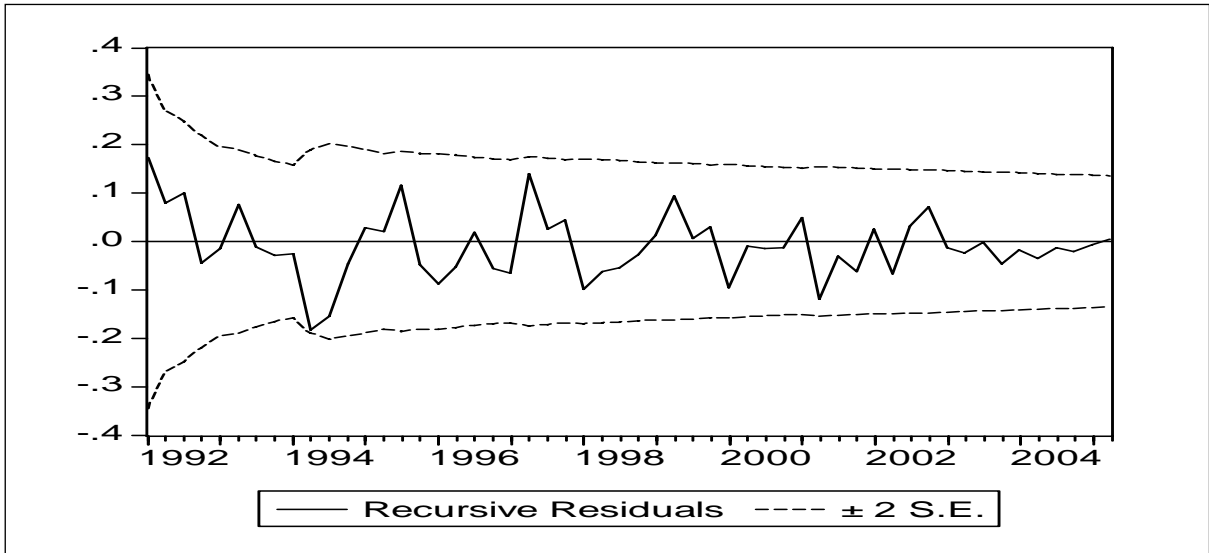
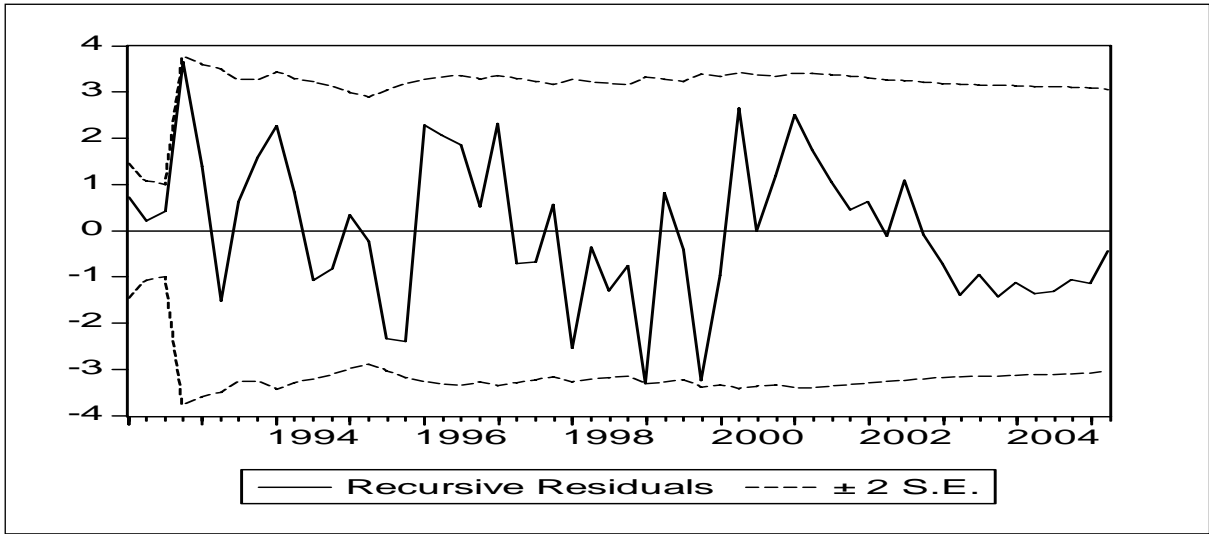


Note: Residuals outside the standard error bands (i.e., ± 2 s. e.) suggest instability in the parameters of the equation in the VAR model.

Annex 1.6: Stability Test-Recursive Residuals (Private Sector Investment Spending)



Annex 1.7: Stability Test-Recursive Residuals (Residential Investment Spending)



Annex 1.8: Stability Test-Recursive Residuals (Business Fixed Investment Spending)

