MONETARY POLICY AND THE ROLE OF EXCHANGE RATE THE CASE OF Jordan

By

NABIH YOSEF ABDALLAF MOUSA

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Department of Economics
School of Social Sciences
The University of Birmingham
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ABSTRACT

This thesis aimed at investigating the impact of changes in the exchange rate on the demand for money and the trade balance in Jordan. Using Johansen (1991 and 1995) approach for cointegration analysis and the equilibrium-correction model (ECM), we examined the existence of stable long-run relationships for the demand for money and the demand for exports and imports. Using the VAR analysis, we analyzed the potential channels of monetary policy transmission mechanism as a vehicle to evaluate the efficiency of monetary policy.

A stable long-run relationship has been found for the narrowly defined money which is found positively related to domestic income and the exchange rate and negatively related to domestic real interest rate and foreign interest rate. A stable long-run relationship was also found for the demand of exports and imports. The volume of exports is positively related to income in the trade partner countries and negatively related to exports relative price. Similarly the volume of imports is positively related to domestic income and negatively related to imports relative price. The analysis of monetary policy transmission mechanisms revealed that actions of monetary policy in Jordan has little impact on either the channels of monetary transmission or on the ultimate targets of monetary policy.

DEDICATION

To my wife Khawla and my children

ACKNOWLEDGMENT

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CHAPTER ONE

INTRODUCTION

1.1 Background

Stability of the exchange rate of the Dinar, the currency unit in Jordan, has been a mile stone in the economic policy in Jordan. The Jordan dinar was issued in 1950 and declared as the legal tender in the Kingdom (CBJ 1989a). Since then, the Dinar has been pegged either to a single currency or to a basket of currencies except for a short period during the second half of the 1980s.

Since the late 1980s, and in the aftermath of the financial crisis, Jordan has implemented a comprehensive economic reform process. Within the framework of these reforms Jordan has widely liberalized the economy in all aspects, giving way to the market forces to work freely and efficiently. This included the liberalization of both the financial and the trade sectors as well as declaring the Dinar fully convertible for all visible and invisible transactions effective February 1995 and for capital transfers effective July 1997 (CBJ 1995 and 1997). Yet, and throughout the reform process, great emphasis was given to the exchange rate as a nominal anchor. The Jordan dinar was first pegged to a basket consisting of the same currencies that constitute the Special Drawing Rights but with different weights reflecting Jordan's external economic relationships. More interestingly, and specifically to emphasize the stability of the Jordan dinar against the US dollar, the authorities moved to peg the Dinar to the US dollar in the late 1995 (CBJ 1995).

This move, while liberalizing all other aspects of the economy, raised query about the role of the exchange rate in the Jordanian economy. The main pressing issues that arise in such circumstances are the implications of such policy for the independence of the domestic monetary policy, the implications for the competitiveness of the economy on the one hand,

and on maintaining the external balance on the other, and, having the financial crisis in mind, the ability to maintain the fixed exchange regime given the openness of the Jordanian economy and the full convertibility of the Jordan dinar.

On the other hand, the pro-fixed exchange rate attitude has influenced the formulation and conduct of monetary policy in Jordan. The Central Bank of Jordan (CBJ) has sometimes resorted to tight monetary policy just to defend the exchange rate regardless of the non-existence of inflationary pressures or the absence of heated economic activities. The most clear examples of such an attitude were the sharp rises in interest rate on the certificates of deposits issued by the CBJ in the mid- and the late 1990s. The above-mentioned query has motivated the desire to investigate some aspects of the role of the exchange rate in the Jordanian economy.

1.2 Research Objective

The aim is to investigate the interaction between monetary policy and the exchange rate on the one hand, and the indirect role of the exchange rate in affecting the trade balance on the other. Limiting the scope of this thesis to these two aspects of the role of the exchange rate was bounded by the fact that economic effects of changes in the exchange rate is quite a wide subject and has several interactions with different economic indicators and policies, which makes it beyond the scope of any single thesis.

At the monetary policy level, this thesis intends to investigate whether changes in the exchange rate has any impact on the demand for money in Jordan. The objective of doing so is to investigate the rationale behind the attitude of monetary policy towards protecting the fixed exchange rate system. To this end, the existence of a stable long-run demand for money relationship will be investigated, with special attention to the role of the exchange rate in such a relationship. Therefore, our objective is to ascertain whether the exchange rate is a significant element in the money demand function in Jordan or whether the above-mentioned effects were just one-off events. If it is significant, the second question that arises is whether it is large enough to create more harm than would a monetary contraction rigorous enough to defend the fixed exchange rate.

The second area to be investigated at the monetary policy level is the monetary policy transmission mechanism in Jordan. The intention here is to investigate the potential channels for the transmission mechanism and to investigate the interrelations between the shocks caused by monetary policy and those channels on the one hand, and the response of these channels to such shocks and the end economic targets of monetary policy on the other. The objective is to evaluate the efficiency of monetary policy in Jordan to affect the money demand and, consequently to achieve its targets.

Although our interest is on the role of the exchange rate, addressing the exchange rate channel among other channels for monetary transmission mechanism is not possible in the context of Jordan because of the fixed exchange regime prevailing. However, we intend to include the change in the exchange rate in our model as exogenous to check whether the change has any significant role in the transmission mechanism. A word of caution is needed here, however, because the VAR system in this case is non-structural and not designed for forecasting purposes. Further, the variables included in the VAR system are expected to be non-stationary, which makes the residuals of any individual equation not following the standard distribution and, therefore, any inferences based on the estimation results would be invalid.

At the trade sector level, the intention is to investigate the existence of a stable long-run relationship featuring the demand for each of exports and imports. In this regard we intend to examine the standard form of the demand for exports and imports, which relates the volume of either variable to a scale variable, real GDP in the importing country, and to the relative price measured by the ratio of the domestic currency export (import) price to the foreign (domestic) price level. The exchange rate will not be explicitly included in our model because no data available on the pure foreign price for imports or the actual competing price in the importing country for exports. Volume and unit price indexes used for the purpose of this thesis are composite weighted indexes and it is common for such indexes to have some inconsistency between different points of time, which makes it difficult to split the domestic import or export price into its two components, the original price and the exchange rate. However, if a stable demand function for export and import exists, the price elasticity of such a relationship could be interpreted towards the impact of the exchange rate. This is based on the assumption that any change in the exchange rate will be totally reflected in the relative price, especially in the long-run.

In summary, the aim of this thesis is to provide some answers to the following questions.

- Does a stable relationship for the demand for money exist? If it does, is the exchange rate one of its argument? And how significant its role is?
- What are the channels that work as good vehicles for the transmission of the effects of monetary policy shocks? And what is the magnitude of responses of these channels and the real side economic variables to shocks caused by monetary policy actions? Answering these two questions enables us to evaluate the ability of monetary policy to affect the demand for money and, consequently, to affect the real economic variables.
- Do stable relationships for the demand for exports and demand for imports exist? If they do, what are the implications of the price elasticities for the trade balance?

1.3 Research Methodology

To answer these questions, the research will apply quantitative analysis to examine the relationship between the exchange rate and macroeconomic aggregates in a number of developing countries, including Jordan. This will include multi-variable model estimation and time series analysis. Given the advancement that has been achieved in the econometrics analysis, we will use the VAR analysis to investigate the monetary policy transmission mechanism, and cointegration analysis and the equilibrium-correction model to investigate the existence of long-run relationships for the demand for money and the demand for exports and imports[1]. Economic theory and the findings of the published empirical studies related to the field will be the reference for evaluating the resultant relationships we are after.

Bounded by the availability of data, we will use annual time series of the variables to be used for the estimation of the demand for money and the demand for exports and imports functions. For the VAR analysis on the monetary policy transmission mechanism, we will use quarterly time series of the variables included in the system. Because no quarterly data is available on real GDP in Jordan, we have to construct our own quarterly time series based on the annual published data for period 1969 through 2004, and on the average quarter to annual ratio of unpublished quarterly data for the period 1993 through2002. No data has been published yet on the nominal and real effective exchange rate indexes. Therefore we also constructed our own time series on these variables. The two constructed indexes are composite weighted indexes for the exchange rate of the dinar, the Jordan's unit of legal

[1] A detailed discussion on the VAR analysis and cointegration and equilibrium-correction models and other econometric techniques needed for this thesis is provided in Chapter 3 and Chapter 4 below.

tender. The index measures the number of units of foreign currencies in the dinar, a rise in the index means appreciation of the Dinar[2].

1.4 Sources of Data

Data on Jordan will be obtained mainly from the Central Bank of Jordan's publications, namely the *Monthly Statistical Bulletin*, the *Yearly Statistical Series (1964-2003)*, and the *Annual Report*. Data on other countries will be drawn from the databases and publications of international institutions such as the International Monetary Fund (IMF) and the Organization for Economic Co-Operation and Development (OECD). In Certain cases, some data are downloaded from the websites of national institutions in the relevant countries.

The rest of this thesis will proceed as follows: Chapter two will provide a summary of macroeconomic developments in Jordan, including a brief description of economic policies and the reforms that Jordan has implemented. Chapter three will address the investigation of the existence of the demand for money function. The analysis of the monetary policy transmission mechanism and the evaluation of the efficiency of monetary policy in Jordan will be addressed in Chapter Four. Chapter five will look into the investigation about the existence of stable long-run demand function for exports and imports. The final sixth chapter will elaborate on the findings of the study.

[2] For details of the methodology used to construct these indexes and the countries included in them, see Chapter three below.

CHAPTER TWO

MACROECONOMIC OVERVIEW OF THE JORDANIAN ECONOMY

2.1 Background

Jordan is a small developing country with an area of 89.3 thousand squared kilometres with only 8% of which is arable (CBJ 2003). Although it has declined considerably from 7.4% in 1971 to 3.7% in 2002, fertility rate in Jordan has been one of the highest in the world[3]. Thanks to this and to several waves of immigration inflows due to political instability in the region, Jordan registered a high population growth rate of 3.9%. The population of Jordan has risen from 1.52 million in 1970 to 5.7 million in 2007.

Being situated on the edge of the Arabian Desert, Jordan has a relatively dry weather with varying rainfall between an average of 600 mm on the hilly areas and an average of only 5mm on the desert areas, varying considerably from one year to another (Kasasbeh 1984). Such a dry weather has, in practice, hindered the development of the agricultural sector and kept its contribution to national income on the low.

The vulnerability of the agricultural sector, the limited natural resources, which are limited to phosphate and potash, and the lack of sufficient investments, collectively, contributed to maintaining the narrow productive base and to the domination of the services' sectors in the Jordan economy.

Although Jordan has enjoyed a relatively high degree of internal political stability over the last three decades, it has effectively been in the eye of the storm when it comes to the regional level. In a way or another, the political instability and military conflicts that dominated the Middle East over the second half of the last century have had negative effects

[3] Online from http://www.dos.gov.jo/sdb_pop/sdb_pop_a/index3_o.htm

on the Jordanian economy during that period. The long lasting Israeli-Palestinian conflict has been the main landmark of the whole region. The resulting impression of the lack of stability that arose from this conflict contributed to deterring foreign direct investment off the region in general and off Jordan in particular. One even could argue that it might have contributed to the outflow of domestic investments and to the reluctance of domestic investors to invest in long term projects.

The successive wars in the Gulf have negatively affected Jordan in several ways. First, the Iranian-Iraqi war during the period 1980-1988 contributed to the loss of the largest part of foreign grants that Jordan used to get from Arab oil-producing countries; as these countries directed their resources to support Iraq at the time. Second, the Iraqi invasion of Kuwait in 1990 and war followed that invasion resulted in the loss of Jordanian exports' traditional markets for several years in the first half of 19990s and led to the repatriation of a large number of Jordanian workers who were working in the gulf oil-producing countries. Third, the long lasting sanctions on Iraq over the 1990s hindered the growth prospects of Jordanian exports by blocking the free access to the Iraqi market, which used to absorb the largest share of these exports.

2.2 Main features of the economy

The economy of Jordan is relatively small, with a nominal Gross Domestic Product (GDP) of JD 8.16 billion (the equivalent of US $ 11.50 billion) in 2004. GDP per capita increased constantly from JD 131 (the equivalent of US $ 366) in 1970 to JD 1466 (the equivalent of US $ 2068) in 2004. With an external trade (imports + exports) to GDP ratio of 99% in 2004, the economy is relatively open. Although this ratio has fluctuated considerably from year to year, it has been upward trending over time; rising from 32% in 1970 to 99% in

2004. Table 2.1 shows the size and openness indicators of the Jordanian economy compared to some other developing, as well as relatively small industrial countries as of in 2004.

Table 2.1: Selected Economic Indicators of Jordan and Other Selected Countries

	GDP (US $ Billion)	GDP per-capita (US $)	External Trade/ GDP Ratio (%)	External Trade/ World Trade Ratio (%)
Jordan	11.5	2068.2	99.3	0.1
Egypt	78.2	1076.9	26.1	0.2
Tunisia	28.1	2811.2	79.8	0.2
Saudi Arabia	250.6	10461.7	67.9 1/	1.8
Turkey	302.7	4191.1	52.2	1.7
South Korea	679.7	14266.9	70.4	5.1
Malaysia	117.8	4731.8	196.2	2.5
Greece	204.1	18382.8	32.6	0.7
Spain	1034.0	24244.4	42.5	4.7
Italy	1668.3	28749.1	42.5	7.6

Source: IMF International Financial Statistics, September 2005.
1/: Includes exports of crude oil.

Although the Jordanian economy has always been a market oriented one, the government has intervened, in practice, in different economic activities. One form of government intervention took place in the form direct investment in certain projects where the shortage of financing was clear and the capital needed was beyond the abilities of the private sector. The impression that public services-producing projects, such as water, telecommunications, and public transportation, do not attract sufficient investment from the private sector, and the intention to provide the public with such services at subsidized prices motivated the government to invest in such projects.

The second form of intervention came in the form of heavy regulation, which exceeded the limit necessary to facilitate and maintain the market forces. During the 1970s and 1980s, the government intensified the use of regulatory measures to achieve social targets or to provide a certain level of protection for domestic producers. The determination of market prices of many goods and services by the Ministry of Supply, the determination of deposit and lending interest rates by the Central Bank, and the use of import duties to protect certain domestically produced goods are clear examples of such regulatory measures. One could argue that heavy regulations during the 1970s and 1980s had distorted the process of allocation of resources.

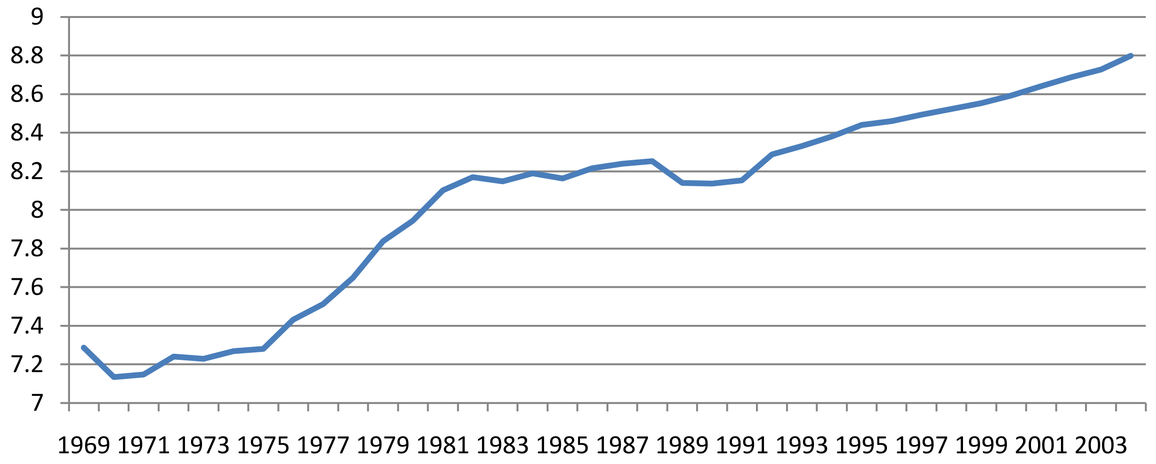
Given the scarcity of natural resources and the lack of sufficient investment on the one hand, and the high level of fertility rate on the other, tackling the issue of unemployment has been on top of the agenda for policy makers in Jordan since the 1950s. To address this issue, Jordan paid special attention to education. As a result, Jordan has become one of the highest literate among Arab countries and, consequently, its labour force is considered one of the highest qualified in the region. This led to a huge outflow of Jordanian workers mainly to the Gulf oil-producing countries. Since the mid 1970s, workers' remittances have considerably contributed to financing private investment and consumption in Jordan and to partially offsetting the large and increasing trade deficit, which has been a landmark of the Jordanian balance of payments.

2.3 Macroeconomic performance

During the period of 1975 through1983, Jordan enjoyed some favourable conditions that led to relatively high economic growth rates. Although the surge of oil prices during that period had considerably raised the cost of imported oil, the rise in income of the Arab oil-producing countries and the consequent ambitious investment programmes implemented by those countries had several positive effects on the Jordanian economy. First, the rise of income in those countries enabled them to allocate more grants to Jordan. During that period Jordan received a total of JD 1393 million in grants compared to a total of JD 348.6 million during the period 1966 through 1974 (CBJ 1996). Second, the rise of income and the consequent ambitious investment programmes implemented by the Arab oil-producing countries had significantly raised their aggregate demand and, consequently their demand for Jordanian exports, especially fruits and vegetables, and for Jordanian workers as well. This led to a significant increase in returns from exports and workers' remittances.

Collectively, these favourable developments had raised both investment and consumption in Jordan and, consequently, contributed to the relatively high growth rates. Jordanian GDP grew during that period at an average of 17.3% in nominal terms and 11.5% in real terms. Figure 2.1 shows the path of real GDP over the period 1970- 2004.

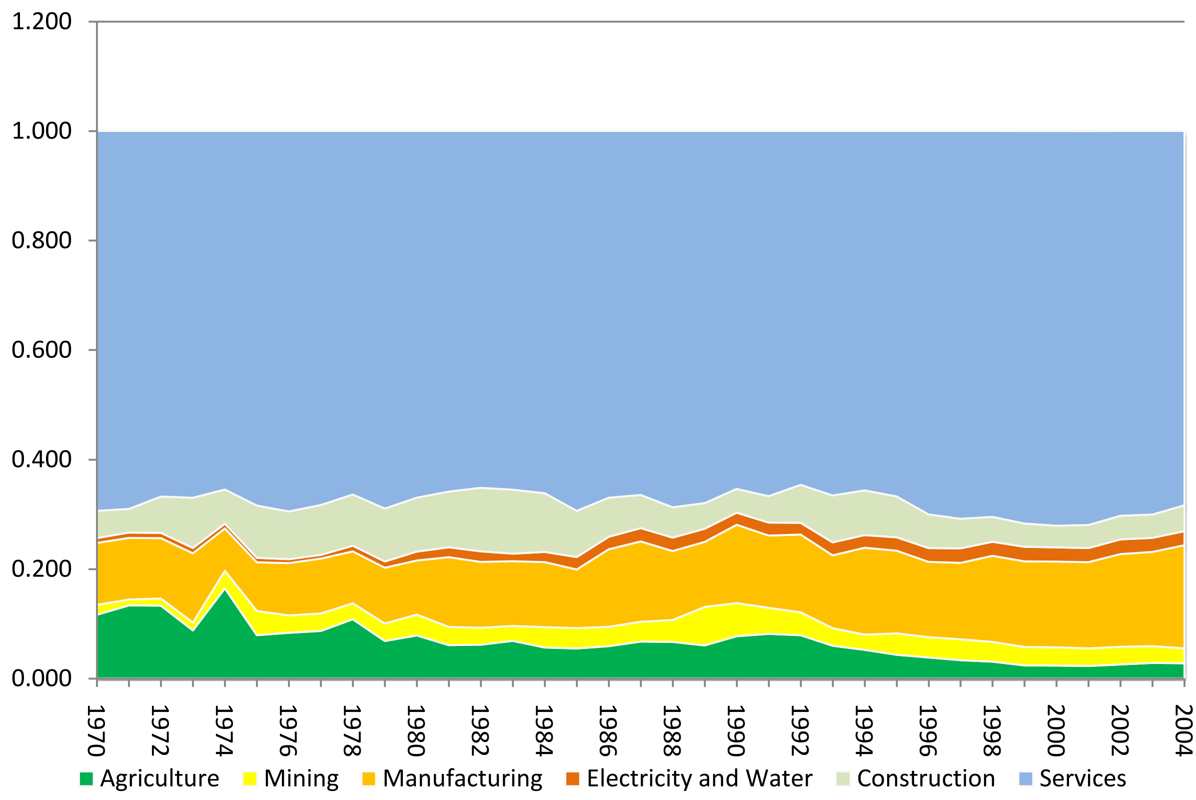
Figure 2.1: Time path of real GDP in Jordan (Logarithms)



With the exception of 1986, growth rates of real GDP decelerated significantly over the period 1984 through 1991 registering a low negative record of -21.4% in 1989 and bounced over the 1990s but remained in the positive side for most of the time. The low record of real growth rates in 1989 was a reflection of the record high inflation at 25.6% due to the depreciation of the dinar during late 1988 and early 1989.

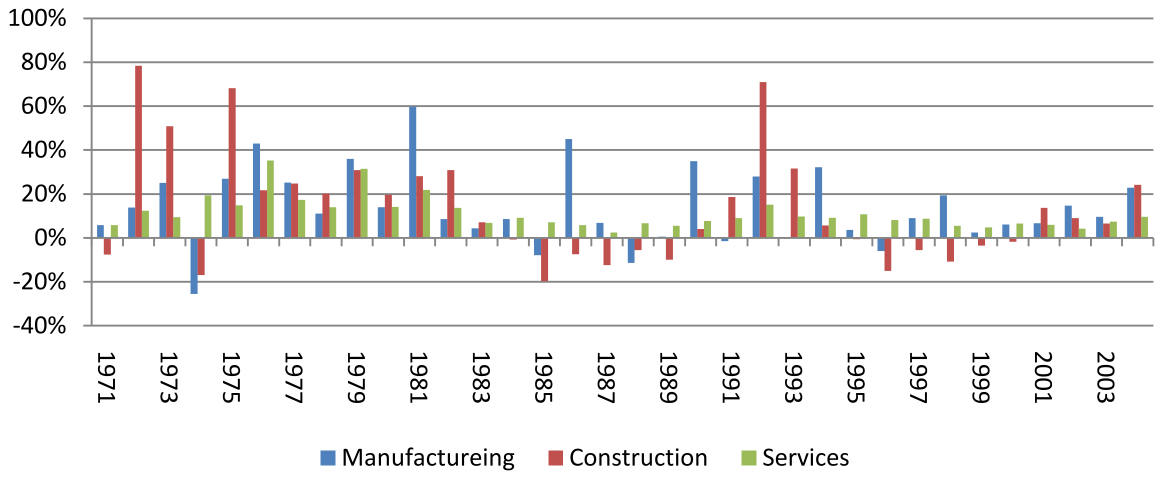
The industrial origin of GDP at factor cost shows that services sectors has been dominating the Jordanian economy. The yearly value added originated from services sectors as a percentage of GDP averaged at 68% over the period 1970 through 2004. More interestingly, the contribution of services sector showed a steady rise since 1990 to peak at 72.2% of GDP at factor cost in 2000. On the other hand, the commodity producing sectors (Agriculture, Mining, Manufacturing, Electricity and water, and construction) had collectively contributed only to less than one third of GDP on average featuring a clear downtrend during the 1990s (Figure 2.2).

Figure 2.2: Industrial Origion of Real GDP by Sector (Percentages)



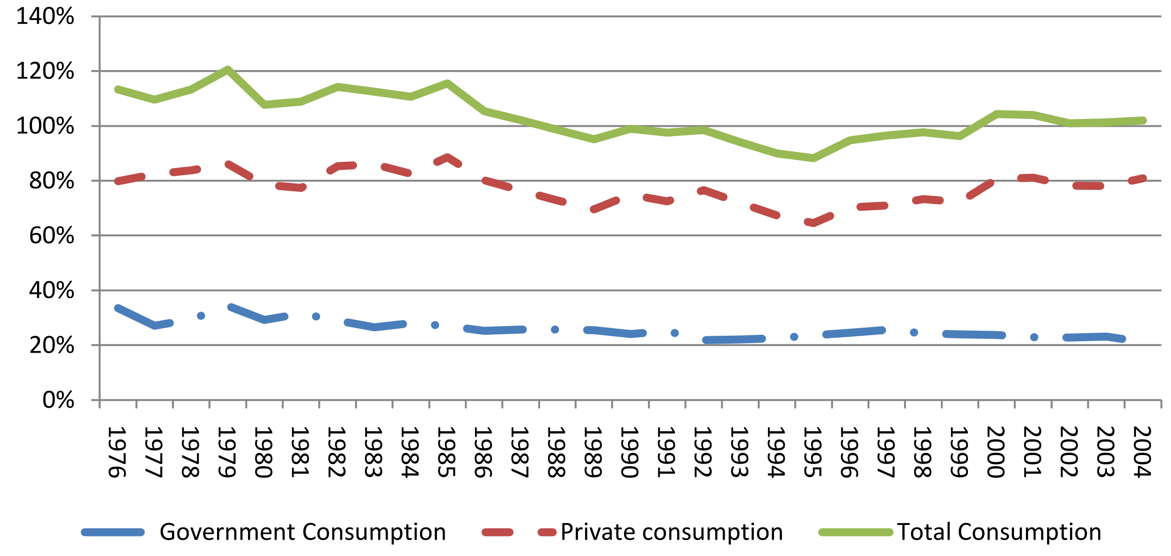
The upward trend of the contribution of services' sectors to GDP and the downward trend of the contribution of productive sectors during the 1990s reflect the decelerated growth rates in the agricultural and construction sectors. Both sectors registered considerably high rates of growth in the early years of 1990s before a sudden turn to large negative growth rates for the rest of that decade. The manufacturing sector, however, continued achieving positive rates of growth for most of the period. Although these rates fluctuated considerably, they were, on average, well above the ones achieved in the late 1980s and relatively high to the extent that it maintained its share of GDP stable. By contrast, services sectors continued to achieve relatively high growth rates, although slightly decelerating towards the end of that period. Figure 2.3 shows the annual growth rates of Agricultural, Manufacturing, construction, and the collective Services sectors.

Figure 2.3: Growth Rates of Selected Sectors of Real GDP



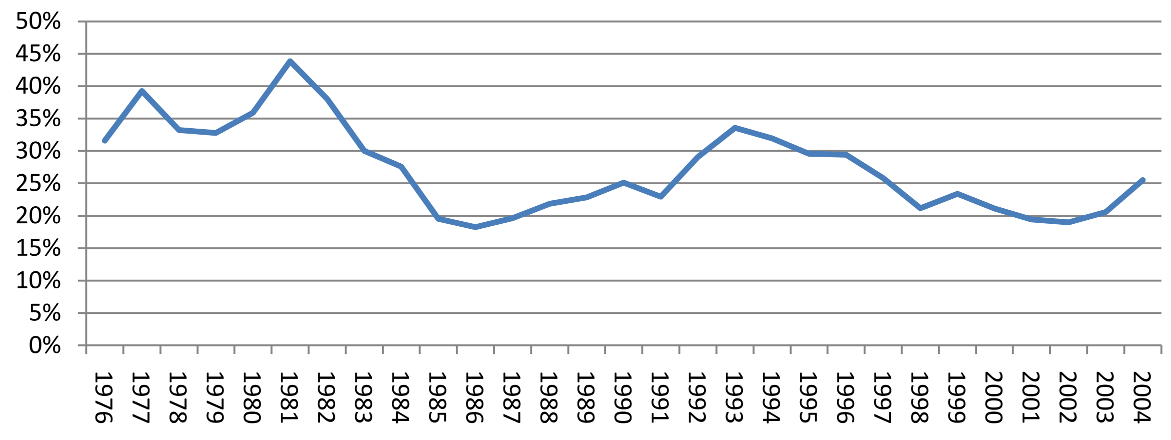
At the expenditure level, total consumption relative to GDP in Jordan has been considerably high. For many years, total consumption to GDP ratio well exceeded unity especially in late 1970s and early 1980s. As figure 2.4 shows, the ratio of government consumption to GDP, which averaged over the whole period at 25.8%, was relatively stable compared to that of private expenditure with an average of 77.3%, which shows more fluctuations and change the trend over time. Maintaining such a high level of expenditure for such a long period was not possible without the large inflows of funds from abroad in terms of workers' remittances, foreign grants, or foreign borrowing.

Figure 2.4: Private and Government Consumption as percent of GDP



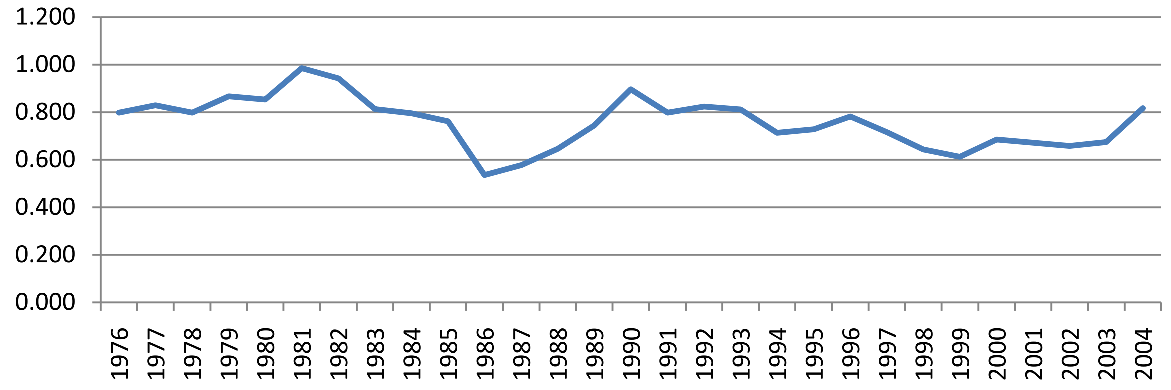
The high consumption GDP ratio has in effect lead to two major consequences for the Jordanian economy. First, effectively it resulted in negative or very low levels of domestic savings, which in turn left investment to be determined, mainly, by the availability of external financing, especially for capital expenditure of the government. The downtrend of gross capital formation to GDP ratio in the first half of 1980s and the second half of 1990s is a clear example of this fact. Figure 2.5 shows the time path of gross fixed capital formation to GDP ratio over the period 1976 through 2004.

Figure 2.5: Gross Capital Formation as Percent of GDP



The second consequence resulted from the high level of consumption relative to GDP was the chronic trade deficit due to the high level of imports needed to meet such a high level of consumption, especially with the prevailed narrow productive base in the Jordanian economy. Imports of goods and services rose sharply in the late 1970s and early 1980s not only in response to the rising consumption but to the increasing investment as well. The ratio of imports of goods and services to GDP reached a peak at 98.5% in 1981 before trending downwards on average afterwards. Figure 2.6 shows the time path of imports of goods and services as percent of GDP.

Figure 2.6: Imports of Goods and Services as Percent of GDP in Jordan (1976-2004)



2.4 Financial system and monetary policy

2.4.1 Financial structure in Jordan

Financial system in Jordan is relatively a primitive one, consists mainly of traditional banking institutions. The Central Bank of Jordan (CBJ) was established in 1964 to replace the Jordan Currency Board as the monetary authority in Jordan. According to its law, the CBJ enjoys the status of an autonomous corporate body. In addition to designing and implementing the monetary policy, the CBJ takes on the role of regulating and supervising the banking system in Jordan.

Twenty-three banks operate in Jordan to date, eight of which are branches of foreign banks and two are Islamic banks. Beside these banks, there are five specialized credit institutions and one real-estate financing company (CBJ 2006). Although banking activities in Jordan goes back to the mid-1920s, financial services and instruments remained mainly limited to traditional deposits and lending. Most of the new instruments available in the developed financial markets, such as options, futures, bankers' acceptances, portfolio management, and credit cards are relatively new to the Jordanian financial market. In practice, some banks provide such services only to a limited number of selected customers. The limitations usually associated with small size markets might be responsible for this lack of development in the Jordanian financial market.

Within its capacity as a regulatory authority, and within the general framework of government intervention during the 1970s and 1980s, the CBJ had issued several directives to influence activity in the financial sector in Jordan. In practice, some of these measures exceeded the boundaries of regulatory objectives and might, therefore distorted the process of allocation of resources. Clear examples of such directives include determining interest rates on different types of deposits and credit facilities, the use of direct and preferential measures to affect the structure of deposits and the structure of financial institutions' portfolio as well, and a wide range of restrictions on foreign exchange transactions; mainly on outward payments and maintaining foreign currency deposits (CBJ 1989).

Although restrictions on foreign exchange transactions started to be relaxed in the late 1970s, it was only in the aftermath of the financial crises and the considerable depreciation of the Dinar in 1988 and 1989, that Jordan launched a comprehensive process of deregulation in the course of adjustment programmes implemented in cooperation with the International

Monetary Fund (IMF). By 2000, the financial sector in Jordan became almost free of administrative regulations other than those applied for prudential purposes.

The rationale behind the above-mentioned regulation of the Jordanian financial sector was to achieve certain social and economic objectives within the comprehensive government economic policy. Nevertheless, it, probably, could have negatively affected the market mechanism. Moreover, one could argue that the relatively high level of regulation, along with the lack of a well-developed bond market, contributed to the shallowness of the financial sector in Jordan.

Until the late 1990s, the stock market in Jordan was a narrow one either in terms of the number of securities available or in terms of the number of dealers in the market. Trading in Amman Stock Exchange Market is limited to shares of public shareholding companies and government bonds. By the end of 1997, total capitalization of the companies listed in the market amounted to only JD 819.2 million. For the vast majority of households, access to the stock exchange market has been effectively limited by certain practicalities (less developed communication system) and, probably, by the relatively low level of income.

However, activity in the stock market has risen sharply over the last ten years, whether in terms of prices or in terms of volume of trading. This in addition to the increase in the capitalization, whether through the new companies listed in the market or through raising the capital of the existing companies, raised the market capitalization of the companies listed in the market to JD 26.7 billion in 2005 before slumping down to JD 21.1 billion in 2006 (CBJ 2006).

2.4.2 Monetary policy and monetary developments

Alternatives to money available in the well-developed markets, such as bonds, stocks and other financial instruments, are limited in Jordan, either in nature or due to practicalities.

On behalf of the government, the CBJ issues government bonds in limited amounts, at their face value, with fixed interest rates paid every six months, and with relatively long intervals between successive issues. Only few institutions issued corporate bonds in late 1970s and the early 1980s and sold them mainly to banks and financial companies. The secondary market for both types of bonds was almost non-existent. In practice, to sell those bonds, the holder of the bond has to go in person to the underwriting institution (the CBJ in case of government bonds and a commercial bank in case of corporate bonds). In addition to the financial costs the holder might incur and the time consumed in such a process, the seller may also lose the interest due on these bonds for the period between the last interest instalment paid and the date of selling if it took place before the next scheduled one. In other words, financial assets that could be substitutes for one another in Jordan are, effectively, limited to the components of narrowly and broadly defined money supply (M1 and M2 respectively).

Given the above considerations, the CBJ has been directing monetary policy in Jordan mainly towards influencing the amount of loanable funds in the banking sector as the transmission mechanism. Prior to 1993, the Bank had never specified quantitative targets either for monetary expansion or for inflation. Instead, it followed an ex-post approach of fine tuning to adjust the magnitude of monetary expansion, with the aim of keeping monetary growth in line with the expected economic growth and low enough to combat inflationary pressures. In addition, the CBJ used directives to influence the structure of both bank credit and deposits. Some of these measures were designed to finance the budget deficit reflecting the lack of independence of the CBJ during that period (CBJ 1989). The following are examples of these directives:

- The Central Bank of Jordan (CBJ) used to determine minimum or/and maximum interest rates on different types of both deposits and credit facilities.

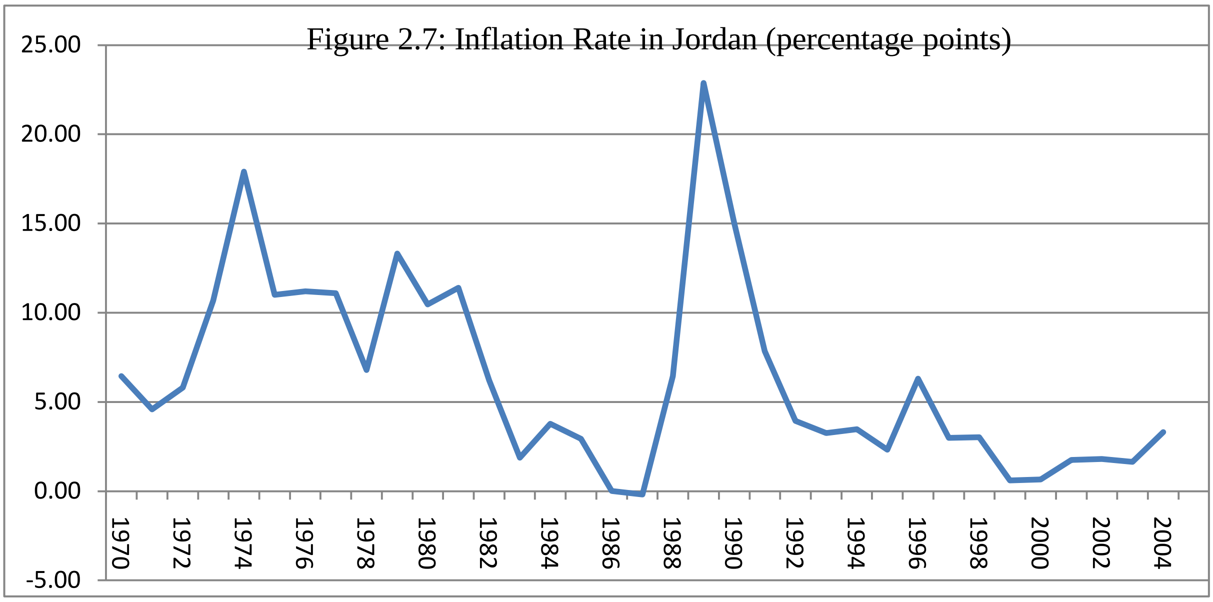
- The use of Reserve required ratios beyond their traditional function as a prudential measure, to affect the structure of deposits and credit facilities. This took place either by applying different ratios to different types of deposits or by partial exemptions against banks' investments in certain financial instruments (mainly Government bonds and Treasury bills).
- Reserve required ratios were used also to encourage certain activities by applying different ratios to different banking and financial institutions (Specialized and investment banks vis-à-vis commercial banks) (CBJ 1989).
- Banks were also required to invest a certain minimum percentage of their total assets in each of Government bonds and Treasury bills, while investments in some other instruments were subject to certain limitations (CBJ 1981).
- To encourage certain types of credit, such as export financing, syndicated loans, and corporate bonds, CBJ used to refinance, at preferential rates, up to 50% of banks' investments in such types of credit.

In September 1993, the CBJ resorted to indirect monetary control and started, therefore, manipulating short-term interest rates with an eye on indicative quantitative monetary targets. For this purpose, the CBJ issued special securities (the Certificates of deposits (CDs)) to be sold to banking institutions through auction. Since then, two types of CDs have been mainly auctioned on a fortnightly basis, the certificates of three and six month maturities (CBJ 1993). Repurchase agreements (REPOs) were introduced in April 1994; giving licensed banks more flexibility to manage their liquidity (CBJ 1994).

Exchange rate stability has always been a key factor in monetary policy in Jordan. Nevertheless, during the second half of 1980s foreign grants and workers' remittances declined sharply, while Jordan's external debt services surged. This resulted in a sharp decline in official foreign reserves, which, in turn, created a great deal of uncertainty regarding the sustainability of the exchange rate. The realization of the overvalued Dinar at the time had led to a wide scale process of currency substitution. This resulted in a sharp depreciation in the exchange rate of the Dinar in the parallel market and led, therefore, to a considerable gap between the official and market exchange rates of the Dinar (CBJ 1989).

Consequently, exchange rate of the Dinar was floated in mid-October 1988. Enhanced by a high degree of uncertainty and the lack of confidence prevailing at the time, a wide scale speculation followed this decision, which in turn, led to a further depreciation in the Dinar exchange rate against the US dollar. The 30% depreciation over a period of October 1988 through February 1989 (IMF 1989) forced the CBJ to revert to the fixed exchange rate policy by fixing the rate of the Dinar against US dollar. This, however, could not survive for long because of the shortage in foreign exchange. In May 1989, the Dinar was pegged to a special basket composed of the five foreign currencies that compose the Special Drawing Rights but reflecting the relative importance of these currencies in Jordan's transactions with the rest of the world (CBJ 1989a). Enhanced by the prospects of issuing a Palestinian currency and the consequent uncertainty about the sustainability of the Dinar exchange rate, a wave of currency substitution took place in the first half of 1995. As a measure of assurance, the CBJ reverted in October 1995, to pegging the exchange rate of the Dinar with the US dollar at a rate of US $ 1= JD 0.709 (CBJ 1995).

The depreciation of the Dinar in the late 1980s led to a high record inflation rate in Jordanian history (26.2% in 1989) and to a record decline in real GDP as well (-18.2% in 1989). This led to a relatively contractionary monetary policy throughout the 1990s. During the period 1989 through 1993, the CBJ resorted to direct credit ceilings to control the monetary growth. Since late 1993, when the CBJ resorted to manage monetary expansion indirectly through the biweekly auctions of the Certificates of Deposits, interest rates on these deposits has been rising sharply. The interest rate on the three-month certificates of deposits rose between 1993 and 1996 by 6 percentage points to reach 9.25%. After easing down to 6.25% in 1997, this rate surged again to 10.20% in October 1998 before it started to decline gradually over 1999.



Although this policy had lowered the inflation rate considerably, it could have had undesirable impact on the real sector performance. Figure 2.7 shows inflation rate in Jordan over the period 1971 through 2004; measured by the percentage change in the consumer price index. Table 2.2 below shows the average growth in monetary aggregates, income and expenditure variables, and inflation rate over the period of study and sub sample periods, which were chosen on the basis of inflation rate behaviour.

Table 2.2: Average Growth rates of Monetary Aggregates, Income, and Inflation

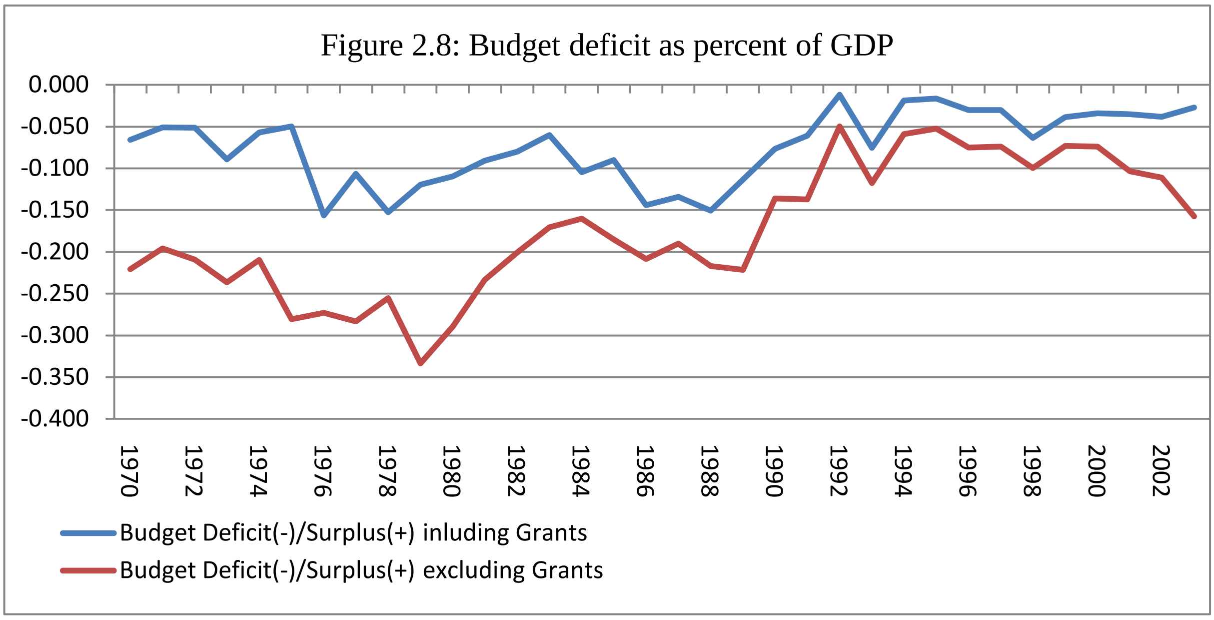
	70-72	73-80	81-87	88-90	91-98	99-00	70-00
Real Money Supply M1	0.0	8.4	3.8	-2.3	-2.8	10.6	2.8
Real Broad Money Supply M2	1.1	11.9	9.1	-2.2	1.2	10.2	6.0
Real Gross Domestic Product	-1.9	7.2	5.6	-8.5	5.1	1.7	3.5
Real Gross National Expenditure	-2.5	8.3	3.6	-7.1	3.9	4.5	3.3
Inflation Rate (Change in CPI)	5.9	11.8	3.7	14.8	4.3	0.6	7.0

2.5 Fiscal Policy

The narrow productive base in the Jordanian economy and the associated low level of income has kept domestic revenues in the government budget on the low side. In contrast, the ambitious seeking of economic and social development had always pushed government expenditures to the high. This made the persistent budget deficit a major feature of fiscal policy in Jordan even after taking into account external grants. Over the period 1970-2004, overall budget deficit (including grants) as a percentage of GDP amounted at 7.3% on average. If foreign grants excluded, the budget deficit to GDP ratio rises to 17.2% on average.

Figure 2.8 show that the deficit had changed the course a couple of times. In the 1970s, the deficit showed an upward trend with a high record of 16.2% of GDP in 1976 and 15.6% of GDP in 1978 if foreign grants were included and a peak of 33.4% of GDP if grants were excluded. In the 1980sThis upward trend could be explained by the implementation of first “Three Year Development Plan 1973-1975” and the consequent “Five Year Development Plan 1976-1980”. The implementation of these two plans pushed capital expenditures from 11% of GDP in 1972 to a record of 19.8% of GDP in1979. The expansion of government sector associated with these two plans pushed the current expenditures upwards to reach a high record of 32.8% of GDP in 1979 also.

In the first half of the 1980s, both current and capital expenditures declined considerably relative to GDP. This along with a gradual improvement in domestic revenues relative to GDP resulted in a decline in the budget deficit before it reverted to an upward trend during the second half. When Jordan implemented the comprehensive adjustment programmes after the financial crisis in 1988, the budget deficit including grants improved to a record low of 1.7% of GDP in 1995, while that excluding grants amounted at 5.4% of GDP.



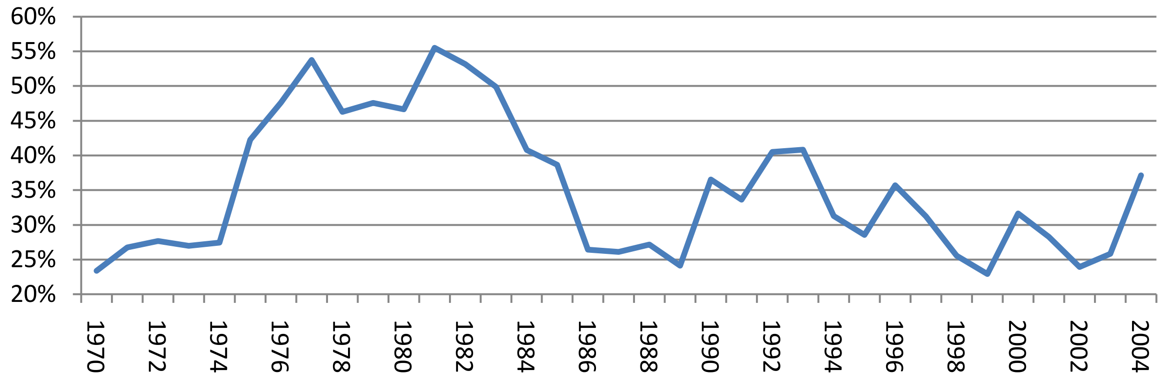
Regardless of the fluctuation of fiscal performance in the short term, some noticeable improvements had taken place between over the long term. First, the ratio of domestic revenues to GDP had almost doubled between 1970 and 2004, while the ratio of foreign grants to GDP declined during the same period from 15.5% to only 9.9%. Such development reflects the increasing reliance on domestic revenues to finance government and provide the policy maker with more certainty. Second, the ratio of capital expenditures to GDP declined from 9.5% in 1970 to only 4.8% in 2000 before it rise again to 9.9% in 2004. This trend became obvious since 1994 in response to the privatization policy and the tendency of government to leave economic activities to the private sector.

2.6 Balance of Payments and Trade developments

2.6.1 Trade Balance

As mentioned earlier, the narrow productive base in the Jordanian economy, forced the Jordanians to resort to imports to fulfil their consumption and investment needs. Accordingly, Jordan balance of payments suffered all the time from a persistent trade deficit. Over the period 1970 through 2000, the average ratio of trade deficit to gross domestic product (GDP) amounted to 41% in nominal terms and 34.5% in real terms. Considering the short-term developments, however, reveals that trade deficit as a percentage of GDP, in both nominal and real terms, rose steadily during the 1970s, while it declined considerably during the 1980s.In the 1990s, this ratio fluctuated up and down but on net basis, it rose by five percentage points. Figure 2.9 shows trade deficit movements during the period 1970 through 2004.

Figure 2.9: Trade Balance as percent of GDP



Despite that exports' growth rate was relatively higher than that of imports, trade deficit as a percent of GDP rose between 1970 and 2004 by almost 12 percentage points in nominal terms and 13 percentage points in real terms. This rise in trade deficit reflects the fact that the relatively much higher volume of imports continued to dominate the outcome of trade deficit.

During the1970s, both real exports and real imports grew on average at an equally high rate (13%). While real exports continued to grow at a high rate (11.3% on average) during the 1980s, the growth rate of real imports decelerated sharply to an average of 1.9%. However, such a trend has been reversed since the early 1990s, where real exports grew only by 6.3% on average while real imports grew on average by 5.6% (Table 2.3).

Table 2.3: Average Growth Rates of Selected Trade Indicators (Percentages)

	70-04	70-79	80-89	90-04
Export Prices	0.054	0.065	0.074	0.033
Import Prices	0.060	0.087	0.054	0.046
Real Imports	0.065	0.130	0.019	0.056
Real Exports	0.091	0.129	0.113	0.063

The oil shock was the major factor behind the high growth of both exports and imports during the 1970s. On the one hand, the rise in oil prices and the resulted high inflation rates in industrial countries led to an increase of 8.7% in Jordanian import prices. On the other hand, the resulting boom in the Gulf countries at the time led to a considerable increase in their demand for Jordanian exports and for Jordanians workers, as well. Furthermore, the resulted high income of Arab oil producing countries enabled them to allocate more grants to Jordan. Collectively, these grants and the increase in foreign exchange revenues from exports and workers' remittances enabled Jordan to implement two ambitious development plans during the period 1973 through 1980, where imports grew at considerably high rates.

On average, both export prices and import prices had accelerated during the periods in which both exports and imports registered high growth rates, while prices of both exports and imports declined at the time of lower growth rates in export and import prices (See Table 2.3 above). This might suggest that price elasticity of both exports and imports is on the low side.

Table 2.4 shows that the structure of both exports and imports has considerably changed over the last three decades. In both cases, the relative importance of crude materials and intermediate goods rose sharply at the expense of that of consumer goods. The former rose from an average of 46.9% during the 1970s to an average of 58.1% during the 1990s in the case of exports, and from an average of 23.4% to 53.3% in the case of imports. The average ratio of consumer goods declined between the two periods from 50.7% to 38.3% in the case of exports and from 48.1% to 26.6% in the case of imports. These developments reflect the relative success of the policy adopted in the late 1970s to diversify national exports on the one hand, and to encourage import substitution on the other.

Table 2.4: Structure of National Exports and Imports by Economic Function (Percentages)

	70-04	70-79	80-89	90-04
National Exports				
Consumer Goods	44.5	0.507	0.395	42.7
Crude Materials and Intermediate Goods	52.7	0.469	0.586	53.6
Crude Materials	31.4	0.353	0.380	24.3
Intermediate Goods	21.3	0.115	0.206	29.3
Capital Goods	2.8	0.024	0.019	3.7
Total Exports	1.000	1.000	1.000	1.000
Imports				
Consumer Goods	36.7	0.481	0.380	26.9
Crude Materials and Intermediate Goods	39.7	0.234	0.372	53.5
Fuels Including Crude Oil	12.7	0.077	0.169	13.8
Intermediate Goods and Other Crude Materials	27.0	0.156	0.203	39.8
Capital Goods	23.6	0.285	0.248	19.6
Total Imports	1.000	1.000	1.000	1.000

Exports of fertilizers since 1982, potash since 1984, and medicaments since late 1970s were the major steps towards diversification of exports. In the case of imports, the decline in the relative importance of manufactured goods could be the main example of import substitution.

2.6.2 Services Balance

In contrast to trade balance, services balance has always been in surplus. Disregarding some fluctuations in the short-term, the surplus of this balance showed a clear upward trend over the last three decades; from 3.0% of GDP in 1970 to 24.6% in 2004. This increasing surplus in services balance has partially offset the large deficit of trade balance and resulted in a declining deficit in the balance of goods and services. Workers' remittances have been the factor contributing to the surplus in the services' balance.

2.6.3 Current Transfers

Like the services balance, current transfers have always been in surplus. However, the net surplus of current transfers has been downward trended from a surplus of 17.8% of GDP in 1970 to a surplus of only 12.5% of GDP in 2004. Foreign grants to government were the main determinant of this item of balance of payments.

2.6.4 Current Account

The surpluses in the services balance and the current transfer balance played an important role to offsetting the large trade deficit. These surpluses were always sufficient to bring the deficit in current account down to manageable levels and, in many years, they were sufficient to turn current account into surplus.

2.7 Trade Policy

Stability of the exchange rate of Jordan Dinar has been always a key factor in planning and conducting monetary policy in Jordan. This, in fact, made exchange rate policy in Jordan serving towards combating inflationary pressures rather than adjusting the balance of payments distortions. Adopting such a policy for such a long time suggests that the policy makers in Jordan doubted the ability of flexible exchange rate to adjust the imbalance of the balance of payments. Instead, Jordan relied heavily on tariffs and, in certain cases, on non-tariff barriers to cut down imports.

All imports to Jordan are subject to an import license fee of 4%. The licensing system, however, proved to be just a routine and it serves as a fiscal measure rather than a trade barrier. With the exception of the prohibited importation of certain goods, all import licenses are issued automatically. Prior to February 1995, when Jordan declared the dinar fully convertible for all current transactions and such licenses became a pure fiscal measure, import licenses were a pre-requisite for import payments. Commercial banks, however, were authorized to make all outward payments for licensed imports without the prior approval of the Central Bank provided they can submit the right documentation afterwards.

Amid the 1970s, the Government stepped into the trading business and became the sole importer and domestic wholesaler of the main food items such as wheat, sugar, rice, meat, and powdered milk. This step was motivated by social objectives to provide the public with such items at reasonable prices. In effect, the government used to subsidize all these items as well as petroleum products during that period.

With the exception of little number of goods, such as tobacco (which used to be banned until early 1990s), certain drugs, and some agricultural products, no quotas or any other quantitative restrictions were imposed on imports. The only exception of this took place in 1989 when the government decided not to issue new import licenses of all luxury goods. This step aimed at cutting down the demand for foreign currencies in amid the financial crisis that took place in late 1988.

With the aim of protecting domestic industries, Jordan applied a system of preferential import duties. Within this framework, Jordan applied some relatively high import duty rates and/or consumption tax rates on imports of goods that compete with local alternatives and a relatively low import duty on raw materials and intermediate goods used by domestic producers, especially for export-oriented industries. A second aim of this policy was to cut down the import bill in general. Raw materials and intermediate goods were exempted of import duties or subject to a relatively low rate of duties (up to 15%). On the other hand, import duties on consumer goods were relatively high and ranged between 30% and 100% depending on the degree of luxury of these goods. In certain cases, such as imports of cars, extremely high rates of consumption tax (60-200% depending on the engine size) were introduced for fiscal and energy saving reasons rather than trade policy reasons.

Jordan has been a member of several bilateral and multilateral trade agreements aiming at facilitating the flow of trade with its trade partners. Three of these agreements (with Yemen, Syria and Iraq) included bilateral payments arrangements. In practice two of these three payments arrangements (with Syria and Yemen) lasted only for few years in early 1980s, while the arrangement with Iraq still active due to the long prevailed scarcity of foreign exchange in Iraq since 1980.

With the introduction of sales taxes in early 1990s, consumption tax on imports has been abolished. Within the framework of the adjustment program, the same rate of sales tax is applied to both domestically produced and imported goods of the same nature (13% on most of consumer goods).

Within the same framework, and in line with the guidelines of the World Trade Organization (WTO), of which Jordan became a member in 2000, import duties on all consumer goods were gradually reduced. The present maximum tariff is 30%, while the non-weighted average tariff is about 15%.

CHAPTER 3

DEMAND FOR MONEY IN JORDAN

3.1 Introduction

Monetary policy in Jordan has always been directed towards managing the quantity of money with the aim of keeping inflation rates at low levels whilst accommodating, at the same time, the desired growth rate in the economy. However, quantitative targets have never been set either for inflation or for any of the money supply aggregates, except during the 1990s. In this period, performance targets for the expansion in the monetary base and indicative targets for the growth of broadly defined money supply M2 used to be agreed upon with the International Monetary fund (IMF) within the framework of the adjustment programmes implemented in cooperation with the Fund. Inflation rates below 5% have been usually considered acceptable.

Stability of the exchange rate of the Jordanian Dinar has also been a key factor in the planning and conduct of monetary policy in Jordan. To ensure a minimum volatility in the exchange rate, the Jordan Dinar has always been pegged either to a single currency or to a basket of currencies. This, of course, lies in line with the reluctance of most developing countries, and even some industrialized countries, to allow exchange rates to fluctuate freely (See Calvo and Reinhart 2002). In practice, and regardless of the fact that the Jordanian economy had no inflationary pressures during the mid-- and the late 1990s, the Central Bank of Jordan (CBJ) raised interest rates during that period to unprecedented levels solely to ensure the stability of the exchange rate and to reduce the currency substitution process that was taking place at the time[1].

While such a policy might have helped in maintaining low inflation rates, it could have had negative impacts on real side of the economy, especially in a small open economy such as Jordan. It also could have resulted in the central bank losing some control over the money supply and the independence of its monetary policy (See Obstfeld and Rogoff (1995) and Bernanke (2005)). In fact, that policy has been rigorously criticised by the business sector, which has claimed that it has indeed affected real sector negatively. Although this criticism could have some support at the theoretical level, its validity has not been tested at the empirical level. Over the period 1969-2004, economic growth had a positive correlation of the magnitude 0.4 with both the contemporaneous and the one period lagged expansion in real balances of broadly defined money supply M2. However, a test of the causality between these two variables suggests that the null hypothesis that the monetary expansion does not Granger-cause economic growth could not be rejected even at the 10% level of significance. This, in addition to the fact that investment had not shown any negative correlation with the interest rate over that period, suggests that the tightened monetary policy during the 1990s could not be directly blamed for the lower economic growth rates.

On the other hand, over the same period economic growth had a low negative correlation (-0.04) with the contemporaneous inflation rate, and a higher negative correlation (-0.2) with the change in the inflation rate, which is positively correlated with the one period lagged expansion in real money balances at a rate of 0.39. Causality tests suggest that the null

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[1] During the 1990s, Jordan faced two waves of currency substitution. The first wave took place in the mid--1995 and was associated with the prospects of issuing a Palestinian currency and the consequent uncertainty about the sustainability of the Dinar exchange rate had the Palestinians decided to exchange their holdings of the Dinar for their own currency. The second wave took place in the second half of 1998 and was associated with the ailment of the late King, Hussain I.

hypotheses that the monetary expansion does not Granger-cause the inflation rate and the inflation rate does not Granger-cause economic growth could be rejected at the 5% level of significance. More interestingly, when correlation rates were calculated over the period of the tightened monetary policy (1995-1999), the result was more conclusive against the above-mentioned criticism. Over that period, economic growth had a negative correlation rate of -0.43 with the contemporaneous inflation rate, and a negative correlation rate of -0.40 with the change in the inflation rate. The positive correlation between the change in the inflation rate and both the contemporaneous and the lagged growth in broad money supply rose to (0.59). These results indicate that the tightened monetary policy must have contributed to the low inflation rates achieved in the majority of the 1990s, which should have a positive impact on economic growth rather than a negative one.

Within the general framework of this thesis, whose aim is to evaluate the role of the exchange rate in stabilising the economy, the above-mentioned facts provided the motivation for the estimation of a demand for money function in Jordan; the objective being to check what impact the exchange rate has on money demand in Jordan. The currency substitution waves that took place in the late 1980s and the mid-- and late 1990s suggest that exchange rate risk has an impact on the money demand function in Jordan. The first wave of currency substitution was triggered by realization that the exchange rate of the Dinar was overvalued. The expected devaluation materialized in the late 1988 and early 1989. The second wave was inspired by the fear of devaluation should the Palestinians rush to convert their holdings of the Jordanian Dinar once their own currency was issued after the establishment of the Palestinian Authority in 1994. The third wave, in the late 1990s, broke-out with the increasing uncertainties related to the political situation caused by the lengthy ailment of the late King Husain I at the time. Therefore, our objective is to ascertain whether the exchange rate is a significant element in the money demand function in Jordan or whether the above-mentioned effects were just one-off events. If it is significant, the second question that arises is whether it is large enough to create more harm than would a monetary contraction rigorous enough to defend the fixed exchange rate.

3.2 Background

3.2.1 The Jordanian economy

As explained earlier in Chapter 2, the economy of Jordan is relatively small but widely open with an external trade to GDP ratio of 99% in 2004. While the high degree of openness aided the economic development in Jordan, it left the economy relatively vulnerable to economic shocks emanating from the rest of the world. To stem the negative impact of such shocks, especially the surging inflationary pressures in the aftermath of the oil shock in the early 1970s, the government intervened in different economic sectors to maintain certain social and economic objectives. Within this framework, the financial sector in Jordan was, until the late 1980s and the early 1990s, subject to a number of administrative regulations, which might have had an adverse impact on the allocation of resources. These regulations include determining interest rates on different types of deposits and credit facilities, and the use of direct and preferential measures to affect the structure of deposits and the structure of financial institutions' portfolios. A wide range of restrictions on foreign exchange transactions, mainly on outward payments and maintaining foreign currency deposits, also existed (CBJ 1989). This relatively heavy regulation of the Jordanian financial sector until the late 1980s has had a negative impact on the market mechanism. It could be even argued that, along with the lack of a well-developed bond market, it contributed to the shallowness of the financial sector in Jordan.

Although restrictions on foreign exchange transactions started to be relaxed in the late 1970s, it was only in the aftermath of the financial crises and the considerable depreciation of the Dinar in 1988 and 1989, that Jordan launched a comprehensive process of deregulation during the course of adjustment programmes implemented in cooperation with the International Monetary Fund (IMF). By 2000, the financial sector in Jordan became almost free of administrative regulations other than those applied for prudential purposes (Box 1).

Box 1: Main Features of the Financial Sector in Jordan after Deregulation (End 2000)

- Since 1990, interest rates on all types of deposits and credit facilities are market determined.
- The Jordan Dinar is fully convertible, for both current and capital transactions.
- Each resident can maintain foreign currency accounts with licensed banks and / or financial companies up to the equivalent of JD 500,000; An amount far beyond the reach of the vast majority of the population.
- All types of credit ceilings and other direct and preferential measures have been eliminated.
- Reserve required ratios on different types of deposits with different kinds of financial institutions have been unified at one rate.
- A new banking law was put into force in 2000. The new law levelled the playfield for all kinds of banking institutions by applying equal performance and prudential measures to different kinds of institutions, and by allowing different financial institutions to participate in all banking and financial activities subject to their license.

Although this deregulation process must have had a positive impact on the market mechanism and the competitiveness of the financial sector in Jordan, one should keep in mind, however, that it would enhance the role of expectations with regard to interest rate movements. This could create more uncertainties about inflation and, consequently, might create instability in the money demand function (See Apergis (1997), and Tan (1997)). However, Ericsson and Sharma (1996) found that a stable money demand function exists in Greece regardless of the ongoing financial liberalization process, but they argued that stability might be precluded as deregulation proceeds.

3.2.2 Monetary policy and monetary developments in Jordan

Alternatives to money available in the well-developed markets, such as bonds, stocks and other financial instruments, are limited in Jordan. Government bonds have been issued in limited amounts, at their face value, with fixed interest rates paid every six months, and with relatively long intervals between successive issues. Only a few corporate bonds were issued in the late 1970s and the early 1980s and they were sold mainly to banks and financial companies. The secondary market for both types of bonds has been almost non-existent. To sell either type of bonds, the holder of the bonds has to go in person to the underwriting institution (the CBJ in the case of government bonds and a commercial bank in the case of corporate bonds). In addition to the financial costs the holder might incur and the time consumed in such a practice, the seller would also lose the interest due on these bonds for the period between the last interest instalment and the date of selling if the selling took place between two scheduled interest instalments.

For the vast majority of households, access to the stock exchange market has been effectively limited due to the relatively low level of income. Accordingly, financial instruments available to the household sector were largely limited to conventional deposits with banks. In other words, financial assets that could be substitutes for one another in Jordan are effectively, limited to the components of narrowly and broadly defined money supply (M1 and M2) respectively.

Given the above considerations, and until early the 1990s, monetary policy in Jordan was designed mainly towards influencing the amount of loanable funds in the banking sector as the transmission mechanism. Prior to 1993, the CBJ had never specified quantitative targets either for the monetary expansion or for the inflation rate. Instead, it followed an ex-post approach of fine-tuning to adjust the magnitude of the monetary expansion, with the aim of keeping monetary growth in line with the expected economic growth and low enough to combat the inflationary pressures. In addition, the CBJ used directives to influence the structure of banks' credit, the banks' portfolios, and customers' deposits. Some of these measures were designed to finance the budget deficit, reflecting the lack of independence of the CBJ that prevailed at the time (CBJ 1989). The following are examples of these directives:

1. The CBJ used to determine minimum or/and maximum interest rates on different types of both deposits and credit facilities.
2. Reserve required ratios were used, beyond their traditional function as a prudential measure, to affect the structure of deposits and the banks' portfolios, either by applying different ratios to different types of deposits or by partial exemptions against banks' investments in certain financial instruments (mainly government bonds and treasury bills).
3. Reserve required ratios were used also to encourage certain activities by applying different ratios to different banking and financial institutions (Specialized and investment banks vis-à-vis commercial banks) (CBJ 1989).

4. Banks were also required to invest a certain minimum percentage of their total assets in Government bonds and Treasury bills, while investments in some other instruments were subject to certain limitations (CBJ 1981).
5. To encourage certain types of credit, such as export financing, syndicated loans, and corporate bonds, the CBJ used to refinance, at preferential rates, up to 50% of banks' investments in such types of credit.

In September 1993, the CBJ resorted to indirect monetary control and started, therefore, manipulating short-term interest rates with an eye on indicative quantitative monetary targets. Certificates of deposits of three and six month maturities have been auctioned on a fortnightly basis for this purpose (CBJ 1993). Repurchase agreements (Repos) were introduced in April 1994; giving licensed banks more flexibility to manage their liquidity (CBJ 1994).

Exchange rate stability has always been a key factor in monetary policy in Jordan. Nevertheless, this policy was severely challenged during the second half of 1980s. Due to the continuous shrinkage of the inflow of net current transfers (including foreign grants and workers' remittances) on the one hand, and the surge in Jordan's external debt services over the 1980s on the other (See Table A3.1 in the appendix), official foreign exchange reserves were almost depleted by mid--1988 (Figure 3.1). The overvalued Dinar at the time had led to a wide-scale process of currency substitution. This resulted in a sharp depreciation in the exchange rate of the Dinar in the parallel market and led to a considerable gap between the official and the market exchange rates of the Dinar (CBJ 1989)[1].

Consequently, the Dinar was floated in mid--October 1988. Enhanced by a high degree of uncertainty and the lack of confidence prevailing at the time, a wide-scale

[1] Official rate refers to the rate that the CBJ is ready to deal at with its customers (the government and the banking institutions), while the market rate is the rate that the money changers deal at with the public.

speculation followed that decision, which in turn, led to a further depreciation in the Dinar exchange rate against the US dollar. Over a period of five months (October 1988 through February 1989), the Dinar depreciated by 30% (See Table A3.1 in the appendix). The CBJ responded by reverting to the fixed exchange rate policy and fixed the rate of the Dinar against the US dollar. This, however, could not survive for long because of the shortage in foreign exchange. In May 1989, the Dinar was pegged to a special basket composed of the five foreign currencies that compose the Special Drawing Rights but with different weights, reflecting the relative importance of these currencies in Jordan's transactions with the rest of the world (CBJ 1989a). Encouraged by the prospects of the issuing of a Palestinian currency and the consequent uncertainty about the sustainability of the Dinar exchange rate, a wave of speculation and foreign currency substitution took place in the first half of 1995. As a measure of assurance, the CBJ reverted in October 1995, to pegging the exchange rate of the Dinar with the US dollar at a rate of US $ 1= JD 0.709 (CBJ 1995).

The depreciation of the Dinar in the late 1980s led to a record high inflation rate of 25.9% in 1989 and, consequently, real GDP declined by -18.2% in that year. The CBJ responded with a relatively contractionary monetary policy throughout the 1990s. During the period 1989 to 1993, the CBJ resorted to direct credit ceilings to control the monetary expansion. Since late 1993, when the CBJ resorted to the indirect management of monetary policy, inflation rates came under control (below 5%). Nevertheless, the tight monetary policy, depicted by the rising interest rates on the CDs, continued until the late 1990s, in order to defend the stability of the Dinar's exchange rate (Figure 3.1).

Although this policy, as mentioned earlier, was blamed for lower economic growth, it in fact helped to maintain a considerably low inflation rate. Table 3.1 shows the average growth rates of the monetary aggregates, gross domestic product, and inflation rate over the period of the study and sub-sample periods, chosen on the basis of inflation rate behaviour.

Figure 3.1: End of year interest rate on the three months certificates of deposits

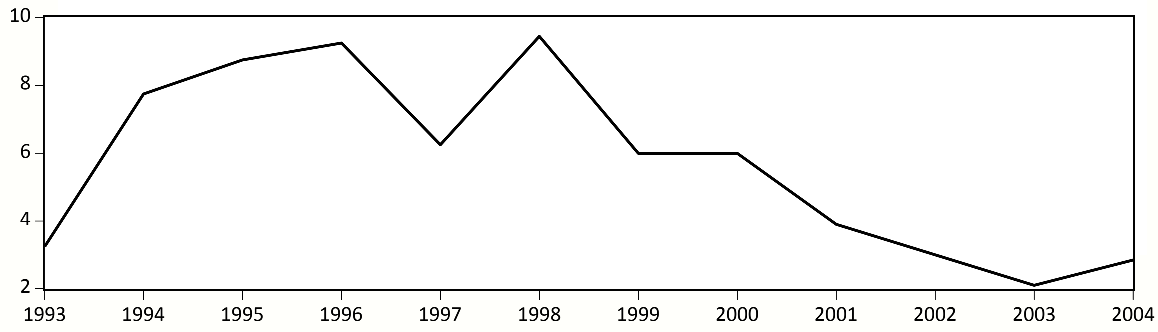


Table 3.1: Average growth rates of monetary aggregates, income, and inflation
(Percentage points)

	70-72	73-80	81-87	88-90	91-98	99-00	70-04
Real money supply M1	0.3	7.8	3.8	-2.3	-2.6	9.5	3.6
Real broad money supply M2	1.4	11.1	9.1	-2.2	1.3	8.9	6.4
Real gross domestic product	-1.6	8.9	4.2	-3.4	4.8	4.6	4.3
Inflation rate (% change in CPI)	5.6	10.9	3.7	14.8	4.1	1.6	6.4

3.3 Demand for money

Understanding the demand for money has special importance for the formulation and implementation of monetary policy. This importance has been demeaned at the theoretical level for a relatively long period, especially with the increase in the number of countries using the interest rate rather than monetary aggregates as the intermediate target of monetary policy. Nevertheless, the demand for money has continued to capture much of the interest at the empirical level (See Duca and VanHoose 2004).

Regardless of the ultimate objectives of monetary policy, and the instruments or the intermediate targets used to achieve these objectives, it is the money supply, which central banks seek to control, explicitly or implicitly. In theory, the money supply should always be sufficient to accommodate the volume of transactions in the economy and the acceptable increase in the price level. In other words, real money supply should always meet the desired real money demand. Any deviation of the actual real money balances from the desired real money balances will affect the total final expenditures in the economy and, consequently, could have an impact on the output and the price level (Riechel 1978). Thus, it is crucial for a central bank, when formulating and conducting its monetary policy, to have clear knowledge of the demand for money function in order to take the right monetary policy action.

Within this framework, it has been well established in the economic literature that the stability of the demand for money function is a key factor to the design and conduct of monetary policy (Sriram 2001). The more stable the demand for money function is, the more predictable the outcome of any policy action is expected to be. However, the lack of stability might not be a serious problem by itself, especially if the source of instability is known. Driscoll and Ford (1980) argued that the effectiveness of monetary policy depends mainly on the degree of certainty regarding the predictions of the target variable and not on the stability of the demand for money function. In other words, if the policy maker knows the source of instability in the demand for money function, they could in this case predict the expected reaction in the target variable to any policy action, regardless of the instability of the demand for money function. In practice, the controversy around the stability of the demand for money function has widened over the last two decades along with the increased number of developing countries getting involved in the process of deregulation and financial liberalization. Several empirical studies found that deregulation, financial liberalization, and the increasing openness of the economy to international markets caused a structural break and, consequently, hampered the stability of the demand for money in several countries (See Vega (1998) and Pradhan and Subramanian (2003) for example).

3.3.1 Theoretical background

There is consensus among different theories of demand for money that real quantity of money demanded is a function of a scale variable, representing the level of economic activity, and a cost variable, representing the opportunity cost that the holders of cash balances have to incur (See Sriram (1999) and Laidler (1985)). Nevertheless, these theories differ widely when it comes to the importance of individual variables in explaining the variance in real cash balances, or to the economic reasoning behind choosing any certain variable. Fisher's quantity theory of money, marked by his equation of exchange (MV=PT), emphasised the role of money as a medium of exchange but did not explicitly raise the issue of the demand for money. When transformed to the Cambridge equation for the quantity of money (Md = kPY), it became the first functional relationship that could be interpreted as a demand for money function, which argued that nominal quantity of money is proportional to nominal income. Assuming that both the price level and the velocity of money circulation are fixed in the short-term, the interpretation of both equations suggests that real income is the sole variable that determines the quantity of money demanded (Laidler 1985).

Keynes analysed, in depth, the different motives for holding money and linked each motive to the explanatory variable that influences it. In his analysis, both the transactions and the precautionary demand for money are positively related to the level of income, while the speculative demand depends on the interest rate and expectations and is negatively related to the interest rate (See Laidler (1985), and Lewis and Mizen (2000)). As cited in Laidler (1985), Keynes argued that in the short-run, where the transactional motive does not vary significantly, the change in interest rates is the dominant factor in determining the demand for real money balances. Moreover, he argued that if interest rates are very low, individuals might choose to hold all their wealth in the form of money balances (Liquidity Trap).

Friedman (1969) questioned the validity of Keynes's analysis. He argued that interest rates could have an impact on the quantity of money demanded, but the magnitude of this impact was never large enough to be considered an important factor in determining demand for money. In contrast to interest rates, Friedman claimed that real income, and permanent real income, in particular, is the dominant factor in determining the demand for real money balances.

With the huge development and sophistication that engulfed the financial markets in the 1980s and the 1990s, where several types of money and alternatives to money were introduced, the disagreement went beyond the choice of explanatory variables to engulf the choice of the monetary aggregate according to the role assigned to money (See Sriram 1999). Furthermore, and with the increasing tendency towards freeing the movement of capital and adopting more flexible exchange rate regimes, the importance of detecting the influence of foreign variables, like foreign interest rates and exchange rates, on domestic demand for money has been emphasized in empirical studies (See Ariz (1994), Nachega (2001), and Ericsson and Sharma (1996)). Day (2002) went even further to suggest that in open economies and where currency substitution is possible, income of foreign countries could have a positive impact on the demand for domestic money, but he found the magnitude of this impact is marginal in the United States. While this positive impact of foreign income on demand for domestic currency could be plausible in a country like the United States, because the dollar is the major reserve currency in the world, it seems implausible in smaller countries, especially the developing countries. On the contrary, it could be quite the other way round;

where currency substitution may have a negative impact on the demand for the domestic currency.

Until the late sixties, empirical studies widely supported the Keynesian hypothesis of the importance of the interest rate in determining the demand for money. A survey of 13 empirical studies (Boorman 1980) showed that the estimated interest rate elasticity of money balances ranged between –0.4 and –0.9 if a long-term rate of interest was included in the equation, and between –0.07 and –0.50 if a short-term rate of interest was included. More interestingly, the high estimated elasticity was found to be associated with the use of the narrow definition of money as the dependent variable, while using a broader definition of money as the dependent variable yielded lower estimated interest rate elasticity (See Boorman (1980), pp. 328-335).

The first strand of empirical estimation of a demand for money function, which lasted from the late 1930s to the early 1980s, concentrated on the long-run relationship between real money balances on the one hand and a real income variable and an interest rate measure on the other. These studies concentrated on industrial countries, mainly the United Kingdom and the United States. Regardless of the choice of the scale variable, the vast number of these empirical studies concluded that the income elasticity of the demand for money is around unity, and verified the assumption of homogeneity between nominal money balances and prices. Interest rate elasticity in these studies varied widely between –0.07 and –0.79 (See Lewis and Mizen 2000). Variation of interest rate elasticity of the demand for money could be attributed to the choice of both the monetary aggregate variable and the interest rate variable, where in general, elasticity of the narrowly defined money is expected to be higher than that of broadly defined one. It also could be attributed to the variance in the level of development and the level of regulation in the financial sectors of different countries. It is expected to be higher in countries with more developed financial markets and lower in countries with less developed and heavily regulated financial markets (See Sriram 1999). Another source of variation in interest rate elasticity of the money demand could be the instability of interest rates, which is not uncommon, especially in the case of financial liberalization (See Apergis 1997).

The dynamics of the short-run demand for money has been estimated during this period using the partial adjustment process; i.e including the lagged money balances in the demand for money equation. Lewis and Mizen (2000) argued that partial adjustment models failed to explain monetary instability during the seventies, and accordingly some economists started to question the whole process of estimating money demand. Lewis and Mizen (2000) stated:

"Both Goldfeld (1976) and Artis and Lewis (1976) concluded that the theory behind money demand estimation needed overhauling and in many aspects the research agenda of the next twenty-five years was set by the break-down of partial adjustment theory" pp 281.

As quoted from Lewis and Mizen (2000), these economists emphasized the need that the new research should address the following three questions:

1. Was the basic money demand function misspecified all the time? If so, it needs re-specification.
2. Was the long-run equation correctly specified but the short-run dynamics were not? If so, re-specification is needed only for the short-run dynamics.
3. Was the demand equation correctly specified during the 1960s and a structural break caused the instability in the mid- 1970s? And, therefore, re-specification is needed only after the break.

Tackling the first question led to the buffer stock models, while tackling the second and the third led to equilibrium-correction models. Buffer stock models incorporate expectations into the partial adjustment model based on microeconomic foundations of individuals' behaviour in adjusting the desired quantity of money (See Makhetha 2002). The basic hypothesis of these models is that the precautionary demand for money enables individuals to adjust any disequilibrium in money balances on a continuous basis without the need to incur the cost of both the continuous monitoring of these balances and the potential inadequate timing of transforming balances between different types of assets. Laidler (1984) argued that this approach provided a better explanation of short-run money demand than the partial adjustment approach did. Nevertheless, the buffer stock models were not free of shortcomings. Sriram (1999) summarized criticisms to this approach in the following:

1. Any estimated equation for money demand from the single equation approach could only be considered as a semi-reduced form. Accordingly one could solve only for one of the explanatory variables at a time rather than solving for all of them simultaneously.
2. Since the complete disequilibrium monetary models allow the disequilibrium in money holdings to influence a wide range of variables, the estimated elasticity of the long-run demand for money are conditional on the correct specification of the entire model. Cuthbertson (1988) found that such estimates are imprecise.
3. The shock absorber model, which was developed, originally, by Carr and Darby (1981), causes some econometric problems due to the appearance of current nominal money stock in both sides of the equation.
4. The exogeneity assumption of money stock in the buffer stock models is questionable. Sriram (1999) stated:

"*as Laidler (1993) pointed out the nominal money supply, in real world, does respond to changes in variables underlying the demand for money. Fisher (1993), indeed, shows in the context of Switzerland that money stock is a dependent rather than an exogenous variable" (pp 36)*.

Choi and Oh (2000) went further and argued that both money supply and money demand could have an impact on each other if money supply is treated as partially endogenous and partially exogenous. They argued that an anticipated tighter monetary policy pushes investors to increase their holdings of money balances in the current period, especially if the adjustment cost of holding money is not too high, to be able to use the extra balances in the way they want in the future. When they applied their model to the US, they found that the monetary policy stance (as a proxy for the exogenous part of money supply) has a positive impact on the residuals from the estimated cointegrating vector for money demand.

In light of these criticisms and with the advancement of econometrics during the 1980s, cointegration analysis and equilibrium (error) correction models (ECM) dominated the empirical work of estimating demand for money during the 1990s (Sriram 1999 and 2001). Thanks to the advantages it has over both the partial adjustment and the buffer stock models, the new approach proved to be successful in detecting both the long-run relationship and the short-run movements of a demand for money function. As Sriram (1999) summarized from Arize and Shwiff (1993), the new technique has the ability to avoid several econometric problems. These problems include the spurious correlation between coincidently trended variables, the misspecification of the short-run dynamics, the loss of long-run relationships between variables when data are expressed in differences to get rid of non-stationarity, and the insufficient lag structure, which imposes certain restrictions on the shape of the model.

3.3.2 Demand for money in developing countries

One of the major developments that featured in empirical research on the demand for money during the 1990s is the focus given to developing countries compared to the previous three decades, where attention was concentrated on industrialized countries; mainly the US and the UK (See for example Sriram 2000). The lesser focus on developing countries before the 1990s could be attributed to certain practical issues, especially the lack of reliable data on the variables to be studied. In addition to that, the different economic structure and the lack of financial development in these countries shed some doubts on the conformity of behaviour in developing countries with that in developed ones. Adekunle (1968) argued that, although the specification of demand for money function in less developed countries is similar to that in developed countries, the behaviour of the demand for money in the two groups is not quite the same. Adeknule (1968) related the difference in the behaviour of money demand between the two groups of countries to the difference in the manners of forming expectations with respect to different arguments of the demand for money function.

Adeknule (1968) highlighted the main differences between the characteristics of the demand for money functions in the developed countries and those in the less developed countries. First, elasticity of expectations in the less developed countries is higher than they are in the developed countries, and almost close to unity (static expectations). This makes current income, rather than expected income more appropriate as a scale variable in the demand for money in these countries. Second, due to the tendency of holding larger amounts of cash balances as income increases in developing countries, income elasticity of demand for money is expected to be greater the less developed the economy is. Third, the lack of well developed financial markets in less developed countries works in favour of the yield on real assets to be more important in explaining the behaviour of money demand in these countries rather than that on financial assets. Therefore, inflation is expected to be more appropriate as the opportunity cost argument of demand for money in less developed countries, while the interest rate is the more appropriate argument in case of developed countries.

Empirical evidence supports Adeknule's findings to a great extent. In a study of 19 developing countries, Crocket and Evans (1980) found that income elasticity for both narrow and broad money is statistically significant in all of the countries. In the case of narrow money, the income elasticity was found to be more than unity in 14 out of the 19 countries, while for broad money the elasticity exceeded unity in 17 countries. On the other hand, Crocket and Evans found the opportunity cost variable statistically significant only in three out of the 19 countries.

A survey of recent empirical studies on the demand for money in developing countries shows relatively strong evidence in support of the above-mentioned findings. Table 3.2 below shows that in the majority of studies, income elasticity of demand for money was quite high and close to unity, while interest rate elasticity was relatively low. Furthermore, it shows that whenever the interest rate and inflation rate were included among the arguments of the demand for money, the money demand elasticity with respect to the inflation rate was usually higher than that with respect to the interest rate. This conforms with Adekunel's (1968) contention that return on real assets is more important as a measure of opportunity cost in developing countries than that on financial assets.

Table 3.2: Survey of empirical studies on demand for money in developing countries

Author (year)	Money Variable/ Frequency	Explanatory Variables	Country/Money Variable	Long-run Estimated Elasticity with Respect to					Short-run Speed of Adjustment
				Income	Wealth	Interest rate	Inflation	Exchange rate	
Arize (1994)	M1-P M2-P Quarterly	Y, Δp_{t+1}, ΔE_{t+1}, i^d, i^w, i^L, s	Korea M1 M2 Pakistan M1 M2 Singapore M1 M2	0.57 1.16 1.03 0.77 0.71 1.12		-0.034(d) -0.018(w) -0.09(w) $-0.04^{(ii)}$ $-0.008^{(ii)}$ 0.038^{L} 0.11(d) -0.03(d)	n.a -9.15 -5.48 -7.88 n.a n.a	-0.008(s) -0.017(s) -0.04(e) -0.008(e) -1.78(s) -1.83(s)	-0.27 -0.022 -0.16 -0.109 -0.19 -0.14
Nachega (2001)	M2-p Annual	Y, Δp, Δe, FMMR, RD	Cameroon M2	1.0	n.a	10.4(D) -1.2 (F)	-1.3	-0.9	0.6
Carruth and Sanchez-Fung, (2000)	M1-p	Y, RUSB, EBM, Δp	Dominican Republic: m1	1.043	n.a	-0.047	-0.547	0.648	0.6-0.7
Ericsson and Sharma (1996)	M3-p Quarterly	Y, RTB, RDD, Repo, RSD, RTD, ST=RTB-RTD SR=RTB-Repo EBM, Δne, Δp.	Greece:M3	1.22	n.a	4.58(RTD) -3.07(ST) -7.02(SR) Alternatively 7.65(RTD) 7.02(RR) -10.09(RTB)	-3.38 (4. Δp)	n.a	.127
Buch (2001)	M1-p, M2-p. Monthly	IPI, Δp, RD, ΔE.	Hungary: M1 M2 Poland: M1 M2	n.a n.a 0.95 1.14	n.a n.a n.a n.a	-0.01 -0.007 n.a 0.003	-0.04 -0.04 -0.04 -0.002	n.a n.a n.a n.a	-0.15 -0.03 -0.09 -0.07
Karfakis and	M1-p	Y, P, RD_{3-12}.	Greece: M1	2.19	n.a	-0.020	n.a	n.a	n.a

Table 3.2: Survey of empirical studies on demand for money in developing countries

Author (year)	Money Variable/ Frequency	Explanatory Variables	Country/Money Variable	Long-run Estimated Elasticity with Respect to					Short-run Speed of Adjustment
				Income	Wealth	Interest rate	Inflation	Exchange rate	
Sidiropoulos (2000)	Quarterly								
Apergis (1997)	M1-p Quarterly	IPI, R_s, $(m\text{-}p)_{t-1}$, infVol.	Greece: M1	0.064	n.a	-0.067	-0.49	n.a	n.a 0.366 for $(m\text{-}p)_{t-1}$
Kogar (1995)	M1-p, M2-p. Quarterly	Y, ΔP. ΔE.	Turkey: M1 M2 Israel: M1 M2	0.552 0.303 0.481 0.348	n.a	n.a	-0.314 -0.427 -0.715 -0.231	-0.034 -0.052 -0.049 -0.029	n.a
Bahmani-Oskooee, Martin, and Niroomand (1998)	M1-p, M2-p. Quarterly	Y, I, NE.	Spain: M1 (E excl.) M1 (E incl.) M2 (E excl.) M2 (E incl.)	 4.65 5.63 3.77 3.64	 n.a	 -1.0 -0.13 -0.67 0.01	 n.a	 n.a 0.71 n.a 0.36	 n.a
Felmingham and Zhang (2001)	M2 Monthly	Y, R^m, R^o, Δp.	Australia: Broad money	 1.21		 0.25 $(R^m - R^o)$	 -0.28		
Arestis and Demetriades (1991)	Per head M2 Per head (M2-P). Annual	Per head Y, Per head C, P, ΔP_{t+1}, AveRD,	Cyprus: M M/P	 0.89(Y) 0.94(C) 0.90(Y) 0.89(C)	Dum. 0.04 0.04 0.04 0.03	 0.24 0.23 0.24 0.23	 1.01(P) -0.70(π) 0.93(P) -0.75(π) -0.72(π) -0.66(π)	 n.a	 -0.96 -0.97
Nell (1999)	M3 Annual	Y, R.	S. Africa: M3 Johansen	 1.29	 n.a	 n.a	 n.a	 n.a	

Table 3.2: Survey of empirical studies on demand for money in developing countries

Author (year)	Money Variable/ Frequency	Explanatory Variables	Country/Money Variable	Long-run Estimated Elasticity with Respect to					Short-run Speed of Adjustment
				Income	Wealth	Interest rate	Inflation	Exchange rate	
			Engle & granger	1.32					0.88

Note: The abbreviations used in this table have the following meanings:
M1= narrowly defined money supply; M2 or M3 = broadly defined money supply; Y = real GDP; P= price level measured by CPI; E = exchange rate; NE = nominal effective exchange rate index; FMMR; French overnight money market rate; RD = deposit interest rate; S = foreign exchange rate risk; i^d = domestic interest rate; i^w = foreign interest rate; i^L = Pakistani government bonds yield; RUSB = interest rate yield on US government bonds; RTB = interest rate on treasury bills; RDD = interest rate on demand deposits; Repo = interest rate on repos; RSD = interest rate on saving deposits; RTD= interest rate on time deposits; EBM = real black market exchange rate; RD_{3-12} = three-twelve months deposit rate; IPI = industrial production index; R_s = short-term time deposit rate; Infvol; = inflation volatility; R^m = own interest rate on money; AveRD= average deposit interest rate; R^o = interest rate on alternatives to money; Δ = the first difference operator on the relevant variable; and the subscript $_{t+1}$ refers to the next period expected value.
(i) The results reported here are those related to Johansen technique only. In addition to these, Arize reported also the results related to Engle-Yoo procedure.
(ii) Elasticity with respect to interest rate differential (domestic interest rate – foreign interest rate).

3.3.3 Demand for money and "cointegration and equilibrium-correction models"

As mentioned earlier, empirical studies that used the standard OLS procedure to estimate the demand for money function during the 1970s had failed to estimate a stable demand for money function in several countries. Problems with the classical OLS models arise from the fact that most of the economic variables involved in the estimation of the money demand relationship are non-stationary[1]. In their Monte-Carlo experiments, Granger and Newbold (1974) showed that standard OLS regressions involving non-stationary variables usually have a high coefficient of determination (R^2) and a very low Durbin-Watson statistic, indicating highly autocorrelated residuals. Accordingly, they argued that conventional tests for statistical significance of the estimated parameters in such regressions are usually biased towards rejection of the null hypothesis of no relationship, which means that such regressions are spurious (the coincidence of the highly correlated variables).

In support of these findings, Phillips (1986) proved that the estimated parameters in regressions involving non-stationary time series do not converge in probability to constants as the sample size (T) converges to infinity (∞). Similarly, Phillips (1986) proved that the conventional tests for statistical significance of the estimated parameters do not have a limiting distribution as T approaches ∞, which means that there are no correct critical values for these tests. However, Phillips (1986) argued that major differences (regarding the convergence of the parameters and the limiting distribution of the tests of significance) arose when the time series involved in the OLS estimation were cointegrated.

While differencing the non-stationary variables might be a cure for potential spurious regression and autocorrelation, Banerjee et al (1986) argued that OLS models involving the first differences of the integrated variables are not without cost. The main issue raised about using the first differences in regressions instead of the level of the variables is that such regressions focus

[1] The definition and more detailed discussion of non-stationarity follow in the next section.

the attention only on the short-run relationship and give no information about the long-run relationship (Harris 1995). The need to capture both the long-run relationship and the short-run dynamics led to the introduction of cointegration analysis and equilibrium-correction models (ECM), which have been used extensively in empirical studies on demand for money since mid--1980s. These models helped, not only in overcoming the problems related to spurious regressions, but also in overcoming the problem of multicollinearity and in capturing both the long-run relationships and the short-run movements in the relevant variables. Thomas (1997) argued that adding (removing) more differenced variables to (from) explanatory variables in an equilibrium-correction model could only affect the short-run variation of the dependent variable, while adding or removing any level variable will affect the specification of the long-run relationship and, hence the ECM definition.

The use of cointegration in estimating long-run relationships between non-stationary economic variables was introduced first by Granger in 1981, and was elaborated by him and his co-authors, as well as by others, during the 1980s (See Johansen 1988). The importance of the cointegration concept in econometric analysis stems from the link between cointegration and the existence of a long-run relationship between these variables (Banerjee et al 1993). This link has led to two essential characteristics highlighted by several econometricians. First, once a cointegrating vector exists, a static equation, which represents a long-run equilibrium relationship between the cointegrated variables, could be estimated using the method of Ordenary Least Square (OLS) (See Enders (1995) and Johansen (1988)). Second, the assurance of a stable long-run equilibrium relationship between the variables in that vector means that any deviation from this equilibrium must be stationary and, therefore, should be, automatically adjusted through the dynamics in the successive periods.

The Granger's Representation Theorem implies that whenever there is cointegration between any set of variables, there should be an equilibrium-correction representation (Engle and

Granger 1987). In other words, a certain proportion of any deviation from the equilibrium level (the error term in the long-run relationship) in any period must be corrected in the following period. This means that the change in the dependent variable in any period depends not only on the change in the explanatory variables but also on the magnitude of the deviation from equilibrium in the previous period.

3.4 Cointegration and ECM: Definitions, representation, and testing

3.4.1 Non-stationary variables and testing for unit roots

As mentioned earlier, the problem of spurious regression in the standard OLS method arises when all or some of the variables used are non-stationary. A stationary variable is the variable that has a constant mean and a constant variance over time. In other words, such a variable fluctuates around its mean within a finite range and tends to return to that mean. If the mean or the variance of any variable changes over time, this variable is non-stationary (Harris 1995). Non-stationarity is usually associated with the time trend in the variable's movement over time. Therefore, it is of quite importance to determine whether the series has a deterministic or a stochastic trend because each type could be removed by a special procedure. Maddala (2001) showed that removing any of them by the procedure relating to the other leads to spurious autocorrelations. If a non-stationary series has only a deterministic trend, it is called trend-stationary and the trend effect could be removed by de-trending the relevant series, thus transforming it into a stationary one, or by adding a time trend to the explanatory variables of the estimated model. If non-stationarity is caused by the existence of a stochastic trend, it should be removed by repeated differencing of the series until we get a stationary one. The number of times that a series needs to be differenced to become stationary is called the order of integration (See Hamilton 1994). When a series needs to be differenced k times to become stationary, it is called integrated of order k or I(k). Accordingly, a stationary series is I(0).

To express the definition of non-stationarity in a formal way, consider the simple case where the variable x_t is generated by the first-order autoregressive process

$$(3.1) \quad x_t = \alpha x_{t-1} + \varepsilon_t$$

where ε_t is a disturbance term with zero mean and a finite variance. In this simple data generating process, the current value of x_t depends on its own one period lagged value and the disturbance term. If the value of α in 3.1 equals unity ($\alpha \geq 1$), this variable is non-stationary, while if (α < 1), it is stationary. In other words, the existence or non-existence of a unit root in the data generating process of any variable is the determinant whether this variable is non-stationary or stationary.

3.4.2 Testing for unit roots

The first step towards cointegration analysis is to test for the order of integration of individual series. This is essential to understand the implications of including any variable in the system of equations under consideration at the start.

Several tests have been introduced to determine the order of integration of individual variables. Since the technical discussion of all these tests is out of the scope of this piece of research, one could refer to Phillips (1997) and Phillips and Xiao (1998) for a detailed list and discussion of these tests. For the purpose of this thesis, and following several empirical studies, three different tests are used to test for the unit root; namely: The Augmented Dickey-Fuller (ADF) test, the non-parametric Phillips and Perron test, and the Perron (1997) test for a unit root with a trend break.

3.4.2.1 Augmented Dickey-Fuller (ADF) test

The simple Dickey-Fuller (DF) test is designed to test the null hypothesis of $\alpha = 1$ in equation 3.1 above. If the null hypothesis is rejected this means that the data generating process has no unit root and, consequently, the variable is stationary. Otherwise, the unit root exists in the data generating process and the variable is non-stationary. Since the test statistics do not follow standard distributions of normal *t* and *F* ratios, Dickey and Fuller calculated special critical values based on the asymptotic distributions to be used as reference for the calculated statistics (Maddala 2001). However, and because this test associated with the first-order autoregressive data generating process, it has been found not suitable for the multiple autoregressive case, where the current value of the variable depends not only on its one period lagged value but also on its lagged values for several periods. Maddala (2001) showed that performing this test on a variable that follows a multiple autoregressive data generating process shifts the impact of the missing lagged values of the variable into the error term, which will suffer from autocorrelation. In such a case, the resulted test statistics would not follow the standard distributions and would not be suitable for statistical inferences.

To overcome this problem, Dickey and Fuller (1979 and 1981) proposed the Augmented Dickey-Fuller (ADF) test, which was constructed for the general Autoregressive Data Generation Process by adding lagged difference terms to the data generation process. The number of lags to be included in the test is very sensitive due to its impact on the size and power properties of the test; especially in the case of small sample sizes; where the number of observations is limited (Thomas 1997). Harris (1995) argued that adding a low number of lags that is less than sufficient to cure for the problem of autocorrelation would distort the size properties of the test and lead to under rejection; that is accepting the null hypothesis of a unit root when it is false. On the other hand, adding too many lags leads to a loss of the degrees of freedom and, consequently, reduces the power of the test leading to falsely rejecting the null hypothesis of a unit root when it is true.

Consider a series x_t that is generated from a general autoregressive process of the order p and represented by the following equation:

$$x_t = \beta_1 x_{t-1} + \beta_2 x_{t-2} + \dots\dots\dots + \beta_p x_{t-p} + \varepsilon_t \quad (3.2)$$

with the error term ϵ_t having a zero mean and a finite variance; i.e $\epsilon_t \sim N(0, \sigma^2)$. By re-parameterization, equation (3.2) could be transformed into the form:

$$(3.3) \qquad x_t = \alpha x_{t-1} + \sum_{i=2}^{p} \delta_i \Delta x_{t-i+1} + \varepsilon_t \qquad \text{where } \alpha = \sum_{i=1}^{p} \beta_i$$

By subtracting x_{t-1} from both sides, we get the first difference of x_t in the form:

$$(3.4) \qquad \Delta x_t = \lambda x_{t-1} + \sum_{i=2}^{p} \delta_i \Delta x_{t-i+1} + \varepsilon_t \qquad \text{where } \lambda = \alpha - 1$$

If the parameter of the lagged variable x_{t-1} in (3.3) equals unity (α =1), then the variation of the variable x tends to be increasing over time and, therefore, the process is non-stationary since the variable do not have a non-zero mean. Accordingly, the null hypothesis to be tested is H_0: α= 1 in equation (3.3), which is equivalent to λ= (α - 1) = 0 in equation (3.4), against the alternative hypothesis H_1: $\alpha < 1$ or $\lambda < 0$ in the two equations respectively. Rejection of the null hypothesis means that the variable is stationary, while the failure to reject the null hypothesis means the existence of a unit root and, therefore, the variable is non-stationary. We reject for large "enough" negative ADF statistic.

If the original data generation processes (DGP) of some variables include one or more deterministic factors such as a constant and/or a time trend, equation (3.3) could be extended to include such deterministic factors. Equations (3.3a) and (3.3b) are the extended forms of (3.3) for the inclusion of a constant, and the inclusion of a constant and time trend, respectively (See Banerjee et al 1993 for a detailed discussion).

$$(3.3a) \qquad x_t = \mu + \gamma x_{t-1} + \sum_{i=2}^{p} \eta_i \Delta x_{t-i+1} + \varepsilon_t$$

$$(3.3b) \qquad x_t = \mu + \beta_t + \psi x_{t-1} + \sum_{i=2}^{p} \varphi_i \Delta x_{t-i+1} + \varepsilon_t$$

The null hypothesis to be tested in this case is $\gamma = 1$ in equation (3.3a) and $\psi = 1$ in equation (3.3b).

3.4.2.2 Phillips-Perron Test

To avoid the problems related to the size and power properties of the ADF tests for unit roots, Perron and Phillips (1988) suggested a non-parametric correction to the DF test statistic. The suggested correction takes account of any possible bias due to autocorrelation in the error term instead of adding extra lagged terms that will lead to the loss of degrees of freedom. The Perron-Phillips test is a generalized form of the Dickey-Fuller procedure allowing the disturbance term to be weakly independent and heterogeneously distributed (Enders 1995). If the autocorrelation does not exist, the test statistic proposed by Perron and Phillips reduces to the standard DF statistic (Harris 1995). Banerjee et al (1993) showed that the Phillips-Perron test has more power than the ADF test but has also more size distortions in small size samples.

3.4.2.3 Perron Test with a Break-Trend

One of the main assumptions behind both the ADF test and the Phillips-Perron test is the correct specification of the deterministic trend. However, Perron (1989) showed that these tests could be misleading if a break in the deterministic trend exists. Assuming that only one time break exists, either in the level (the value of the constant) or in the slope (the value of the time-trend parameter) and the time of this break is known, he included a dummy variable in the model to account for this break. Perron (1989) argued that the failure to incorporate the trend-breaks in the model correctly would most likely lead to the acceptance of the null hypothesis of the unit root when in fact it is not true. Consequently, one could conclude that a series is non-stationary while in fact it is stationary with one or more structural breaks. The fact that Perron (1989) has assumed that the date of the break in the trend is known a *priori* and could be taken account for by including a dummy variable in the related equation has been criticised and considered unrealistic (See Harris 1995). Mohd (2005) showed that several researchers, including Perron (1997) had developed new tests after relaxing that assumption and allowing the break to be determined endogenously.

In his analysis of the impact of a trend break on the unit root tests' results, Perron (1989 and 1997) started from the general autoregressive case with a constant and time trend included in the model (equation 3.3b above). He discussed three types of models depending on whether the break affects the level of the trend (the constant term), the slope (the value of the coefficient of the time trend), or both. The first model, which he called the crash model, is known as the Innovational Outlier Model 1 (IO1). This model allows only for a change in the value of the intercept under both the null and the alternative hypotheses. Perron (1997) assumed this change in the intercept to take place gradually. The second Model, which Perron called the changing growth, is known as the Innovational Outlier Model 2 (IO2). This model allows for a shift in the intercept and a change in the slope of the trend at the time of the break. The third model, which is called the Additive Outlier Model (AO) allows for a smooth change, although occurring rapidly, in the slope of the trend so that the end-points of the two segments of the broken trend are joined. In this model, Perron (1989) adopted a two-step procedure. First, the series is de-trended, accounting for a trend break in the equation, and second the de-trended series is tested for a unit root assuming that it is generated by a general autoregressive process. The formal representations of the above-mentioned three models are as follows:

(3.5) $$x_t = \mu + \theta DU_t + \beta t + \lambda D(T_b)_t + \alpha x_{t-1} + \sum_{i=2}^{p} \delta_i \Delta x_{t-i+1} + \varepsilon_t$$ for (IO1)

(3.6) $$x_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \lambda D(T_b)_t + \alpha x_{t-1} + \sum_{i=2}^{p} \delta_i \Delta x_{t-i+1} + \varepsilon_t$$ for (IO2)

(3.7a) $$x_t = \mu + \theta DU_t + \beta t + \gamma DT_t^* + \tilde{x}_t$$ for de-trending the original series x_t, and

(3.7b) $$\tilde{x}_t = \alpha \tilde{x}_{t-1} + \sum_{i=1}^{p} \delta_i \Delta \tilde{x}_{t-i} + \varepsilon_t$$ for (AO)

where $DU_t = 1$ ($t > {}_{Tb}$) and 0 otherwise, $D(T_b) = 1$ ($t = T_b+1$) and 0 otherwise, DT_t=1 ($t > T_b$)t, and $DT_t^* = 1(t > T_b)(t - T_b)$.

In all the three models, both T_b and α are treated as unknown and determined endogenously by the models. Perron (1997) discussed three different statistical methods to determine the time of the trend break T_b endogenously. The first method, which is known as (method UR), assumes that T_b is selected from the potential values such that it minimizes the t-statistic for testing $\alpha = 1$. The second method, known as (method STUD), assumes that T_b is chosen such that it minimizes either the t-statistic of the test that is associated with the break in the constant term or the t-statistic associated with the break in the slope. Although this method allows the date of the change to be unknown, it allows, however, for the possibility of restricting the analysis to the cases of a crash or a slowdown in growth. The third method known as (method STUDABS) uses the same procedure of the second method to select T_b but without any a priori assumption on the sign of the change. In this case the time of the break is chosen such that it maximizes either of the two t-statistics associated with the change in the intercept or in the slope. The null hypothesis to be tested in each model is $\alpha =1$ against the alternative hypothesis $\alpha < 1$ in equations (3.5), (3.6) and (3.7b) respectively.

3.4.3 Cointegration

Consider a vector of non-stationary time series consisting of n variables ($X_1, X_2,....X_n$) that are all integrated to the same order d; i.e. all the variables need to be differenced d times to become stationary. The components of this vector are said to be cointegrated, if and only if, there exist a number of linear combinations of them that are integrated to a lower order c < d. If the difference between the two orders of integration is b = d – c, these variables are said to be cointegrated of order (d, b) and denoted by x_t ~ CI(d,b). Such linear combinations are called cointegrating vectors, and the number of cointegrating vectors is the rank of cointegration (See Banerjee et al 1993). If x_t is cointegrated of order CI(1,1), this means that the existing cointegrating vectors are stationary or I(0).

Ideally, the model should be balanced, i.e. all the variables included are of the same order of integration. Banerjee et al (1993) argued that it is not safe to use the standard distributions for statistical inference if the regression equation is unbalanced. However, Harris (1995) argued that it is possible to include variables of different order of integration in the model and still have cointegration between a subset of the variables, which are of the same order of integration. Harris (1995) argued that the inclusion of an I(0) variable helps in establishing the cointegration between the I(1) variables, especially if the economic theory supports such in inclusion. However, for every stationary variable added to the model, the number of cointegrating vectors increases correspondingly.

As mentioned earlier, once cointegration is ensured, Granger's Representation Theorem implies that there must be an equilibrium-correction-representation. The formal representation of these definitions starts with the unrestricted VAR system. Considering a general VAR of order k

$$(3.8) \quad x_t = \sum_{i=1}^{k} A_i x_{t-i} + \mu + \phi D_t + \varepsilon_t$$

where x_t is a $(n \times 1)$ vector of non-stationary variables, μ is a constant, D_t is a vector of deterministic variables (if needed to be included in the model), A_i and ϕ are the coefficient matrixes to be estimated, and ε_t is a vector of innovations. By successive substitution for each x_{t-i} for $i \geq 2$ by its equivalent in terms of $x_{t-i} = x_{t-1} - \sum_{i=1}^{k-1} \Delta x_{t-i}$, the VAR representation could be transformed into the form:

$$(3.9) \quad x_t = \sum_{i=1}^{k} A_i x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \mu + \phi D_t + \varepsilon_t$$

where $\Gamma_i = -\sum_{j=i+1}^{k} A_j$ for all i=1,….,k-1.

By subtracting x_{t-1} from both sides, the level VAR representation is transformed into a first difference representation of the form:

$$(3.10) \quad \Delta x_t = \Pi x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \mu + \phi D_t + \varepsilon_t$$

where Δ is the first difference operator and $\Pi = \sum_{i=1}^{k} A_i - I$

Equation (3.10) is known as the Vector Equilibrium-correction Model (VECM), where the first term in the right-hand side reflects the long-run equilibrium relationship, while the second term reflects the short-run dynamics.

3.4.4 Testing for cointegration

Since the introduction of the cointegration theory by Granger (1981), several techniques were introduced to test for cointegration in systems of integrated time series. The two-step technique introduced by Engle and Granger (1987) has been a common test for cointegration. The first step in this test is to estimate a static equation of the dependent variable (using OLS) on the regressors and to make a new series of the residuals of this equation. The second step is to test for the stationarity of the residuals' series using the ADF null hypothesis for a unit root test. If this new series is found to be stationary, i.e the unit root hypothesis is rejected, the variables included in the static equation are cointegrated, but if the residuals' series contain a unit root, these variables are not cointegrated.

Similar to the univariate test for unit roots, this test for cointegration depends on a non-standard distribution of a t-test. Harris (1995) argued, however, that the standard Dickey-Fuller critical values are not the right ones to be used when performing this test because of two reasons. First, and since the residual series has been constructed from an OLS regression, it has the smallest variance and, consequently, it tends to be as stationary as possible. This means that the test would tend to reject the null hypothesis of the unit root more than necessary. Second, and since the distribution of the test statistic is affected by the number of explanatory variables, the existence of the deterministic terms, and the sample size, it means that we need different critical values for each model specification. According to Harris (1995) and others, the more appropriate critical values to be used are the ones calculated by MacKinnon (1991).

The two-step procedure, however, was criticised even before the work of Engle and Granger was published. Banerjee et al (1986) objected to the estimation of a static relationship and argued that the estimated parameters of such a static regression are subject to the small sample bias. Instead of a static regression, Banerjee and his co-authors suggested an equilibrium-correction model; i.e a dynamic relationship that includes both the long-run variables and the variables reflecting the short-run dynamics. As in the Engle and Granger procedure, the residuals of this dynamic regression are to be tested for stationarity as a test for cointegration. Both the Engle and Granger procedure and the Banerjee et al procedure allow for only one cointegrating vector.

The above-mentioned two procedures might work well in the two-variable case, because the cointegrating vector, if found, is unique. In the multivariable case, however, these two tests might not be adequate because there could be more than one cointegrating vector. Maddala (2001) argued that, in the case of the existence of multiple cointegrating vectors, any of these vectors might not be uniquely determined and some of them might not have economic sense. This means that the modeller has to identify the meaningful economic vector(s) based on economic theory.

Johansen (1988), (1991) and (1995) introduced a likelihood ratio technique to test for and estimate cointegration relationships in the multivariate system case. Johansen's procedure is to estimate an unrestricted VAR for the variables under consideration, and then to test for the rank of the coefficients' matrix $\prod$ in the system of equations represented in equation (3.3). According to the Granger's Representation Theorem, if the coefficient matrix $\prod$ has a reduced rank r < n, then there exists n × r matrixes α and β such that $\Pi = \alpha\beta'$ and $\beta' x_t$ is I(0), which means that the components of x_t are cointegrated. The rank r is the number of cointegrating vectors. Each column in β represents a cointegrating vector and, therefore, could be interpreted as a long-run relationship, while the elements of α are the adjustment factors in the VECM. Once cointegration is found, the next step is to identify the right cointegrating vector(s) by imposing certain restrictions on the coefficients of the α and β matrixes depending on the underlying economic theory.

If the coefficient matrix ∏, however, has a full rank (r = n), then all the variables in the vector x_t are stationary; they are neither integrated nor cointegrated. In such a case, any OLS regression estimated for any subset of these variables is not spurious and should be valid for statistical inferences binding on its economic interpretation. On the other hand, if the rank of the ∏ matrix is zero (r = 0), then all the components of x_t are non-stationary and not co-integrated, which means it is impossible to obtain any stationary linear combination for any subset of these variables and, therefore, there is no long-run relationship between these variables (See Maddala 2001).

Johansen discussed two test statistics for determining the number of the cointegrating vectors within the system; the maximum eigenvalue statistic and the trace statistic. In the literature, the trace statistic has been relied upon more than the maximum eigenvalue statistic because it has more power, although it has more size distortion (Mohd 2005). Doornik et al (1998) argued that the trace statistic provides a consistent rank determination procedure, while such consistency is not found in the case of the maximum eigenvalue statistic. The maximum eigenvalue statistic, which tests for the null hypothesis of (r + 1) cointegrating vectors versus the hypothesis of r cointegrating vectors is given by

(3.11) $$\lambda_{\max} = -T\ln(1-\hat{\lambda}_{r+1}) \quad \text{for r = 0, 1, 2,……, n-2,n-1.}$$

where $\hat{\lambda}_{r+1}...\hat{\lambda}_{p}$ are the (n-r) eigenvalues and T is the sample size. The trace statistic, which tests for the hypothesis of at most (r) cointegrating vectors, is

(3.12) $$\lambda_{trace} = -2\log(Q) = -T\sum_{i=r+1}^{p}\ln(1-\hat{\lambda}_{i}). \quad \text{for r = 0, 1, 2,……, n-2, n-1.}$$

where *Q* is the restricted maximized likelihood divided by the unrestricted maximized likelihood.

For the purpose of this thesis, the Johansen approach will be used for cointegration analysis using Pc-Fiml version 9 (See Doornik and Hendry 1997). Based on the trace statistic, the first step in this procedure is to determine the number of cointegrating vectors, with the aim of finding only one cointegrating vector. As mentioned earlier, the null hypothesis to be tested is the existence of at most r cointegrating vectors against the alternative hypothesis of the existence of r+1 cointegrating vectors. Because the number of observations is limited (a maximum of 35 years), the calculated trace statistic will also be compared with the critical values calculated for the small sample applying the Monte Carlo simulation done by Santoso (2001).

If cointegration is found, the second step is to identify the long-run relationship that makes economic sense through testing certain restrictions on the parameters of the found cointegrating vector based on the economic theory and other restrictions on the adjustment factors to check the weak exogeneity of the regressors (See Johansen 1995). Once the cointegrating vector is identified in line with economic theory, it would be possible to re-parameterise the VAR in first differences into the Vector Error Correction Model (VECM) form.

3.5 Demand for Money in Jordan

3.5.1 Previous empirical studies on demand for money in Jordan

To my knowledge, there are few empirical studies on demand for money in Jordan. Within the framework of a multi-country study, Crockett and Evans (1980), estimated a single equation for the money demand in Jordan, and found that inflation, as a measure of opportunity cost, does not show a significant role in determining the demand for money (this result was applicable to all but three of the 19 countries included in their study). Therefore, they concluded that real gross national product is the sole determinant of real money demand for both narrow and broad definitions of money (M1 and M2 respectively), with income elasticity of 0.87 for M1 and 1.1 for M2. Although the absence of the opportunity cost variable could be explained by the lack of a proper interest rate variable, and the lack of enough variation in the inflation rate, any statistical inference from this result remains subject to doubts due to the limited number of observations; only twelve annual observations (1967-1978) were used for estimation.

Toqan (1993) estimated demand functions for different components of monetary aggregates in Jordan in both real and nominal terms. When estimating the demand for real money balances, Toqan used real GDP as a measure of income, the investment/GDP ratio as a proxy of capital stock[1], and expected inflation rate as a measure of opportunity cost variable as explanatory variables. When estimating the demand for nominal money balances, he added the price level to the above-mentioned variables. The income elasticity of demand for real money balances reported by Toqan was almost invariant between narrow and broad money definitions (See Table 3.3). The elasticity with respect to both the investment/GDP ratio and the expected inflation rate were found to be positive in the case of M1 and negative in the case of M2. In addition to the fact that the positive sign of elasticity of M1 with respect to expected inflation conflicts with the expected theoretical sign, it is also statistically insignificant, which makes the model inappropriate for any reliable inferences.

Table 3.3: Elasticity of Real and Nominal Money Balances Reported in Toqan (1993) With Respect to Different Independent Variables

Independent Variables	Real Money Balances		Nominal Money Balances	
	M1	M2	M1	M2
Price Level	--	--	1.01	1.58
Income	0.66	0.64	0.64	0.63
Investment/Income	27.22	-22.44	27.72	-23.02
Expected Inflation	0.10	-0.18	0.11	-0.18

Toqan also found that nominal balances of M1 adjust proportionately to the price level, while nominal balances of M2 adjust by almost 60 per cent more than proportional to the price level. The elasticity of the nominal balances of both M1 and M2 with respect to income, the

[1] Toqan argued that the inclusion of the capital stock variable was to reflect the fact that the Jordanian economy is a self-financing one where the savers are most likely to be the investors also. He stated that he is "*following Mckinnon (1973)*").

capital stock proxy, and the expected inflation rate remained almost at the same level of those estimated in the demand for real balances of (M1) and (M2). Inferences from this model are also subject to doubt due to the small sample size (Eighteen annual observations 1971-1988).

Shibli (1999), using cointegration and the ECM modelling techniques, estimated a demand function for nominal balances of both the narrowly and broadly defined monetary aggregates in Jordan (M1 and M2). Shibli used a system of five variables namely: nominal M1 or M2 for the monetary aggregate, nominal GDP, interest rate on time deposits, workers' remittances, and exchange rate of the Jordan Dinar in terms of US dollar. He found a cointegrating relationship between M2 on the one hand, and GDP, interest rate, workers' remittances, and exchange rate on the other. No cointegrating relationship for M1 was found. Table 3.4 shows the Shibli's reported long-run elasticity of the two monetary aggregates with respect to the relevant arguments of each equation.

Table 3.4: Shibli's Long-run Elasticity of M1 and M2 with Respect to Different Arguments

Monetary Aggregate	GDP	Workers' Remittances	Interest Rate	Exchange Rate
M1 (RALS) [t-values]	0.36 [2.39]	-0.31 [-5.25]	-0.32 [-3.34]	0.15 [3.3]
M2 (ECM) (Ses)	1.75 (0.071)	-0.61 (-0.071)	-0.33 (0.17)	0.07 (0.061)

The demand for nominal M2 is positively correlated to income and the exchange rate, while it is negatively correlated to interest rate and workers' remittances. When estimating the short-run relationship, the sign of each elasticity remained the same, but their magnitude with respect to income, interest rate, and workers' remittances declined considerably, while that with respect to the exchange rate increased. The reported speed of adjustment for the imbalances between actual and desired money balances was 0.46.

Since no cointegrating relationship for M1 was found, Shibli applied the Autoregressive Least Square technique (RALS) to estimate the long-run demand for M1. He concluded that, in the long-run nominal balances of M1 are also positively affected by GDP and the exchange rate, and negatively affected by workers' remittances and the interest rate. However, as shown in Table 3.5 above, the magnitudes of the long-run elasticity in this case differ remarkably from those of the long-run demand for M2.

Shibli's work has three advantages over the work of both Crocket and Evans, and Toqan. First, his sample is relatively longer (Annual data 1976-1996). Second, he included workers' remittances and the exchange rate in the model to measure the impact of external factors on the demand for money. Third, he used a more advanced econometric technique to estimate the demand for money. Nevertheless, one could argue that his results are hardly reliable for statistical inferences. The main source of disagreement stems from the nominal specification he used for the money demand function, which gives limited information, if any, about the relationship between real variables, on which all the demand for money theories were based. In other words it is difficult to tell from the estimated relationship between the nominal variables whether the positive impact of nominal GDP on nominal money balances is generated from an increase in real output or from rise in the price level.

However, it is worth noting, in this regard, that some empirical studies have called for estimating the demand for money function in nominal terms rather than real terms. Liang (1984), for example, argued that the nominal specification of the demand for money function is more stable and gives better forecasts than the real specification does. Accordingly, Liang (1984) claimed that the nominal specification of the demand for money function provides the solution to the issue of over-prediction, which was raised by Goldfeld (1976) and Enzler et. al (1976), and known in the monetary literature as "the missing money". Nevertheless, the majority of empirical studies continued to use a real specification rather than a nominal one because the former conforms better to the economic theory behind the demand for money. Moreover, Garcia and Pak (1979) argued that the relatively large errors reported by Goldfeld (1974) were not the result of misspecification of the demand for money function but the result of inappropriate definition of money. Garcia and Pak argued that these errors declined considerably when Goldfeld's model was re-estimated using a wider definition of money that includes some financial transactions, which used to be classified as money alternates. The most obvious example of such transactions, according to Garcia and Pak, is the Immediately Available Funds Transactions, which have spread widely during the 1970s. These transactions allowed the large institutional depositors to sell, overnight, their end-of-day demand deposits to their banks and retrieve these deposits the next morning.

A second point one could argue about Shibli's work is the use of workers' remittances among the arguments of the demand for money function to represent, in addition to the exchange rate, the external factors that affect the demand for money in Jordan. First, and especially in a small developing country like Jordan, remittances are mainly used to finance domestic investment or consumption and, consequently, they are most likely to have a positive impact on domestic income. Glytsos (2005) showed that remittances have a significant impact on economic growth in five Mediterranean countries including Jordan. According to Glytsos's calculations, half of the overall growth rate of output in Jordan during the periods 1975-1985 and 1991-1997 was induced by the growth in remittances, while during the recession episode (1986-1990), all the decline in output was induced by the decline in remittances. In light of this high correlation between the income variable and remittances, adding remittances to the arguments of the demand for money function is expected to cause multicollinearity, which complicates the statistical properties of the estimated equations. Second, and even if remittances are directed mainly towards savings, it is hardly defendable to argue that these remittances have a negative effect on the demand for money, especially in the case of the broadly defined money (M2) when foreign currency deposits are included in that definition. Finally, remittances constitute only one source of foreign currency income and, hence, the estimation of its impact on the quantity of money without considering other sources of foreign currency income and the outgoing payments of foreign currency results in very limited information.

3.5.2 The model

As previously mentioned, the standard model of the demand for money is generally a function of a scale variable and an opportunity cost variable or set of variables. Laidler (1984) argued that the choice of these variables is an empirical issue. Arize (1994) argued that the set of opportunity cost variables should take account of foreign portfolio decisions in addition to domestic portfolio ones. Arize and Shwiff (1998) argued that after the adoption of more flexible exchange rate systems by several countries, the exchange rate became a possible factor in the demand for money function.

In light of these new directions in the literature, and to address the above-mentioned shortcomings in the estimation of a demand function for money in Jordan, we use the Johansen technique of cointegration analysis and equilibrium-correction mechanism to explore the existence of a long-run demand for money relationship in Jordan. The aim is to estimate a long-run demand relationship for real rather than nominal money balances by using a system of variables that incorporates both internal and external factors that could affect the demand for money.

For this purpose, the scale variable is represented by either real GDP (y) or real final total expenditure (Ex). The opportunity cost is represented by measures of both domestic and foreign factors. The discount rate and the inflation rate are used as measures of domestic opportunity cost. On the other hand, the impact of foreign opportunity cost is represented by a measure of the foreign interest rate and by a measure of the exchange rate. Therefore, the long-run demand for real money balances (RM) in Jordan could be written in the form:

$$rm_{jt} = \beta_0 + \beta_1 y_t + \beta_2 i_t + \beta_3 \Delta p_t + \beta_4 fi_t + \beta_5 \Delta e_t + \varepsilon_t \quad (3.12)$$

where all the variables are in the log form except for the interest rates, and *rm* represents real money balances with the subscript *j* refers to the definition of the monetary aggregate used, *y* is the scale variable represented by either real GDP or real total final expenditure, *i* is the discount rate, Δp is the inflation rate measured by the percentage change in the consumer price index *p* as a measure of price level, Δe is the percentage change in the exchange rate, measured in terms of the number of foreign currency units per one Jordan Dinar (where a positive value means an appreciation of the Dinar), and *fi* is the US Federal Funds rate. $ß_0$, $ß_1$,…., and $ß_5$ are parameters, and ε is the error term.

From theories of money demand, and from previous empirical studies, *y* is expected to have a positive effect on real money balances with ($ß_1$>0). The impact of the domestic interest rate is ambiguous. On the one hand, it could be positive if the monetary aggregate constitutes a major part of the interest-bearing portfolio of individuals as in the case of the developed countries (See Doornik et al 1998). On the other hand, if the monetary aggregate does not bear any interest, like the narrowly defined money supply in the case of Jordan, the impact of the interest rate is expected to be negative. Therefore, the sign of $ß_2$ depends upon the proportion of the interest bearing components in the monetary aggregate. Thus, it is expected that $ß_2 < 0$ when estimating a demand function for the *M1* while it could be either way when estimating the demand function for the broadly defined money *M2*. Inflation and foreign interest rate are expected to affect money demand negatively; i.e $ß_3$, and $ß_4$ <0. The exchange rate impact on the demand for money is ambiguous. Arango and Nadiri (1981) argued that a change in the exchange rate of a certain currency is expected to have a negative impact on the demand for that currency as a result of the wealth effect resulting from the revaluation of the residents' foreign currency assets. This negative impact conforms also to the substitution effect associated to the expected shift in the demand for domestically produced and imported goods due to the resulting change in relative prices. On the other hand, Bahmani-Oskooee (1991) and Bahmani-Oskooee et al (1998) argued that if the change in the exchange rate, especially in the case of depreciation, was viewed as the first step to be followed by further successive changes in the same direction, this change could have a positive impact on the demand for money.

To explore the existence and the validity of a long-run demand for money relationship in Jordan, we follow the following procedure:

- Determining the order of integration of the individual series.
- Testing for cointegration and the rank of cointegration between the set of variables mentioned earlier, using the Johansen technique as implemented in PcGive version 10.0 incorporated in GiveWin 2.02 (Doornik and Hendry (2001).
- Identifying the right cointegrating vector(s) by imposing the required restrictions on the suggested vector(s) to identify the significant explanatory variables that affect the demand for money. The idea is to find one cointegrating vector standardised for real money, therefore, estimating the static long-run money demand function, and finally
- Estimating its dynamic equation with the equilibrium-correction term.

3.5.3 The data choice and description

Most of the data were extracted from the IMF database/ International Financial Statistics, using either the DataStream service at the library of the university, or the IMF's CD. All the extracted series were updated and verified by matching them to the latest updated published national sources; mainly the Monthly Statistical Bulletin of the CBJ. With the exception of interest rates, all variables were transformed into logarithmic form and represented by letters in lower case. Real balances of monetary aggregates and income variables are measured by dividing nominal relevant variables by the price level. The following is a brief description of the variables considered for use in the model:

Monetary Aggregates: As is the case in other empirical studies, the choice between the narrowly defined money supply (M1) and the broadly defined one (M2) to represent the monetary aggregate in the demand for money function in Jordan is not a clear-cut case (See Sriram 1999). The fact that the broadly defined money supply (M2) has been used as the intermediate target for monetary policy for more than four decades pushes towards choosing it as the appropriate monetary aggregate for the purpose of this study. One could also argue that this aggregate is more representative when it comes to financing aggregate demand or to the different motives for the demand for money. However, correlation rates between changes in real M2 on the one hand, and the candidate arguments of the demand for money function on the other, may not exclusively support such an argument. Table 3.5 shows that the correlation rates between changes in real M2 and changes in real GDP, exchange rate, nominal effective exchange rate, and inflation rate are higher in magnitude than those between real M1 and these variables. On the other hand, the correlation rates between changes in real M2 and changes in real gross national expenditure, the discount rate, real interest rate, and real effective exchange rate are lower in magnitude than the correlation rates between real M1 and these variables.

Table 3.5: Correlation rates between changes in real monetary aggregates and changes in selected variables

	Real M1	Real M2
Real Gross Domestic Product	0.32	0.38
Real Gross National Expenditure	0.34	0.27
Discount Rate	-0.42	-0.30
Real Interest Rate*	-0.41	-0.28
Exchange Rate (Jordan Dinar in terms of US dollars)	0.39	0.50
Nominal Effective Exchange Rate**	0.15	0.22
Real Effective Exchange Rate**	-0.21	-0.02
Inflation Rate (Percentage change in CPI)	-0.15	-0.22

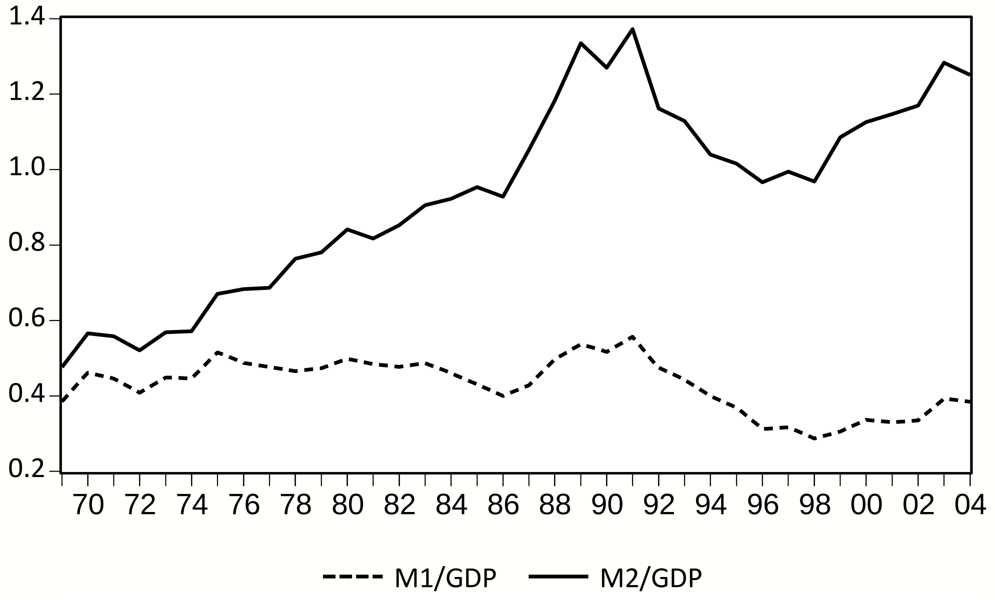
* Equals the discount rate minus the inflation rate.
**An increase means appreciation of real effective exchange rate index of the Dinar.

In addition to the inconclusive correlation rates, there are several factors, which work in favour of choosing M1 rather than M2. *First*, M1 does not bear any kind of interest, which makes it more realistic as a measure of idle money balances. *Second*, the additional part of M2 (Quasi Money), which consists of the interest bearing deposits with banking institutions denominated in both the Jordan Dinar and foreign currencies, could represent a good substitute of money especially in a shallow undeveloped financial market and, therefore, could be interpreted as one form of saving. *Third*, the fact that the two components of the interest bearing part of quasi money (domestic and foreign currency deposits) are almost complete substitutes makes it difficult to detect the accurate variation of quasi money in response to changes in relative interest rates and/ or changes in exchange rates. In fact, changes in relative interest rates and exchange rates might only result in a change in the structure of quasi money. Figure 3.2 shows that although the ratio of foreign currency component to quasi money in Jordan has been upward trending since early 1980s, it fluctuated considerably after the financial crisis in the late 1980s. *Fourth,* the ratio of M1 to GDP shows relatively more stability over time compared to that of M2, which showed an upward trend for most of the time (See Figure 3.3).

Figure 3.2: Foreign currency component of quasi money in Jordan (percent)

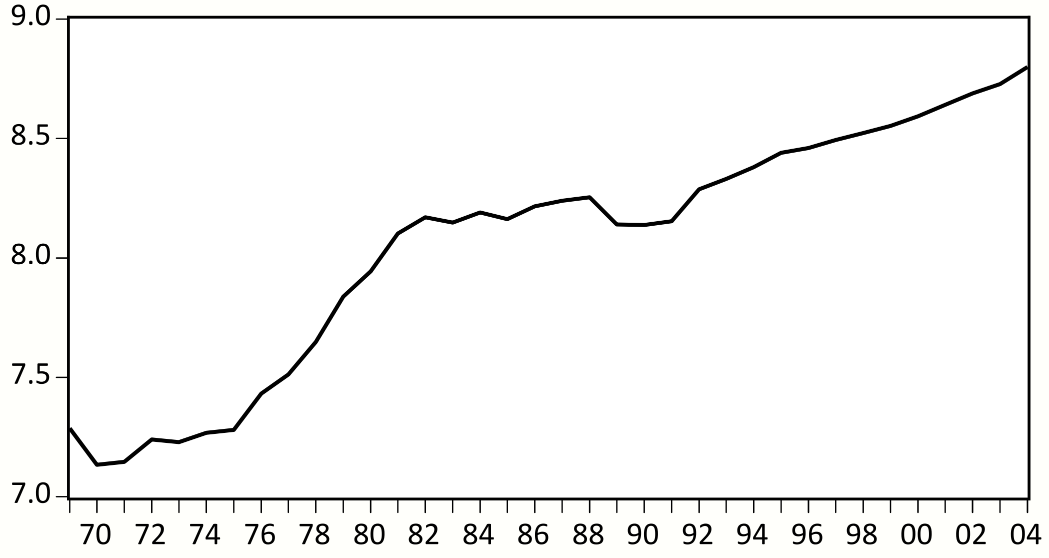
Given the inconclusiveness on the priority of one monetary aggregate on the other, the intention is to estimate a demand function for both monetary aggregates. If an acceptable relationship using the broadly defined monetary aggregate does not exist, the Jordanian Dinar component of this monetary aggregate (RJM2) might be considered as an alternative.

Figure 3.3: Narrowly and broadly defined monetary aggregates ratio to gross domestic product



The Scale Variable: No published data on wealth or any other measure of permanent income in Jordan are available to date. Data on real output in Jordan was not compiled prior to 1986, where national accounts used to be prepared only in nominal terms and then deflated by the consumer price index (CPI). Since 1986 gross domestic product (GDP) is compiled in both nominal and real terms, and the GDP deflator is, therefore, implicitly calculated from the two series. The time span for the new series on real GDP is relatively short for reliable inferences. On the other hand, combining the new series with the old one, which used to be calculated by deflating the nominal output by the CPI could create some inconsistency in the series of real income. Therefore, it seems reasonable to use the old procedure of deflating the nominal GDP by CPI to get real gross domestic product at constant prices. Figure 3.4 shows the time path of real GDP.

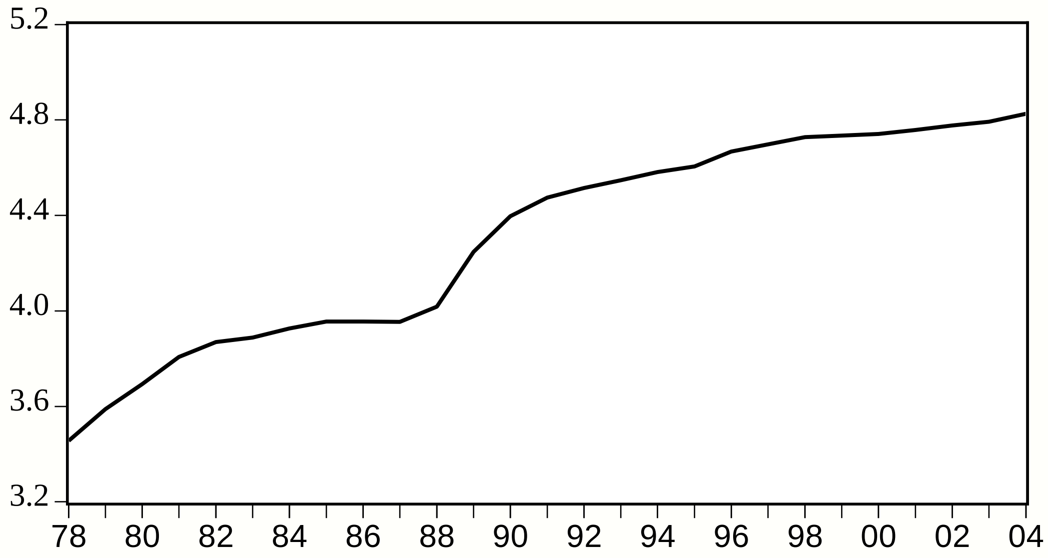
Figure 3.4: Real gross domestic product (Logarithms)



Gross National Expenditure (GNE) is another potential scale variable. Since it measures the total domestic demand for goods and services in the economy, one could consider this measure a better proxy for the scale variable. However, the choice between GNE and GDP is not a clear cut. When changes in real monetary aggregates and real GDP and GNE were considered, the correlation rate of GNE with real M1 is higher than that of GDP, while it is lower in the case of correlation with real M2 (See Table 3.5 above). Therefore, and since the choice of the scale variable has proven to be an empirical issue (See Sriram 1999 and 2001), both measures will be tested in the demand functions for both M1 and M2 for the purpose of this thesis.

The Price Level: Three measures of the price level are being published in Jordan; namely the Consumer Price Index (CPI), the Wholesale Price Index (WPI), and the GDP deflator. The CPI has been published since late the 1960s, and its percentage changes have been adopted as the official measure for inflation since then. In addition to these two advantages over the other two measures of the price level in Jordan, this variable has been commonly used in empirical estimation of the demand for money even in some developed countries (See Sriram 2001). Figure 3.5 shows the time path of the consumer price index in Jordan.

Figure 3.5: Consumer price index in Jordan (Logharithms)



As mentioned earlier, the GDP deflator was published for the first time in 1986. This makes it available for only the second half of the sample period, which is relatively short for reliable statistical inference. The WPI was published for the first time by the CBJ in 1976 covering only the city of Amman the capital city of Jordan. The CBJ continued to publish this index until the end of 1992, when the Department of Statistics (DOS) took over and started to publish a new series of the index in 1993. The components and weights of the two indices are quite different, which makes combining them into one series unrealistic (See Table 3.6). Thus, the CPI will be used to represent the price level for the purpose of this thesis.

Table 3.6: Weights of selected groups in the Wholesale Price Index calculated by the CBJ and that calculated by the DOS

	Dairy Products & Eggs	Meat & Fish	Cigarettes & Beverages	Construction Materials	Transport Vehicles	Clothes, Textiles, & footwear
CBJ Index	4.6	9.3	4.8	24.3	3.6	8.0
DOS Index	0.8	2.2	1.4	12.5	8.2	1.0

Source: CBJ, Yearly Statistical Series (1964-2003), Table 48.

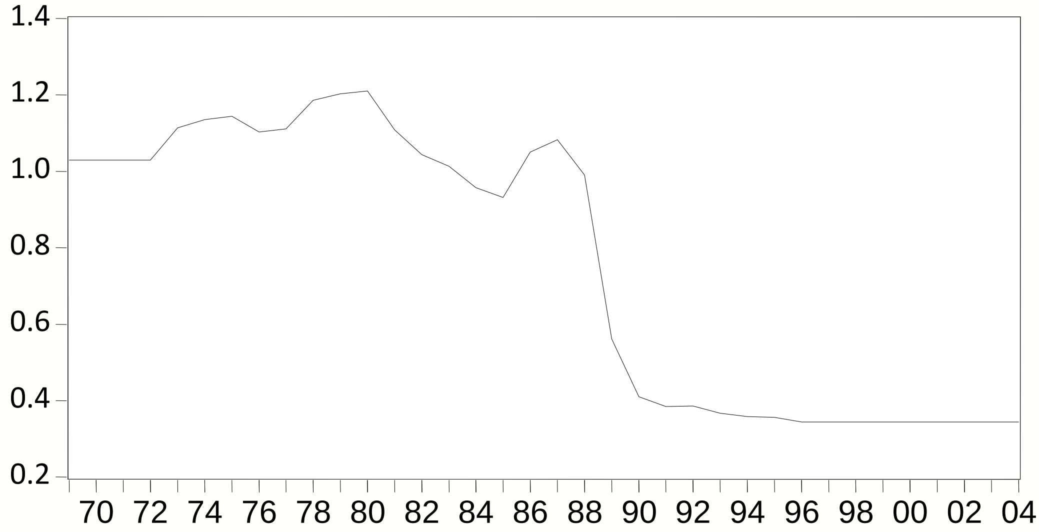
Interest rate: Up to the late 1980s, no data on market deposit interest rates were published in Jordan. Until then, the published data represent only the minimum or the maximum interest rates determined by the CBJ. This, in addition to the regime shift from determining the minimum rate to determining the maximum rate, made it difficult to use the deposit interest rate as a representative of domestic interest rate because of the resultant inconsistency. The best alternative to this rate is thought to be the discount rate, which is used by the CBJ as a policy tool even after resorting to indirect monetary control in 1993. In practice, this rate serves as a benchmark for banks when they set their rates. A second alternative could be the interest rate on long-term government bonds (RGB) since these bonds are considered as an alternative financial asset to money. This rate, however, used to be determined jointly by the CBJ and the Ministry of Finance with the aim of encouraging the public and institutional investors, including banks, to buy these bonds to minimize the direct financing of the budget deficit by the CBJ. The fact that these bonds were issued for relatively long intervals, and that the amounts allocated to the public were relatively small, makes this rate not a good alternative. Comparing the time path of this rate to that of the discount rate (Figure 3.6) shows that it was not directly related to the monetary policy stance as reflected by the movement in the discount rate. Thus, it could be concluded that the latter rate could be more appropriate as a measure of the domestic interest rate. Real interest rate is defined by the difference between the nominal interest rate and the inflation rate.

Figure 3.6: End of period discount rate and government bonds' rate (Percentages)

Foreign interest rate: Whether deposited with local banks or abroad, the US dollar has been the major substitute for the Jordan Dinar. Therefore, the US Federal Funds Rate (USFED), which was extracted from the IMF database, is used as a measure of the foreign interest rate. In addition to the nominal USFED, however, the adjusted return on foreign portfolio assets (FIDE) is considered to replace both the USFED and the exchange variable in certain systems of equations. This return is measured by the nominal value of USFED minus the change in the exchange rate of the Dinar in terms of the US dollar (FIDE = USFED- ΔE).

Exchange rate: The Jordan Dinar exchange rate in terms of US dollar was either fixed or suppressed to ensure a minimum variation. The limited variation of this rate suggests that this rate might have only little impact on money demand in Jordan. Figure 3.7 shows the time path of the Dinar exchange rate in terms of the US dollar. To capture the actual movement of the Jordan Dinar exchange rate in the market, we constructed a nominal effective exchange rate (NEER) and real effective exchange rate (REER) indexes as possible alternative measures of the Dinar exchange rate.

Figure 3.7: The Jordan Dinar exchange rate in terms of the US dollar (Logarithms)



These composite indexes measure the exchange rate of the Jordan Dinar against a set of foreign currencies. They measure the value of the Dinar in terms of the composite unit of the currencies included, weighted by the countries' relative share of Jordan's external trade (exports plus imports). Thus, an increase in the index represents an appreciation of the Dinar. The two indexes were computed for a sample of 18 countries; namely: Australia, Belgium, Egypt, France, Germany, India, Indonesia, Italy, Japan, Malaysia, Netherlands, Pakistan, South Korea, Spain, Switzerland, Turkey, United Kingdom, and United States. Collectively, trade with these 18 countries constitute 51.6% of Jordan's total external trade. Every country that constitutes at least 1% of Jordan's either exports or imports was originally included in the sample. However, ten countries were excluded due to unavailability of reliable data. Argentina was excluded because the related exchange rate index has become meaningless after the countless depreciations of the Peso. China, Kuwait, Syria, United Arab Emirates, and Saudi Arabia were excluded due to unavailability of reliable time series on the price index needed to construct real effective exchange rate; while Iraq, Lebanon, Russia, and Taiwan were excluded due to unavailability of reliable time series on the exchange rate.

To construct these indexes, exchange rates in terms of national currency units per Jordan Dinar were calculated using the cross rates of these countries' currencies with the US dollar. All exchange rates in terms of the number of US dollars per national currency unit were extracted from the IMF database except for the exchange rates of the Egyptian pound and the Turkish Lira. The exchange rate of the Egyptian pound was calculated, implicitly, by dividing the value of Egyptian exports in US dollars by their value in Egyptian pounds, and that of the Turkish Lira was extracted from the online statistical database of the Central Bank of Turkey.

Using the same sample of countries, a composite index for foreign prices was constructed also for the purpose of calculating the REER index. To that end, the Producer's Price Index of each individual country was used whenever available; otherwise, the CPI was used. All such data were extracted from the IMF or the OECD database. Figure 3.8 shows the time path of both the NEER and the REER. With the exception of the period after 1996, variations in both measures seem to be in the same direction.

Figure 3.8: Nominal and real effective exchange rate indexes of the Jordan dinar (Logarithms)

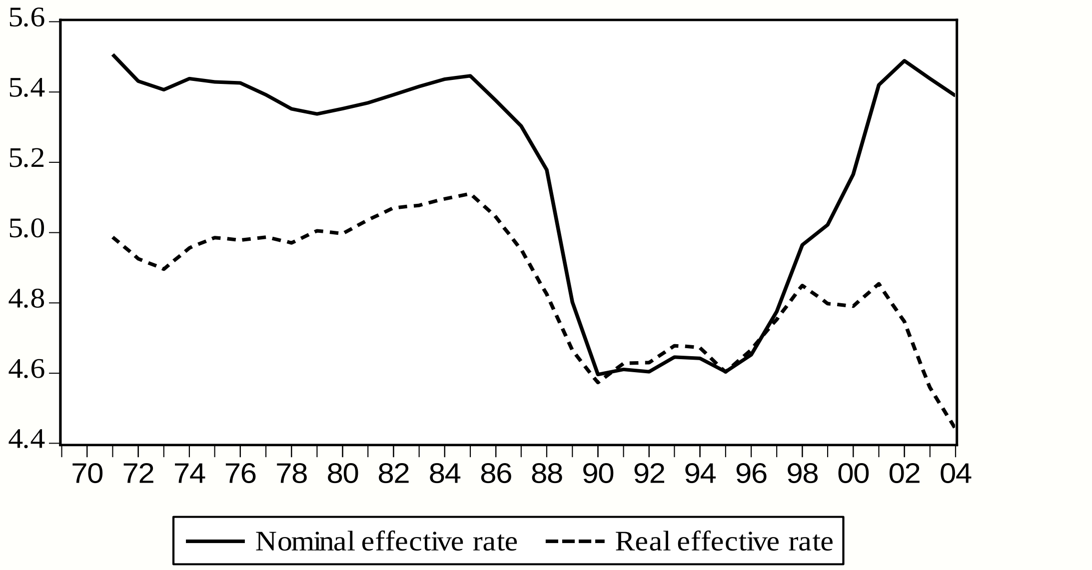


Table 3.5 above shows that changes in the standard exchange rate definition in terms of US dollars and in the nominal effective exchange rate index are positively correlated with changes

in the monetary aggregates. On the other hand, changes in the real effective exchange rate are negatively correlated with those of the monetary aggregates.

3.6 Empirical Results

3.6.1 Unit root tests results

One of the important issues relevant to the specification of the unit root tests is what deterministic variables should be included in the equation (Banerjee et al 1993). Following most of the empirical studies, we consider the three possible models in this regard; i.e, without any deterministic variable, with a constant, and with a constant and a time trend. When performing the ADF and Phillips-Perron tests, Phillips-Perron test automatically chose three lags according to the New-West criterion using Bartlett kernel. As for the ADF test, 5 lags were chosen as a starting point, and then one lag was dropped at a time if the largest lag proved to be insignificant repeating the test with one lag less each time. None of the variables proved to need more than one lag. Table 3.7 shows the unit root test results of both the ADF test and the Phillips-Perron test for the variables in level form.

Table 3.7: Unit Root Test for Money Demand Variables
(in Levels)

Variables	ADF Test			Phillips-Perron Test		
	None	C	C and T	None	C	C and T
E	-1.159143	-0.957877	-2.715000	-1.264724	-0.596601	-0.596601
NE	-0.117055	-1.991598	-2.094174	-0.220211	-1.504242	-1.041662
RE	-0.740739	-1.114948	-2.758670	-1.033173	-0.749795	-1.758417
RM1	2.662658	-1.329104	-1.716743	2.090652	-1.220740	-1.551260
RM2	2.391247	-1.349681	-1.552194	3.508996	-1.171375	-1.241488
RJM2	4.160416	-1.754298	-0.972228	2.741805	-1.534371	-1.199403
Y	2.994619	-1.629275	-2.423586	2.796269	-0.549736	-1.716063
EX	2.262418	-0.405825	-1.668893	2.262418	-0.405825	-1.795021
I	-0.554570	-0.915328	-0.324139	-0.574392	-1.297158	-0.489674
RI	-0.547548	-0.880814	-0.273868	-0.569005	-1.274394	-0.437153
USFED	-0.942014	-2.597192	-3.858889*	-0.809359	-1.524603	-1.930963
P	1.466339	-2.089643	-0.227147	3.425054	-2.620441	-0.665454
1% Critical Value	*-2.634731*	*-3.639407*	*-4.252879*	*-2.632688*	*-3.632900*	*-4.243644*
5% Critical Value	*-1.951000*	*-2.951125*	*-3.548490*	*-1.950687*	*-2.948404*	*-3.544284*

Note: "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% significance level respectively.

The results of the Phillips-Perron test reveal that the unit root hypothesis could not be rejected for all variables neither at the 5% nor at the 1% significance level, regardless of what deterministic variables are included in the equation. The results of the ADF test, however, show that the unit root hypothesis in the case of the US Fed rate is rejected at the 5% significance level if a constant and trend were included in the test equation. This null hypothesis could not be rejected for all other variables regardless of the deterministic variable included. Therefore, and binding on the test results for the first differences of these variables, all the variables are assumed to be I(1) except for the foreign interest rate (USFED), which could be stationary.

Table 3.8 shows the unit root tests' results of the first differences of the variables. If a constant is not included in the model, both the ADF test and the Phillips-Perron test reveal that the first difference of all variables is stationary at the 1% significance level except for the broadly defined real money supply (RM2) and the price level (P). The first difference of RM2 was found to be stationary at the 5% level of significance, while the first difference of P was found to be non-stationary.

When the constant is included in the model, the Phillips-Perron test reveals that the first differences of all the variables are stationary except for the nominal effective exchange rate index (NE) and the price level (P). As for the ADF test results, the first differences are stationary for all variables except for the nominal effective exchange rate (NE) and real effective exchange rate (RE).

As one could see from Figure 3.9, it is clear that the average of the first differences of the price level (P) and the broadly defined real money supply (RM2) are significantly different from zero. This suggests that the relevant results regarding these two variables are those of the model that includes a constant. The test results of this model show that the first difference of RM2 is stationary at the 5% level of significance according to both tests, while the first difference of the price level is stationary at the 5% level of significance according to the ADF test only. However, the ADF test rejection of the unit root hypothesis in the first difference of the price level was only marginal, which suggests that the inflation rate might be non-stationary. Accordingly, it is safe to conclude that all the variables in the system are I(1) except the price level, which is I(2) and the foreign interest rate, which could be stationary.

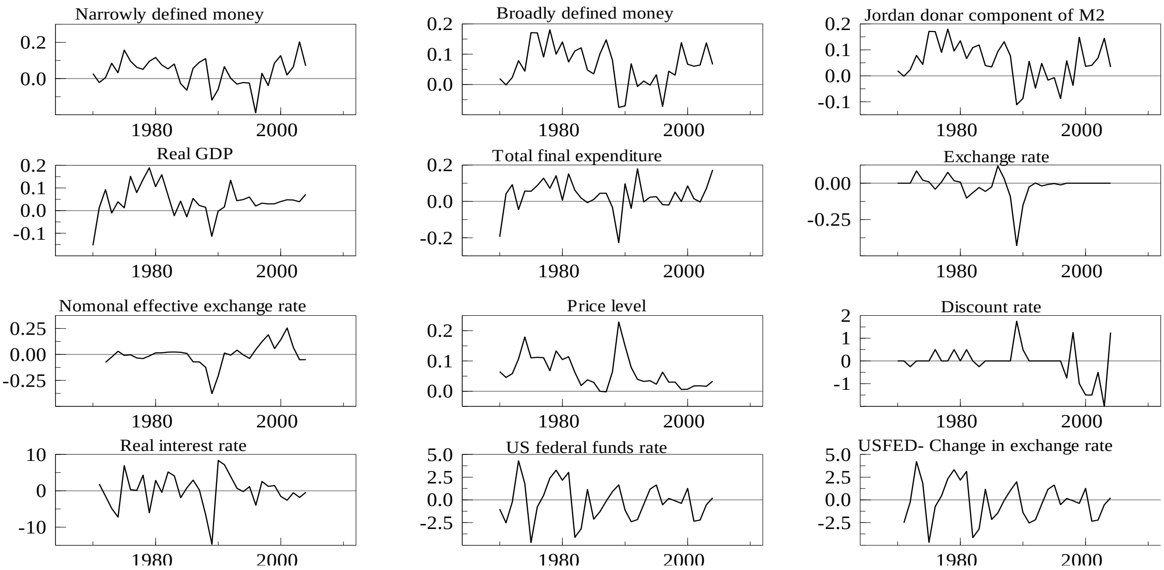
Table 3.8: Unit Root Test for Money Demand Variables (in First Differences)

Variables	ADF Test		Phillips-Perron Test	
	None	C	None	C
ΔE	-3.525650**	-3.602968*	-3.385419**	-3.187133*
ΔNE	-2.647690**	-2.604058	-2.647690**	-2.604058
ΔRE	-2.876230**	-2.934039	-2.984946**	-3.044886*
ΔRM1	-3.633127**	-4.160771**	-3.591928**	-4.138556**
ΔRM2	-2.317896*	-3.602843*	-2.139196*	-3.602843*
ΔRJM2	-2.971300**	-4.002180**	-2.787854**	-4.020972**
ΔY	-3.299261**	-4.824690**	-3.443768**	-4.831180**
ΔEX	-5.221465**	-6.419506**	-5.354342**	-6.419506**
ΔI	-4.932749**	-4.863118**	-4.988780**	-4.925054**
ΔRI	-4.768663**	-4.698606**	-4.824842**	-4.761168**
ΔUSFED	-5.223874**	-5.154630**	-4.456810**	-4.425197**
ΔP	-1.736649	-2.982737*	-1.510763	-2.624024
1% Critical Value	-2.634731	-3.646342	-2.634731	-3.639407
5% Critical Value	-1.951000	-2.954021	-1.951000	-2.951125

"*" and "**" means the rejection of the null hypothesis at the 5% and the 1% significance level respectively.

The conclusion that the price level is I (2) conforms to the clear downward trend of its first difference in Figure 3.9. As for the USFED rate, if the outliers around the year 1980 and after the year 2002 are ignored, this variable is almost stationary for the rest of the sample period. To ensure that the acceptance of the unit root hypothesis in the levels of the variables was not influenced by the existence of a structural break that could be resulted from the wide-scale structural reforms, the Perron test for unit root with a trend-break was also carried out on the levels of the variables.

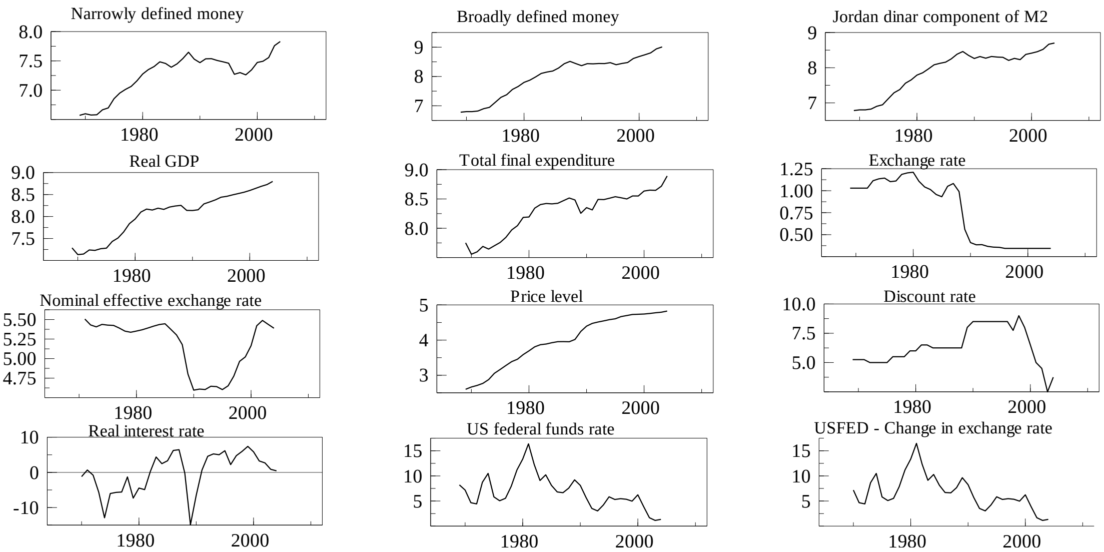
Figure 3.9:First differences of the variables considered for the demand for money function



Following the methods developed by Perron (1997), this test was run using the program written by Colletaz and Serranito (1998) utilizing the WinRATS software Version 5.01. The assumption here is the existence of a trend break but the time of this break is not known and to be determined endogenously. The aim is to test for the existence of a unit root in the time series of each variable taking into account the existence of the trend break. The null hypothesis to be tested is $\alpha = 1$ against the alternative hypothesis $\alpha < 1$ in equations (3.7), (3.8) and (3.9b) mentioned above corresponding to models (IO1), (IO2), and (AO) respectively. Since the test results of the methods (STUD) and (STUDABS) are identical, only the results of the method (STUD) are reported along with the results of the Method (UR).

Tables A3.1, A3.2, and A3.3 in the appendix show the test results for the models IO1, IO2, and AO respectively. The test results vary considerably between the three models, as well as between the three statistical methods that choose the time of the trend break in each model. This variation between different models and different statistical methods indicates that the impact of the trend-break and the time of the break were not universal across the board. The test results of each single model, therefore, are only relevant if the type of the break in the trend of the variable under consideration conforms to the underlying assumption behind that model. In other words, special attention to the type of the break in the trend of each variable is needed in order to choose the most relevant model for that variable. Further investigation of the time path of the set of variables considered for this test, (Figure 3.10), reveals the following characteristics with regard to the type and the time of the trend-break that these variables had shown.

Figure 3.10: Time path of the variables considered for money demand cointegration analysis (Logarithms except for interest rates)



1. Most of the variables had witnessed two breaks in their trend rather than one break. For domestic variables, the first break took place around 1988, while the second one took place around the mid-1990s. The first break is associated with the financial crisis and the sharp devaluation of the exchange rate of the Dinar, while the second one is associated with the intense structural reform process that took place during the first half of the 1990s across all of the Jordanian economy, and in the financial sector in particular. As for the USFED rate, and if the outliers around 1980 are ignored, the first break took place around the year 1988 while the second break took place around the year 2002.

2. The breaks were intense to the extent that they changed the direction of the trend for some variables; namely the nominal effective exchange rate, real effective exchange rate, and the domestic discount rate.
3. The breaks have mainly affected the slope of the trend for six variables; namely the three monetary aggregates (RM1, RM2, and RJM2), the two scale variables (Y and EX), and the price level (P). Accordingly, the most relevant model for these variables is the Additive Outlier Model (AO).
4. Although the break in the trend of the inflation rate (the first difference of the price level in Figure 3.9 above) around the late 1980s produced a distinctive outlier, the main impact of the break was on the slope of the trend. Therefore, the most relevant model to this variable is again the Additive Outlier Model (AO).
5. The dominating impact of the trend-break was on the level of the trend line for the domestic interest rate (I), the domestic real interest rate (RI), the foreign interest rate (USFED), and the standard definition of the exchange rate (E). Therefore, the best relevant model for these variables is the Innovational Outlier Model 1 (IO1).
6. As for the nominal and real effective exchange rate indexes (NE and RE), the impact of the break was on both the level of the trend and the slope, which means that the most relevant model for these two variables is the Innovational Outlier Model 2 (IO2).

Based on these characteristics, Table 3.9 shows the test results of only the relevant model for each variable. Regardless of the statistical method, the null hypothesis of the unit root could not be rejected at both the 1% and the 5% level of significance for the three monetary aggregates, the two scale variables, the price level, the inflation rate, the domestic interest rate and real interest rate. This result complements the results of the ADF and the Phillips-Perron tests and, therefore, we can conclude that these variables are non-stationary even after taking the existence of a trend break into consideration.

Table 3.9: Results of the Perron Unit Root Test with a Trend-Break
(The Relevant Model to Each Variable)

		Method UR			Method STUD		
Variable	Relevant Model	Test Statistic	Break Date	Lags Retained	Test Statistic	Break Date	Lags Retained
Rm1	AO	-2.5796	1975	3	-1.2768	1983	10
Rm2	AO	-3.5156	1994	4	-2.8120	1985	4
Rjm2	AO	-3.6442	1978	6	-2.5917	1985	1
Y	AO	-3.8823	1980	5	-3.4169	1982	5
Ex	AO	-3.7755	1981	0	-3.7628	1982	0
P	AO	-3.4488	1994	1	-2.7876	1992	7
ΔP	AO	-4.2270	1971	1	-3.9633	1974	1
The 95% and 99% Critical Values		*-4.83* *-5.45*			*-4.67* *-5.38*		
I	IO1	-4.1856	1998	2	-4.1856	1998	2
USFED	IO1	-7.1078**	1988	9	-7.1078**	1988	9
RI	IO1	-3.9680	1987	1	-3.9123	1984	10
E	IO1	-8.9924**	1987	1	-8.9924**	1987	1
The 95% and 99% Critical Values		*-5.23* *-5.92*			*-5.18* *-5.85*		
Ne	IO2	-10.0517**	1987	10	-4.6180	1993	8
Re	IO2	-4.4414	1993	7	-4.0550	1987	9
The 95% and 99% Critical Values		*-5.59* *-6.32*			*-5.33* *-6.07*		

Note : "*" and "**" mean rejection of the null hypothesis at the 5% and 1% level of significance respectively.

On the other hand, the test results related to the exchange rate of the Jordan Dinar in terms of the US dollar and the USFED rate revealed that the null hypothesis of the unit root is rejected at the 1% level of significance regardless of the statistical method used, which mean that these two variables are stationary. This result contradicts with those of the ADF and the Phillips-Perron tests, and indicates that the acceptance of the unit root hypothesis in the case of the ADF and the Phillips-Perron tests was influenced by the existence of the trend-break. The stationarity of the exchange rate conforms to the fact that Jordan has maintained, in practice, the variation in the exchange rate of the Dinar in terms of the US dollar very limited. The only exception from this practice was the devaluation of the Dinar forced by the financial crisis during the period 1987-1990; the period associated with the time of the trend-break detected by either statistical method in the case of this variable (1987).

As for the nominal effective exchange rate, the null hypothesis of the unit root is rejected at the 1% level of significance according to the method UR, while it could not be rejected at both the 5% and the 1% levels of significance according to the method STUD. However, since the break had affected both the level and the slope of the trend of this variable, one could argue that the method STUD is more relevant in this case than the method UR. This argument is based on the underlying assumption behind the method STUD, which chooses the time of the break that minimizes the t-statistic of the test that is associated with either the break in the level or the break in the slope.

One caution about the Perron (1997) test results, however, is the existence of two breaks in the time trend of the relevant variables, which sheds some doubt on the test results, because the existence of only one break was the core assumption of this test. Mehl (2000) argued that if two breaks exist, the Perron (1997) test will suffer from lack of power and, consequently, the test might fail to reject the null hypothesis of the unit root, even if false. Nevertheless, and because the results of the Perron (1997) test do not contradict with those of the ADF and the Phillips-Perron tests, it is assumed that adopting these results regarding the order of integration of the individual variables is not expected to cause real problems to our analysis.

In light of this analysis, one can conclude that the results of the Perron (1997) test for the unit root with a trend-break complement the results of both the ADF and the Phillips-Perron tests in this regard. Accordingly, we can conclude that all the variables under consideration are I(1) except the price level, which is I(2), the exchange rate variable, the USFED rate, and the FIDE[1] which are I(0).

Although all the variables included in the model are preferred that to be of the same order of integration, the existence of a stationary variable, like the exchange rate in this case, is not expected to cause severe problems to the analysis (See Harris 1995). As explained earlier, Harris

[1] This variable has not been tested for stationarity because it equals the difference between two stationary variables (USFED and ΔE), thus it is stationary by definition.

(1995) argued that including stationary variables in the model might help in establishing cointegration among the non-stationary variables, especially if the economic theory suggests that such variables should be included in the relationship under consideration. Pesaran et al (2000) went even further and suggested that not only I(0) variables but also I(1) ones could be restricted into the cointegration space as exogenous variables. Although they introduced a new formula for the maximum and the trace statistics, introduced originally by Johansen (1991), to accommodate their relaxation of the assumption that all the I(1) variables should be determined endogenously, Pesaran et al (2000) recommended not to rush to applying the new specification before being definitely confirmed by further work in this area.

Therefore, it is possible to proceed in the cointegration analysis using the inflation rate (Δp), which is I(1), instead of the price level and allowing for certain exogenous stationary variables such as the exchange rate measure and the foreign interest rate to be in the cointegrating space.

3.6.2 Cointegration analysis

3.6.2.1 Experimental framework for cointegration analysis

As discussed earlier, the choice of the monetary aggregate as well as the economic activity variable has been an empirical issue. It has been also shown that the explanatory variables related to the opportunity cost in the demand for money function have varied considerably between different empirical studies. These variables ranged from one single variable (usually a measure of interest rate) to several variables such as a short-term interest rate, a long-term interest rate, the inflation rate, a foreign interest rate, and the exchange rate (See Sriram 1999 and 2001). In light of this wide variation and since the aim of this study is to detect the existence of a reliable relationship featuring the demand for money in Jordan, the following cointegration analysis is designed to tackle these empirical issues. Specifically, the analysis is designed to provide answers to the following questions.

- Which monetary aggregate is more representative of the money demand in Jordan? To answer this question, three monetary aggregates are considered; namely, the narrowly defined money supply (Rm1), the broadly defined money supply (Rm2), and the Jordanian Dinar component of the broadly defined money supply (Rjm2).
- Which variable is more representative for the scale variable to be included amongst the explanatory variables of the demand for money function? Is it real gross domestic product (Y) or real total final expenditure (EX)?
- Given the lack of reliable data on market interest rates, what is the best proxy to represent the domestic opportunity cost variable? The discount rate and the inflation rate are considered for this purpose.
- Does the Dinar exchange rate have an impact on real money balances demanded in Jordan? If so, which measure of the exchange rate is more appropriate? Is it the standard definition of the exchange rate of the Dinar in terms of the US dollars (E) or the nominal effective exchange rate index (NE)?
- Does the foreign interest rate have an impact on the domestically real money balances demanded?

To tackle all these empirical issues, our analysis took the experimental form following the general-to-specific approach starting with the most general system, which includes all the possible domestic and foreign variables that could affect the demand for money. The widest general system to start with is the one identical to equation (3.12). If cointegration is not detected in this case, one variable is dropped at a time and then the analysis is repeated until a cointegrating relationship is found. Once a cointegration vector, with satisfactory statistical properties, is detected the analysis proceeds to the estimation of the Vector Equilibrium-correction Model (VECM).

Between the three monetary aggregates, the two scale variables, the two measures of the exchange rate, the two definitions of the foreign interest rate, and the option to or not to include a time trend in the cointegration space, a combination of 168 systems of equations is needed to address all the above-mentioned empirical issues. Table 3.10 shows the combination matrix of all the systems analyzed for cointegration for this purpose.

Through all the cointegration analysis, only one lag is used, because none of the variables needed more than one lag to become stationary when the individual series were tested to determine the order of integration. The use of only one lag seems reasonable given the fact that the data set used in this analysis is annual. Following most of empirical studies, the cointegration rank will be determined based on the trace statistic only. However, and due to the limited number of observations, as noted earlier, the resultant test trace statistic will be compared to the adjusted critical values calculated for the small sample size from applying the Monte Carlo simulation done by Santoso (2001) rather than to the standard critical values reported in the test results.

In theory, the sign of the coefficient of real GDP is expected to be positive, while those of the coefficients of the discount rate and the USFED are expected to be negative (See Laidler (1985) and Lewis and Mizon (2000)). The coefficients of the inflation rate and the change in the exchange rate are ambiguous depending on the expectations effect (See Adeknule (1968), Arize (1994), and Nachega (2001)).

Table 3.10: Matrix of the different systems considered for cointegration analysis for money demand in Jordan(1)(2)				
	Real GDP		Total final expenditure	
	Endogenous variables	Exogenous variable	Endogenous variables	Exogenous variable
Narrowly defined money	Rm1, Y, I, ΔP, ΔE	USFED	Rm1, Ex, I, ΔP, ΔE	USFED
	Rm1, Y, I, ΔP, ΔNE	USFED	Rm1, Ex, I, ΔP, ΔNE	USFED
	Rm1, Y, I, ΔP, FIDE		Rm1, Ex, I, ΔP, FIDE	
	Rm1, Y, I, ΔP	FIDE	Rm1, Ex, I, ΔP	FIDE
	Rm1, Y, I, ΔE	USFED	Rm1, Ex, I, ΔE	USFED
	Rm1, Y, I, ΔE		Rm1, Ex, I, ΔE	
	Rm1, Y, I, ΔNE	USFED	Rm1, Ex, I, ΔNE	USFED
	Rm1, Y, I, ΔNE		Rm1, Ex, I, ΔNE	
	Rm1, Y, I, FIDE		Rm1, Ex, I, FIDE	
	Rm1, Y, I	FIDE	Rm1, Ex, I	FIDE
	Rm1, Y, I	USFED	Rm1, Ex, I	USFED
	Rm1, Y, I, E	USFED	Rm1, Ex, I, E	USFED
	Rm1, Y, I, NE	USFED	Rm1, Ex, I, NE	USFED
	Rm1, Y, I		Rm1, Ex, I	
broadly defined money	Rm2, Y, I, ΔP, ΔE	USFED	Rm2, Ex, I, ΔP, ΔE	USFED
	Rm2, Y, I, ΔP, ΔNE	USFED	Rm2, Ex, I, ΔP, ΔNE	USFED
	Rm2, Y, I, ΔP, FIDE		Rm2, Ex, I, ΔP, FIDE	
	Rm2, Y, I, ΔP	FIDE	Rm2, Ex, I, ΔP	FIDE
	Rm2, Y, I, ΔE	USFED	Rm2, Ex, I, ΔE	USFED
	Rm2, Y, I, ΔE		Rm2, Ex, I, ΔE	
	Rm2, Y, I, ΔNE	USFED	Rm2, Ex, I, ΔNE	USFED
	Rm2, Y, I, ΔNE		Rm2, Ex, I, ΔNE	
	Rm2, Y, I, FIDE		Rm2, Ex, I, FIDE	
	Rm2, Y, I	FIDE	Rm2, Ex, I	FIDE
	Rm2, Y, I	USFED	Rm2, Ex, I	USFED
	Rm2, Y, I, E	USFED	Rm2, Ex, I, E	USFED
	Rm2, Y, I, NE	USFED	Rm2, Ex, I, NE	USFED
	Rm2, Y, I		Rm2, Ex, I	
Jordan Dinar component of M2	Rjm2, Y, I, ΔP, ΔE	USFED	Rjm2, Ex, I, ΔP, ΔE	USFED
	Rjm2, Y, I, ΔP, ΔNE	USFED	Rjm2, Ex, I, ΔP, ΔNE	USFED
	Rjm2, Y, I, ΔP, FIDE		Rjm2, Ex, I, ΔP, FIDE	
	Rjm2, Y, I, ΔP	FIDE	Rjm2, Ex, I, ΔP	FIDE
	Rjm2, Y, I, ΔE	USFED	Rjm2, Ex, I, ΔE	USFED
	Rjm2, Y, I, ΔE		Rjm2, Ex, I, ΔE	
	Rjm2, Y, I, ΔNE	USFED	Rjm2, Ex, I, ΔNE	USFED
	Rjm2, Y, I, ΔNE		Rjm2, Ex, I, ΔNE	
	Rjm2, Y, I, FIDE		Rjm2, Ex, I, FIDE	
	Rjm2, Y, I	FIDE	Rjm2, Ex, I	FIDE
	Rjm2, Y, I	USFED	Rjm2, Ex, I	USFED
	Rjm2, Y, I, E	USFED	Rjm2, Ex, I, E	USFED
	Rjm2, Y, I, NE	USFED	Rjm2, Ex, I, NE	USFED
	Rjm2, Y, I		Rjm2, Ex, I	

(1): Each system of equations has been analyzed twice depending on the option of including or not including the time trend in the cointegration space.

(2): The abbreviations in this table refer to the variables: Rm1= real narrowly defined money supply, Rm2= real broadly defined money supply, Rjm2= the Jordanian Dinar component of the broadly defined money supply, Y= real GDP, Ex= real total final expenditure, I= the discount rate, P= the consumer price level, E= the exchange rate of the Dinar in terms of the US dollar, NE= the effective exchange rate index of the Dinar, USFED= the US federal funds rate, and FIDE= USFED minus the inflation rate.

3.6.2.2 Results of cointegration analysis

When cointegration analysis was performed on the above-mentioned combinations, none of them produced satisfactory results[1]. In addition to the non-existence of any cointegrating vector in most cases, three major reasons lied behind disqualifying the test result when one or more cointegrating vectors exist. *First*, the existence of at least one root of the companion matrix lying outside the unit circle, which indicates that the system is mathematically unstable. *Second*, the wrong sign of the coefficient of one or more explanatory variable compared to what is expected according to economic theory. And third, in the few cases where all the estimated coefficients have the right sign and the system is found mathematically stable, none of the detected vectors could be identified as a demand for money relationship; mainly because the monetary aggregate was found to be weakly exogenous, which means it should be in the right- hand side of the relationship rather than the left-hand side.

One possible explanation for these unsatisfactory results could be attributed to the structural changes that took place in the Jordanian economy since the late 1980s and to the destabilizing impact of the political instability, which has consistently engulfed the region through the study period. Given the small size and high degree of openness of the Jordanian economy, the recurrent regional shocks might have destabilized the economy to the extent that precludes there being a stable money demand function. Knowing that the region had witnessed six regional wars, all of which had a severe direct impact on Jordan, at both the economical and social level, this explanation has a solid basis. Although it is possible to take account of the structural changes and external shocks by adding dummy variables to the systems under consideration, the inclusion of such dummy variables affects the underlying statistical distribution of the test statistics and thus makes the critical values irrelevant (See Harris 1995). In the context of Jordan, however, the

[1] Results of cointegration analysis of these combinations are not reported to keep the size of the document reasonable. However, the detailed results are available from the author on request.

relatively large number of shocks makes it impractical to include dummy variables to accommodate all these shocks.

Another possible explanation for these unsatisfactory results, which one should not neglect, however, is the possibility of model misspecification. By misspecification here, we mean: Have we used the right proxy variables for the arguments of the demand for money function, especially with regard to the opportunity cost? To check this possibility, two further modifications to the model specification have been considered. First, the nominal discount rate and the inflation rate were replaced by real interest rate (RI) defined as the difference between the discount rate and the inflation rate (RI = I- Dp). Second, the change in the exchange rate was replaced by its level, which was restricted to be an exogenous variable. In practice, the assumption of an exogenous exchange rate is not far from reality, where the exchange rate of the Dinar has been pegged either to a single currency or to a basket of currencies for the most of time.

Testing the modified system for cointegration revealed that a sensible relationship for the demand for the narrowly defined money supply exists regardless of the scale variable used, while such of a relationship for the demand for the two broadly defined monetary aggregates does not exist. The detailed analysis is discussed in the following subsections.

3.6.2.2.1 Cointegration analysis for the narrowly defined monetary aggregate (RM1)

The new modified system consists of three endogenous variables and two exogenous variables. The endogenous variables are the narrowly defined money supply (RM1), either real GDP (Y) or real total final expenditure (Ex) as a scale variable, and real interest rate (Ri). The two exogenous variables are the exchange rate of the Dinar in terms of the US dollar and the US federal funds rate. The sample period for this system is 1970 to 2004 and, similar to the previous cointegration tests, the lag length is set at one. Therefore, the sample size for the cointegration analysis is 34 observations due to the adjustment for lagged variables.

When the time trend is restricted to the cointegrating space, the test results show that regardless of the scale variable included, the null hypotheses of no cointegration and of the existence of at most one cointegrating vector were rejected at the 1% level of significance. On the other hand, the null hypothesis of the existence of two cointegrating vectors could not be rejected (See Table 3.11). In addition to the existence of more than one cointegrating vector, the adjustment factor (α) related to the vector normalized for the monetary aggregate is positive, which indicates that this vector could not be identified as a stable demand for money relationship.

Table 3.11: Johansen cointegration test results for the narrowly defined money supply (RM1)
(with time-trend in the cointegrating space)

Scale variable	No. Of Observations	Rank	Trace Statistic(1)	95% Critical Value(2)	Notes
Y	34	0 1 2	77.57** 29.31** 3.37	47.24 21.89 7.96	Two vectors but with a positive adjustment factor for the relationship normalized for the money demand.
Ex	34	0 1 2	90.93** 31.98** 6.70	47.24 21.89 7.96	Two vectors but with a positive adjustment factor for the relationship normalized for the money demand.

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.
(2): Adjusted for the small sample size from applying the Monte Carlo simulation done by Santoso (2001).

However, when the time trend is not restricted to the cointegrating space, the test results reveal that the null hypothesis of no cointegration is rejected at the 5% level of significance regardless of the scale variable used, while that of the existence of one cointegrating vector could not be rejected at both the 5% and the 1% level of significance (See Table 3.12).

Table 3.12: Johansen cointegration test results for the narrowly defined money supply (RM1)
(No time-rend in the cointegrating space)

Scale variable	Rank	Trace Statistic(1)	95% Critical Value(2)	Cointegrating vector coefficients and adjustment factors	Roots of the companion matrix
Y	0 1 2	37.18* 10.93 2.00	35.02 14.18 4.31	RM1 Y RI E USFED βs 1.00 -1.329 0.046 -0.982 0.056 αs -0.22 -0.03 -8.98	0.8339 0.3035 0.9851
Ex	0 1 2	37.03* 11.43 2.99	35.02 14.18 4.31	RM1 Ex RI E USFED βs 1.00 -1.460 0.035 -0.462 0.033 αs -0.32 -0.07 -12.99	0.2377 0.9971 0.7191

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.
(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

With all the roots of the companion matrix laying inside the unit circle, the mathematical stability of the system is ensured, which means that following any disturbances to it, the VAR model of this system converges to its equilibrium in the long-run. Furthermore, in both cases two of the three roots are relatively high and close to unity, which indicates that (n-r) = 2 and, consequently, supports the existence of only one cointegrating vector. Since all the coefficients have the right signs according to the economic theory behind the demand for money, it is feasible to proceed to impose restrictions on these two vectors (the one involving real GDP and that involving the final expenditure) to test their statistical properties and to check whether they rightly feature the demand for money relationship, and to check which of them is more appropriate.

3.6.2.2.2 Restrictions on the cointegrating vector involving real GDP.

Table 3.13 shows the test results of various restrictions imposed on the cointegrated vector involving real GDP. Ensuring the weak exogeneity of both real GDP and real interest rate means that they only enter the right-hand side of the cointegrating relationship and, therefore, we only have a single equation. Otherwise, the identification of the detected cointegrating vector as a money demand relationship would be inadequate, because any of the three endogenous variables could be modelled, and thus described by this relationship (See Harris 1995).

To test for the weak exogeneity of real GDP and real interest rate, the adjustment factors α_1 and α_2 were restricted to zero, individually and jointly. When tested individually, the test statistic, which follows a χ^2 distribution, amounted to 0.323 with a probability of 57% for the former and to 5.832 with a probability of 1.6% for the latter (See Table 3.14). This means that the null hypothesis of $\alpha_1 = 0$ could not be rejected at both the 5% and the 1% level of significance, while that of $\alpha_2 = 0$ is rejected at the 5% level of significance. In other words, real GDP is weakly exogenous to real balances of money demand, while real interest rate is not.

Table 3.13: Structural restrictions on the cointegrating vector detected for the system RM1, Y, RI, E, and USFED

Restrictions imposed on the coefficients(1)	Statistic $\chi^2(n)^{(2)}$	Probability(3)
β_0 =1; and α_1=0 (weak exogeneity of the scale variable)	0.323	[0.5699
β_0 =1; and α_2=0 (weak exogeneity of real interest rate)	5.832	[0.0157]*
β_0 =1; α_1=0; and α_2=0 (joint weak exogeneity of both variables)	5.958	[0.0509]
β_0 =1; α_1=0; α_2=0; and β_3=0 (significance of the exchange rate)	22.308	[0.0001]**
β_0 =1; α_1=0; α_2=0; and β_4=0 (significance of the USFED rate)	13.781	[0.0032]**
β_0 =1; α_1=0; α_2=0; and β_1=0 (significance of the scale variable)	22.090	[0.0001]**
β_0 =1; α_1=0; α_2=0; and β_2=0 (significance of real interest rate)	13.452	[0.0032]**
β_0 =1; α_1=0; α_2=0; and β_1= -1 (homogeneity between real GDP and money supply)	8.373	[0.0389]*

(1): β_0, β_1, β_2, β_3 and β_4 are the coefficients of the monetary aggregate, the scale variable, real interest rate, the exchange rate, and the USFED respectively, while α_1, and α_2 are the adjustment factors related to the cointegrating relationships normalized for the scale variable and real interest rate respectively.

(2): "n" refers to the number of restrictions imposed other than the first one, which meant to normalize the vector for the demand for money relationship.

(3): "*" and "**" refers to the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.

When tested jointly, however, the test resulted a statistic of the magnitude 5.958 with a probability of 5.1%; which means that the null hypothesis of both α_1= 0 and α_2= 0 is just not rejected at the 5% level of significance. Although marginal, we can conclude that these two variables are weakly exogenous and, consequently, they only enter the right-hand side of the money demand relationship. Since the other two variables in the vector are exogenous by definition, this conclusion makes it possible to identify the detected cointegrating vector as a demand for money relationship and move forward to test the significance of the individual variables in this relationship.

Restricting each of the coefficients in the β vector to zero revealed that the coefficients of all the variables are statistically significant at the 1% level of significance, which indicates that all the four arguments play an important role in determining the demand for real money balances in Jordan (See Table 3.13 above). The null hypothesis of β_1 = -1, which tests for the price level homogeneity between the monetary aggregate and the scale variable, is also rejected at the 5% level of significance. Accordingly, the reduced form of the restricted cointegrating vector could be identified as the long-run demand for money relationship in Jordan by the following relationship. Numbers in parenthesis are the standard errors of the relevant parameters.

$$rm1 = 1.259y - 0.032ri + 1.003e - 0.048usfed \quad (3.13)$$

(0.1507) (0.0088) (0.2155) (0.0158)

According to this relationship, real demand for narrowly defined money is positively related to real GDP and to the exchange rate of the Dinar in terms of the US dollar, and negatively related to real domestic interest rate and the foreign interest rate. In terms of magnitude, the 1.26 income elasticity of the demand for the narrowly defined money is relatively high and comes in line with the findings of several other empirical studies on demand for money in developing countries (See Adeknule (1968), Crocket and Evans (1980), Arize (1994), and Karfakis and Sidiropouos (2000)).

The low interest rate elasticity of the demand for the narrowly defined money (-0.03 with respect to real domestic interest rate and -0.05 with respect to the foreign interest rate) is also similar to the findings of some other empirical studies (Arize (1994), Caruth and Sanchez-Fung (2000), Karfakis and Sidiropouos (2000), and Apergis (1997)). The significance of the interest rates in determining the demand for the narrowly defined money in Jordan, although considerably lower than the elasticity reported by Shibly (1999), contradicts the findings of Crocket and Evans (1980) and Toqan (1993) who found that the opportunity cost role in determining the demand for money in Jordan was insignificant. This difference could in fact be attributed to the different methodology and the different sample period used in the estimation and to the different specification of the model. In both studies, they used the standard OLS regression to estimate the demand for money function and used the inflation rate as a sole proxy for the opportunity cost. Another cause of the difference could be that of sample size. Crocket and Evans (1980) used only 12 annual observations, and Toqan (1993) used only 18 annual observations.

Interestingly, the exchange rate elasticity of the narrowly defined money in Jordan (1.0) is relatively on the high side compared to the findings of other empirical studies. Arize (1994) and

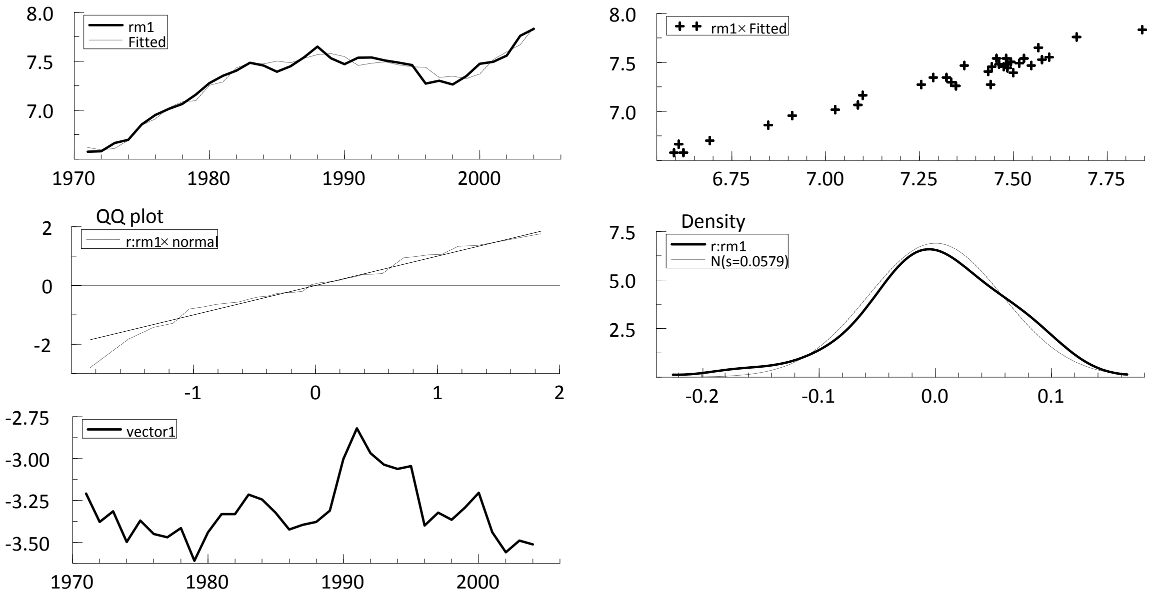
Kogar (1995) found this elasticity negative and low in magnitude for Pakistan and for Turkey and Isreal, respectively. Caruth and Sanchez-Fung (2000) and Bahmani-Oskooee et al (1998) reported a positive elasticity with a magnitude of 0.64 and 0.71 for the Dominican Republic and Spain, respectively. Shibly (1999) also reported, though low in magnitude 0.15, a positive exchange rate elasticity of the demand for the narrowly defined money in Jordan. The difference between Shibly's reported elasticity and the one found above might also be explained by the different methodology and model specification, where he specified his model in nominal terms and used the autoregressive least squares technique to estimate the demand for money function.

Diagnostic tests, show that the residuals of this cointegrating relationship are normally distributed and do not suffer from autocorrelation or from heteroscedasticity. The following are the vector's diagnostic test statistics along with their probability in square brackets.

Vector Portmanteau (4): 42.2093
Vector Normality test: Chi^2(6) = 11.346 [0.0782]
Vector hetero test: F(60,62) = 0.79310 [0.8155]
Vector hetero-X test: F(120,13)= 0.66428 [0.8751]

Graphical analysis of the narrowly defined money demand relationship shows that the behaviour of this relationship was satisfactory. As shown in Figure 3.11, the time paths of the actual and fitted values of real balances of the narrowly defined money were relatively close to each other, the cross plot of the actual and fitted is satisfactory, the residual QQ plot against the standard normal distribution is also acceptable, and the residuals are normally distributed. However, a course of repeated rounds of relatively instability, featured by the existence of relatively large residuals, could be noticed during the period from the mid-1980s to the late 1990s. Taking into consideration the events that took place during that period it would be clear that these relatively large residuals are explained by those events rather than by model misspecification or instability of the estimated relationship itself.

Figure 3.11: Graphic analysis for the RM1 restricted cointegrating relationship
(Real GDP is the scale variable)

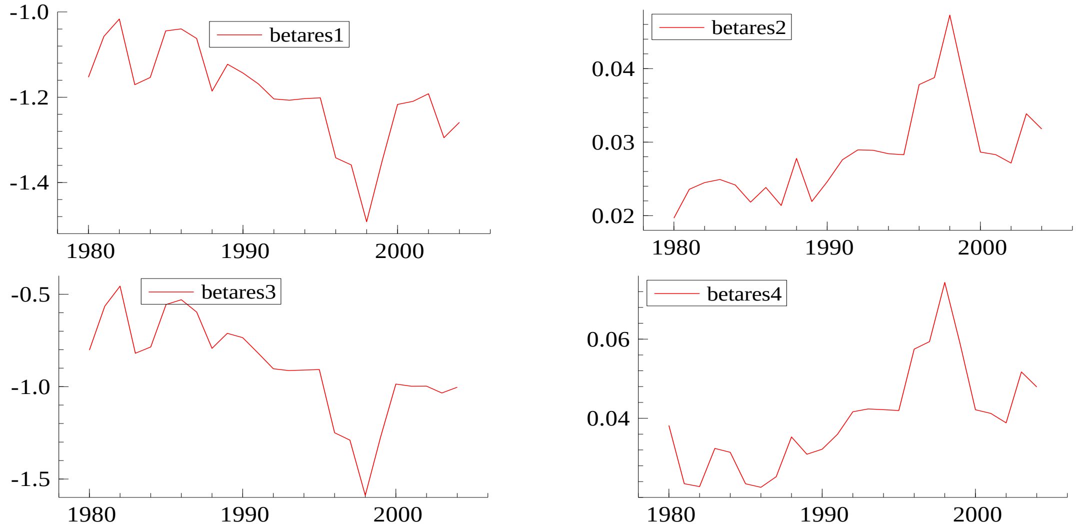


In fact, the above-mentioned period experienced three major shocks, which had significant impacts on most aspects of the Jordanian economy. The first shock was the financial crisis, which took place in the second half of 1980s and resulted in a sharp devaluation in the exchange rate of the Dinar, a record rise in the inflation rate, and a record decline in real GDP. The second shock was the second Gulf war, which resulted in the repatriation of more than 300,000 people from the Gulf countries in the early 1990s. Such a sharp and sudden increase in the population, along with the huge foreign currency inflows associated with their repatriation, had caused a huge jump in aggregate demand in Jordan on the one hand, and in the money balances on the other. The third shock is the comprehensive adjustment and economic reform that took place in Jordan through the 1990s in the aftermath of the financial crisis, which surely had affected the behaviour of different economic agents. Taking these three factors into consideration, one could tolerate the apparent signs of instability and conclude that this relationship is stable and has no signs of misspecification.

Such a conclusion is supported by the vector's graph, which clearly shows that the relatively high residuals during the above-mentioned period form some kind of a temporary trend break in the path of residuals rather than a permanent one. The same observation could be noticed also in Figure 3.12, which shows the recursive test for the parameters' constancy.

The paths of residuals of all the four recursively estimated parameters show almost the same pattern. Over the late 1980s, they all started to deviate slightly further from their previous averages until the late 1990s, when they all have a clear temporary trend break. This break is associated with the surge in the demand for foreign currencies that took place in the late of 1998 and early 1999 during the ailment of the late king Husain I. Had this break been excluded, the paths of the residuals would be almost stationary, which means that the parameters would be constant over the whole sample period.

Figure 3.12: Recursive Graphics for Parameters' Constancy of the Long Run Demand for RM1 (Real GDP is the Scale Variable)



3.6.2.2.3 The short-run dynamics of RM1 relationship involving real GDP.

Given the plausible long-run relationship of the demand for RM1 in equation 3.13, it is possible now to estimate the short-run dynamics of such a relationship. At any point of time, the disequilibrium between the actual real balances of RM1 and the expected value from the long-run relationship is defined by ECMRM1Y. Formally, it is represented by the equation:

(3.14) $ECMRM1Y = rm1 - 1.259y + 0.032ri - 1.003e + 0.048usfed$

Incorporating the one period lag of this definition into equation 3.3 featuring the vector equilibrium-correction model (VECM), and using the OLS method, the estimated short-run dynamic model is reported in Table 3.14.

Table 3.14: Modelling the short-run dynamics of the narrowly defined money using real GDP as scale variable (1972 to 2004)

Variable	Coefficient	Std.Error	t-value	t-prob	Partial R^2
Constant	-0.996	0.255	-3.90	0.001	0.398
ECMRM1Y_1	-0.313	0.078	-4.01	0.001	0.412
Dy	0.095	0.243	0.390	0.700	0.007
Dy_1	-0.058	0.226	-0.259	0.798	0.003
Dri	0.003	0.005	0.706	0.487	0.021
Dri_1	0.0054	0.004	1.06	0.300	0.047
De	0.140	0.193	0.724	0.476	0.022
De_1	0.116	0.228	0.508	0.617	0.011
Dusfed	-0.003	0.007	-0.431	0.670	0.008
Dusfed_1	-0.002	0.007	-0.275	0.786	0.003

R^2 = 0.60 F(9,23) = 3.856 [0.004]**,
Sigma = 0.059 RSS = 0.081
log-likelihood = 52.395 DW = 1.64

A quick look at this table shows that only the constant and the equilibrium-correction term are statistically significant in determining the short-run dynamics of the narrowly defined money. Current and previous year changes in all the arguments appeared to have relatively low coefficients and turned out to be statistically insignificant. When the insignificant variables were dropped systematically by dropping the least significant variable each time, a reasonable parsimonious short-run equation was reached.

(3.15) $Drm1 = -0.798 - 0.255 * ECMRM1Y + 0.351De$
(0.184) (0.056) (0.116)
R^2 = 0.49 Sigma = 0.058 F(2, 31) = 14.88** DW = 1.64 Log-Likelihood = 50.00

The interpretation of this dynamic relationship is that in the short-run the change in the quantity demanded of the narrowly defined money is positively related to the change in the exchange rate of the Dinar in terms of the US dollar and negatively related with the previous period disequilibrium. With a rate of determination (R^2) equals to 0.49, this relationship looks reasonable. The signs of all the coefficients conform to what is expected from economic theory. Since the equilibrium-correction term represents the disequilibrium in during any period of time, its coefficient should have a negative sign, according to Granger's Representation Theorem, to ensure that a certain percentage of this disequilibrium is corrected during the next period (See Engle and Granger 1987). The positive sign of the coefficient of the change in the exchange rate could be associated with the long-term expectations. If the change in the exchange rate is expected to last for a long period or to create further changes in the same direction, then it could have a positive impact on the demand for money (See Bahmani-Oskooee (1991) and Bahmani-Oskooee et al (1998)). In terms of magnitude, the coefficient of the equilibrium-correction term is relatively high (-0.255), where just over a quarter of any deviation from equilibrium is corrected during the following period. The elasticity with respect to the change in the exchange rate is also quite high at 0.35.

The estimated short-run equation passed all the diagnostic tests. None of the null hypotheses of no autocorrelation, of the normally distributed residuals, of no heteroscedasticity, or of no misspecification could be rejected at either the 5% or the 1% level of significance. The following are the test statistics for these tests.

AR 1-2 test:	F(2,29) =	1.0895	[0.3497]
ARCH 1-1 test:	F(1,29) =	0.50210	[0.4842]
Normality test:	Chi^2(2) =	3.4215	[0.1807]
hetero test:	F(4,26) =	0.75153	[0.5661]
hetero-X test:	F(5,25) =	0.66283	[0.6549]
RESET test:	F(1,30) =	0.25086	[0.6201]

Graphical analysis also shows that the short-run dynamic model performs relatively satisfactorily. With the only exceptional outlier in 1996, the first graph of Figure 3.13 shows that the actual and fitted values are relatively close. The QQ plot against the normal distribution looks reasonable with the residuals so close to the criterion line. The residuals are normally distributed.

Figure 3.13: Graphical Analysis for the Short Run Dynamics of the Demand for RM1
(Y is the Scale Varisble)

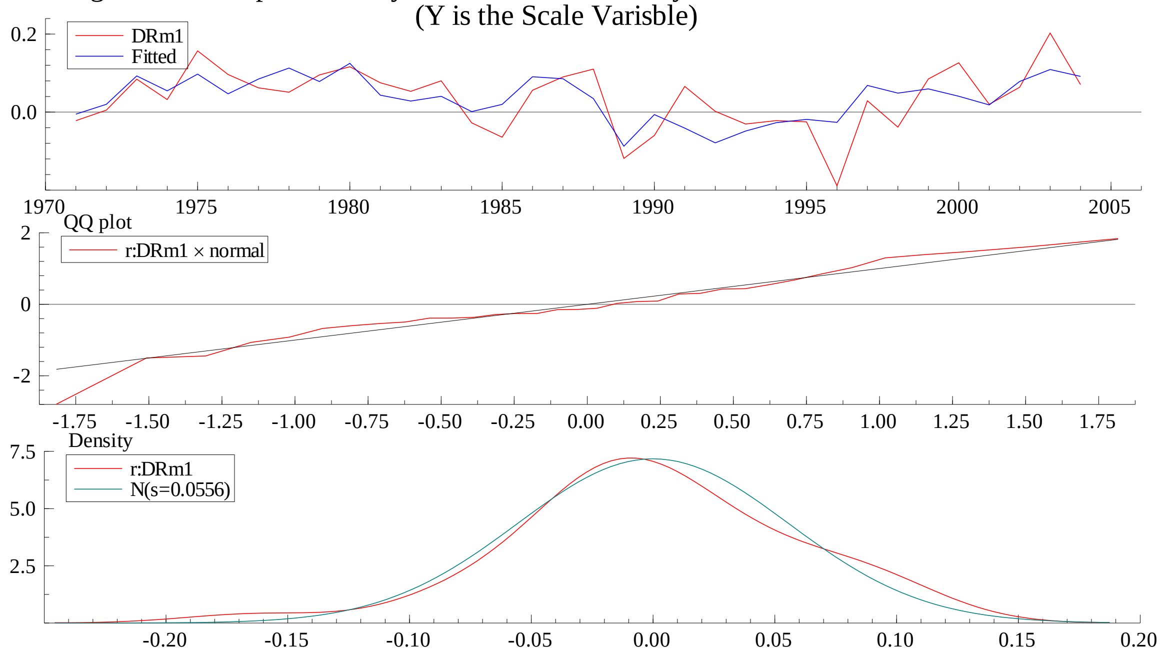
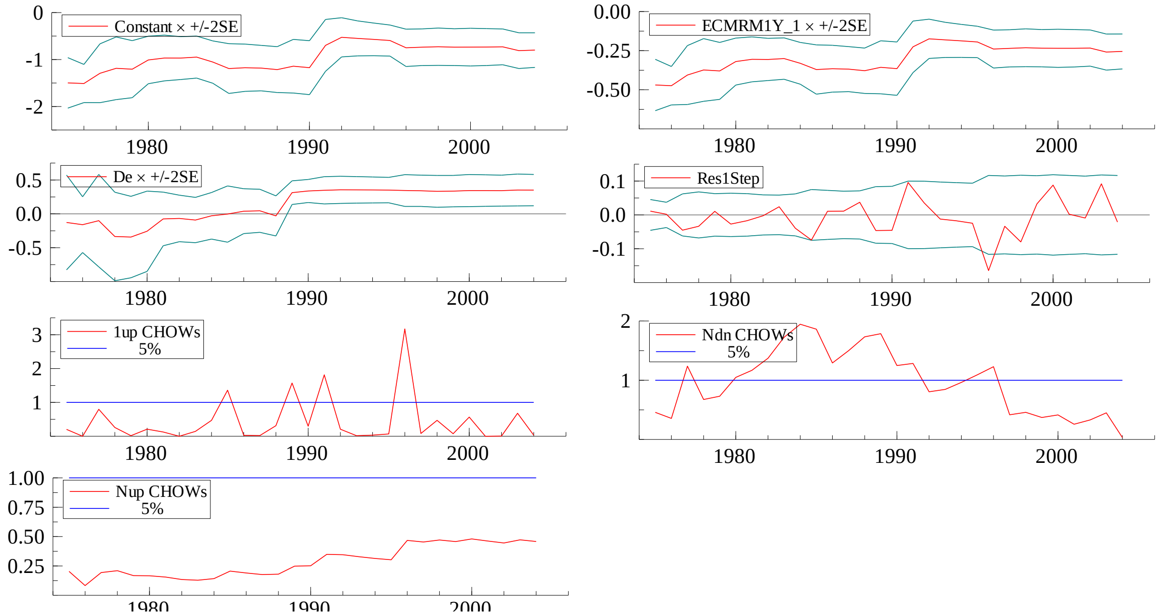


Figure 3.14 shows that recursive analysis for the short-run dynamics of the demand for RM1. It also shows that the model performs relatively well. All the estimated coefficients have been bounded by their mean +/-2σ interval of confidence; giving evidence of the parameters' constancy over the sample period. The fourth graph shows that the one-step residual test supports parameter constancy. All the residuals lie within the 95% confidence interval, except for one outlier around 1996. However, the fifth graph shows some signs of instability, with the One-step Chow test statistic exceeding its critical line four times around the years 1985, 1989, 1991, and 1996. Nevertheless, it is clear from the graph that these incidents are outliers rather than permanent changes in the path, which remains generally stable. Although the sixth graph shows that the series have trend breaks during the period of study, the Chow forecast test (the seventh graph) shows the forecasts do not lie outside their 95% confidence intervals. These tests indicate that the model fits the original data series well, has constant parameters and stable residuals, and performs reasonably well for forecasting purposes.

Figure 3.14: Recursive Analysis for the Short Run Dynamics of the Demand for RM1
(Y is the Scale Variable)



3.6.2.2.4 Restrictions on the cointegrating vector involving total real final expenditure.

The test results of the restrictions imposed on the cointegrating vector involving real total final expenditure are similar to those of the cointegrating vector involving real GDP. Table 3.15 shows the test results of the restrictions imposed on this vector. When tested individually, the null hypothesis of the weak exogeneity of real total final expenditure could not be rejected at both the 5% and the 1% level of significance, while that of the weak exogeneity of real interest rate is rejected at the 5% level of significance. When tested jointly, however, the test resulted a statistic of the magnitude 5.243 with a probability of 7.1%; which means that the null hypothesis of both $\alpha_1 = 0$ and $\alpha_2 = 0$ is not rejected at both the 5% and the 1% level of significance. Therefore, it is safe to conclude that these two variables are weakly exogenous and, consequently, the detected cointegrating vector could be identified as a demand for money relationship; binding on the significance of the individual variables in this relationship.

Similar to the case for real GDP as the scale variable, when each of the coefficients in the β vector was restricted to zero all of them proved to be statistically significant (See Table 3.16

above). Similarly, the null hypothesis of β_1 = -1, which tests for the price level homogeneity of the total final expenditure and the money demand, is rejected at the 1% level of significance.

Table 3.15: Identification process for the cointegrating vector detected for the system RM1, Ex, RI, E, and USFED

Restrictions imposed on the coefficients(1)	Statistic $\chi^2(n)$(2)	Probability(3)
β_0 =1; and α_1=0 (weak exogeneity of the scale variable)	0.589	[0.4427]
β_0 =1; and α_2=0 (weak exogeneity of real interest rate)	5.243	[0.0220]*
β_0 =1; α_1=0; and α_2=0 (joint weak exogeneity of both variables)	5.279	[0.0714]
β_0 =1; α_1=0; α_2=0; and β_3=0 (significance of the exchange rate)	17.369	[0.0006]**
β_0 =1; α_1=0; α_2=0; and β_4=0 (significance of the USFED rate)	11.051	[0.0115]*
β_0 =1; α_1=0; α_2=0; and β_1=0 (significance of the scale variable)	21.43	[0.0001]**
β_0 =1; α_1=0; α_2=0; and β_2=0 (significance of real interest rate)	13.729	[0.0033]**
β_0 =1; α_1=0; α_2=0; and β_1= -1 (homogeneity between real total final expenditure and money supply)	13.205	[0.0042]**

(1): β_0, β_1, β_2, β_3 and β_4 are the coefficients of the monetary aggregate, the scale variable, real interest rate, the exchange rate, and the USFED respectively, while α_1, and α_2 are the adjustment factors related to the cointegrating relationships normalized for the scale variable and real interest rate respectively.

(2): "n" refers to the number of restrictions imposed other than the first one meant to normalize the vector for the demand for money relationship.

(3): "*" and "**" refers to the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.

Accordingly, the reduced form of the restricted cointegrating vector could be identified as the long-run demand for money in Jordan. Real money balances demanded are positively related to real total final expenditure and to the exchange rate of the Dinar in terms of the US dollar, and negatively related to real domestic interest rate and the foreign interest rate. With numbers in parenthesis representing the standard errors of the relevant parameters, this relationship takes the following form.

(3.16) $$\underset{}{rm1} = \underset{(0.1317)}{1.405Ex} - \underset{(0.0061)}{0.026ri} + \underset{(0.1324)}{0.498e} - \underset{(0.0110)}{0.028usfed}$$

Diagnostic tests show that the null hypothesis of no heteroscedasticity could not be rejected, while that of normally distributed residuals is rejected at the 5% level of significance. However, the lack of normality is not expected to cause significant problems in this case for two reasons. *First*, the rejection of the null hypothesis was only marginal and s*econd*, because the rejection is most due to excess kurtosis rather than the existence of skewness as one can see in the graphical analysis (See Johansen and Juselius 1992). The following are the restricted vector's diagnostic test statistics along with their probability in square brackets:

Vector Portmanteau(4): 42.4901			
Vector Normality test:	Chi^2(6) =	13.139	[0.0409]*
Vector hetero test:	F(60,62) =	0.77168	[0.8424]
Vector hetero-X test:	F(120,13)=	0.49939	[0.9740]

Graphical analysis of this restricted relationship reveals a picture similar to that obtained from using real GDP as the scale variable. As illustrated in Figure 3.15, the time paths of the actual and fitted values of real balances of the narrowly defined money were relatively close to each other, the cross plot of the actual and fitted is satisfactory, the residual QQ plot against the standard normal distribution is also acceptable, and the residuals are almost normally distributed. Again, the only concern is the existence of relatively significant residual outliers during the period from mid- 1980s to late 1990s, which could be explained by the same reasons mentioned earlier.

The same could be said about the parameters' constancy. Figure 3.16 shows the recursive test for parameter constancy. The paths of residuals of all the four, recursively estimated, parameters show almost the same pattern. In all cases, the main cause for parameter inconstancy was the temporary drift during that period, without which, the change in the residuals would not be significant.

Although the diagnostic statistical tests and graphical and recursive analysis of the relationship involving real total final expenditure produced similar results to those tests and analysis of the relationship involving real GDP, one could notice a significant difference between the two relationships when it comes to the magnitudes of the elasticities. When real GDP was replaced with real total final expenditure, the elasticity of the demand for narrow money with respect to the scale variable rose from 1.26 to 1.41, while on the other hand the elasticities with respect to all the other arguments went down considerably. Exchange rate elasticity went down by half to 0.5, while real interest rate and the foreign interest rate elasticities declined from -0.032 to -0.026 and from -0.048 to -0.028, respectively.

Figure 3.15: Graphical Analysis for the RM1 Restricted Cointegrating Relatioship
(Ex is the Scale Variable)

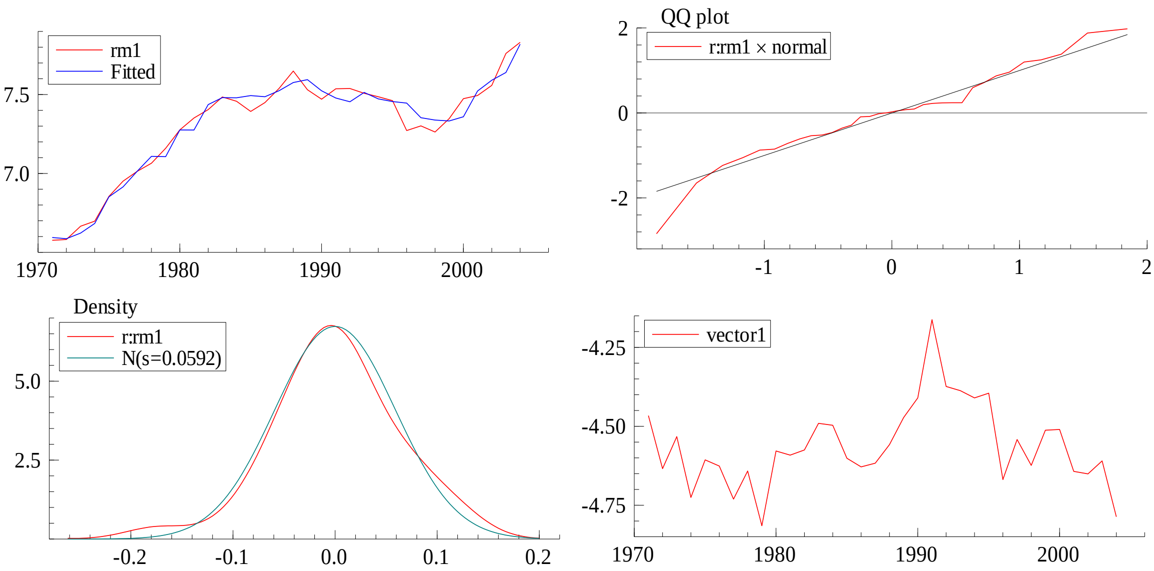
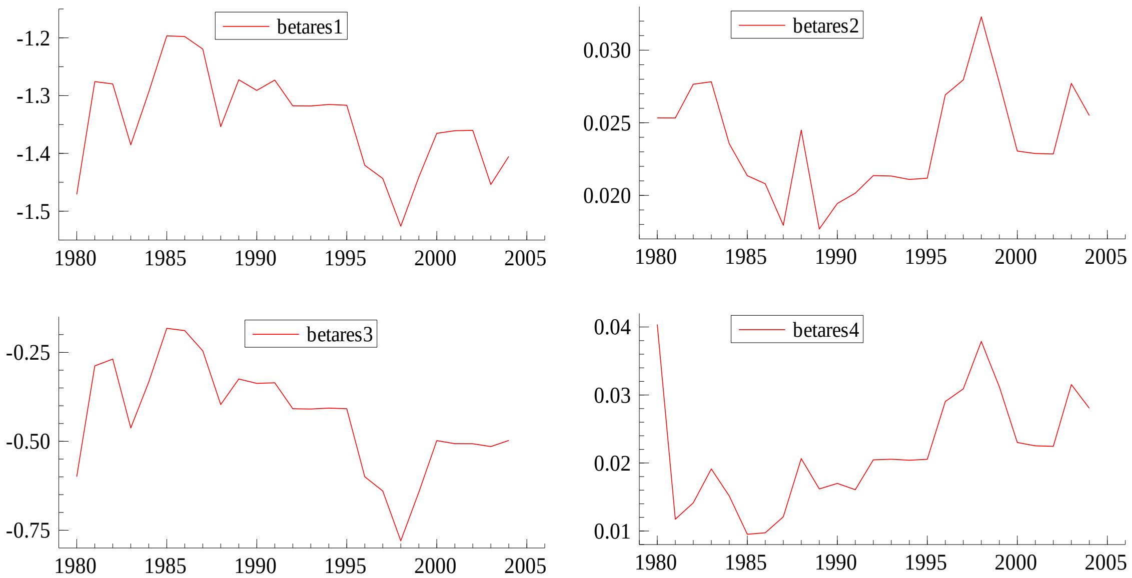


Figure 3.16: Recursive Graphics for Parameters' Constancy of the Long Run Demand for RM1
(Ex is the Scale Variable)



This shift in the magnitude of elasticities emphasizes the larger role of the expenditure scale variable and the lesser role of the opportunity cost in determining the demand for RM1 in the long-run. Such an emphasis might be explained by the fact that total final expenditure is a better proxy for the transactions component of the demand for money than GDP and, therefore, gives support to the theories of demand for money, which place more emphasis on the role of money as a medium of exchange (See Sriram 1999). However, the relatively high positive exchange rate elasticity of the narrowly defined money in Jordan gives some evidence of the importance of the store of value role of money, especially when it comes to financing imports of goods and services, which ratio to GDP averaged at 76% between 1976 and 2004.

3.6.2.2.5 Short-run dynamics of RM1 relationship involving real total final expenditure.

To estimate the short-run dynamics of the above-mentioned long-run relationship the equilibrium-correction term is defined by ECMRM1EX and measured by the disequilibrium between the actual real balances of RM1 and the expected value from the long-run relationship featured by equation 3.16. Formally, it is represented by the equation.

(3.17) $$ECMRM1Ex = rm1 - 1.405Ex + 0.026ri - .498e + 0.028usfed$$

Table 3.16: Modelling the short-run dynamics of the narrowly defined money using real total final expenditure as scale variable (1972 to 2004)

Variable	Coefficient	Std.Error	t-value	t-prob	Partial R^2
Constant	-1.887	0.540	-3.49	0.002	0.346
ECMRM1EX_1	-0.420	0.119	-3.53	0.002	0.351
DEx	0.316	0.179	1.76	0.091	0.119
DEx_1	0.003	0.216	0.012	0.990	0.000
Dri	0.001	0.004	0.182	0.857	0.001
Dri_1	0.003	0.004	0.615	0.545	0.016
De	0.030	0.197	0.151	0.881	0.001
De_1	0.094	0.232	0.407	0.688	0.007
Dusfed	-0.003	0.007	-0.471	0.642	0.009
Dusfed_1	-0.005	0.007	-0.817	0.422	0.028

R^2 = 0.59 F(9,23) = 3.718 [0.005]**, Sigma = 0.060, RSS = 0.082,
log-likelihood = 52.0349 DW = 1.67

Incorporating the one period lag of this definition into the VECM model featured by equation 3.3, and using the OLS method, the output of the estimated short-run dynamic model is reported in Table 3.16 above. Similar to the previous short-run model, only the constant and the equilibrium-correction term are statistically significant, while all the other arguments appeared to have relatively low coefficients and were statistically insignificant.

When the redundant arguments were excluded by systematically dropping the least significant variable each time, the following parsimonious short-run equation was reached; numbers in parenthesis are the standard errors of the coefficients and those in square brackets are the t ratios of the parameter.

(3.17) $$\underset{(0.347)}{Drm1 = -1.842} \underset{(0.076)}{- 0.409 ECMRM1Ex\_1} \underset{(0.127)}{+ 0.393 Dex} \underset{(0.005)}{- 0.010 Dusfed\_1}$$

Sigma = 0.055 $R^2 = 0.556$, $F(3,30) = 12.53^{**}$

AR 1-2 test:	F(2,28) =	0.70381	[0.5032]
ARCH 1-1 test:	F(1,28) =	0.23363	[0.6326]
Normality test:	Chi^2(2) =	0.042225	[0.9791]
hetero test:	F(6,23) =	0.48451	[0.8130]
hetero-X test:	F(9,20) =	0.78179	[0.6355]
RESET test:	F(1,29) =	1.5931	[0.2169]

Different from the case with real GDP, both the scale variable and the opportunity cost factors are important in determining the demand for RM1 in the short-run. Interestingly, the opportunity cost variable that plays a role here is the foreign interest rate and not the exchange rate, which seems more reasonable given the fact that the exchange rate variation has been historically subdued. The parsimonious dynamic relationship passed all the diagnostic tests. None of the null hypotheses of no autocorrelation, of the normally distributed residuals, of no heteroscedasticity, or of no misspecification could be rejected at the 5% level of significance.

Similarly, graphic analysis and recursive analysis show that this relationship performs well. Figure 3.17 shows that actual and fitted values are almost on the same track except for 1996, the QQ plot against the normal distribution is satisfactory with the residuals close to the criterion line, and the residuals are normally distributed, although some signs of kurtosis exist.

Figure 3.17: Graphic Analysis for the Short Run Dynamics of the Demand for RM1 (Ex is the Scale Variable)

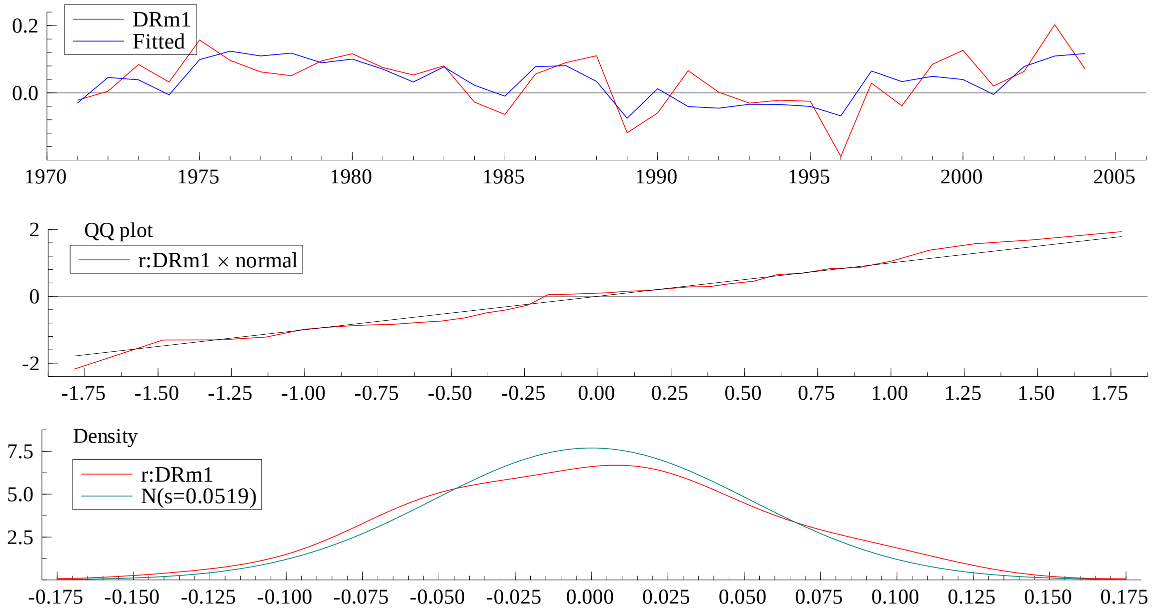
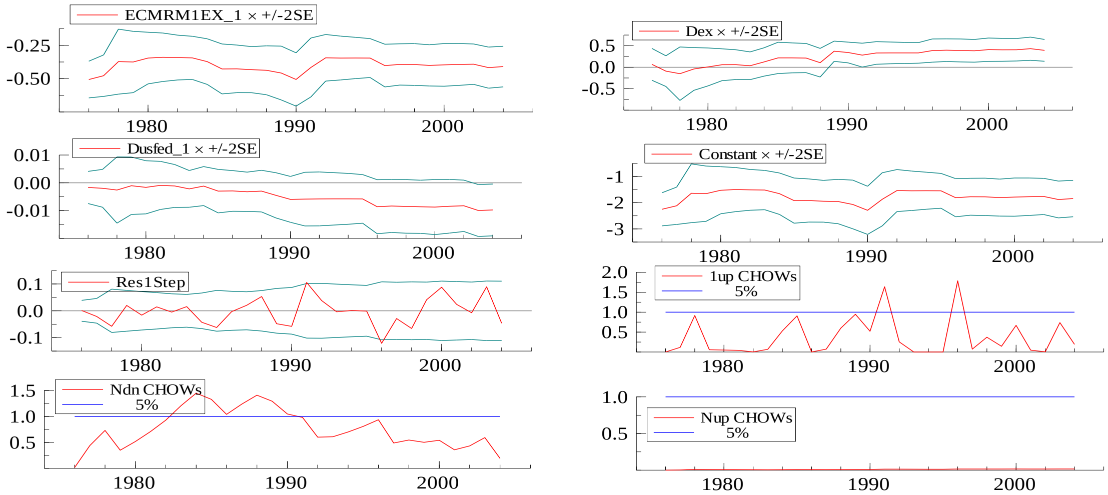


Figure 3.18 shows that all the estimated coefficients have been bounded by their mean +/-2σ interval of confidence; giving evidence for the parameters' constancy. This is supported by the one-step residual test, which shows that all the residuals lie within the 95% confidence interval. The one-step Chow test gives evidence for stability, with only two outliers around 1991, and 1996. Similarly, the Chow test for trend break reveals a lesser number of breaks compared to the model involving real GDP, and the Chow forecast test shows that forecasts do not lie outside their 95% confidence intervals. These tests indicate that the model fits the original data series well, has constant parameters and stable residuals, and has seemingly satisfactory forecasting performance.

3.6.2.2.6 Cointegration analysis for the broadly defined monetary aggregate (RM2)

When the narrowly defined money supply (RM1) was replaced with the broadly defined one (RM2), neither of the resulting two systems produced a plausible demand for money function regardless of the scale variable used and regardless of restricting or not restricting the time trend to the cointegrating space (See Table 3.17). If the time trend is not restricted to the cointegrating

Figure 3.18: Recursive Analysis for the Short Run Dynamics of the Demand for RM1
(Ex is the Scale Variable)



space, the test results reveal that at least two cointegrating vectors exist when real GDP (Y) is used as the scale variable, while all the possible ranks were rejected when real total final expenditure (Ex) is used as the scale variable. Moreover, in both cases the system turned out to be mathematically unstable.

Table 3.17: Cointegration Analysis for the Broadly Defined Money Supply (RM2)
(Sample Period is 1971-2004)

Scale Variable	Rank	Trace Statistic[(1)]	95% Critical Value[(2)]	Roots of the Companion Matrix	Notes
Panel A: No trend is restricted to the cointegrating space					
Y	0 1 2	47.71** 16.52* 1.96	35.02 14.18 4.31	0.8649 0.2704 1.005	Two vectors and the system are mathematically not stable.
Ex	0 1 2	50.53** 21.13** 5.91*	35.02 14.18 4.31	1.034 0.1490 0.5810	All ranks rejected and the system is mathematically not stable
Panel B: The trend is restricted to the cointegrating space					
Y	0 1 2	85.68** 31.84** 4.24	47.24 21.89 7.96	0.9011 0.1392 0.7505	Two vectors and positive adjustment factor
Ex	0 1 2	88.41** 33.72** 8.28*	47.24 21.89 7.96	0.8735 0.5132 0.0880	All ranks rejected.

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.
(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

Similarly, when the time trend is restricted to the cointegrating space, the test results show that two cointegrating vectors exist when using real GDP as a scale variable, while all the possible ranks were rejected when using the total final expenditure. In addition to the existence of two vectors, when using GDP, the adjustment factor related to the demand for money relationship was positive and the elasticities of the arguments were found to be unrealistic. Income elasticity amounted to 41.6 and exchange rate elasticity amounted to -43.4. Accordingly, we can conclude that a reasonable demand for RM2 relationship in Jordan does not exist within the framework of the model specification we have used in this research.

The reason behind the failure to detect such a relationship might lie in the structure of the broadly defined money, which includes savings in both national and foreign currencies additional to the narrowly defined money. Because different components of broader monetary aggregates respond differently to variations in the arguments of the demand for money function, not only in terms of magnitude but also in terms of direction, the net response of the broader aggregates could be ambiguous. Several empirical studies concluded that the narrow definition of money works better than the broader definitions when it comes to estimating a demand for money relationship (See Sriram 1999).

3.6.2.2.7 Cointegration analysis for the Jordanian Dinar component of the broadly defined monetary aggregate (RJM2)

Replacing the broadly defined money supply with its Jordanian Dinar component (RJM2) did not improve the picture, where at least two cointegrating vectors exist regardless of the model specification (See Table 3.18). If total final expenditure is used as the scale variable and the time-trend is restricted to lie in the cointegration space, all the possible ranks are rejected and the coefficient of the scale variable in the vector normalized for money demand has the wrong sign. If the trend is not restricted to the cointegration space, the test results reveal the existence of two cointegrating vectors, but the system is mathematically unstable, which means that any further procedures are invalid.

Table 3.18: Cointegration Analysis for the Jordanian Component of the Broadly Defined Money Supply (RJM2)
(Sample Period is 1971-2004)

Scale variable	Rank	Trace Statistic(1)	95% Critical Value(2)	Roots of the Companion Matrix	Notes
Panel A: No trend is restricted to the cointegrating space					
Y	0 1 2	48.42** 15.03* 1.52	35.02 14.18 4.31	0.8854 0.9766 0.3397	Two vectors with concern about the sign of real interest rate
Ex	0 1 2	54.02** 16.36* 3.46	35.02 14.18 4.31	1.009 0.2916 0.6297	Two vectors but the system is mathematically not stable
Panel B: The trend is restricted to the cointegrating space					
Y	0 1 2	79.00** 32.43** 4.43	47.24 21.89 7.96	0.8944 0.1515 0.7435	Two vectors and wrong sign for the coefficients of Y and USFED
Ex	0 1 2	85.26** 34.61** 8.58*	47.24 21.89 7.96	0.8727 0.0573 0.5059	All ranks rejected and wrong sign for Ex.

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.
(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

As for the use of real GDP as the scale variable, the Johansen cointegration test reveals that at least two cointegrating vectors exist, regardless of the location of the time trend. However, when the time trend is restricted to the cointegration space the coefficients of real GDP and the US federal funds rate in the vector normalized for the monetary aggregate have the wrong signs. If the time trend is not restricted to the cointegration space, the coefficients of all the arguments in the vector normalized for the money demand have the right signs. Nevertheless, once we tried to impose certain restrictions to check the possibility of identifying this vector as a demand for money relationship, three of the coefficients changed signs such that those for real GDP and USFED contradicting economic theory. So this vector could not be identified as a demand for money relationship. The only restrictions imposed were the restrictions on the adjustment factors (α). Table 3.19 shows the unrestricted and restricted cointegrating vector normalized for the monetary aggregate.

Table 3.19: Unrestricted and Restricted Cointegrating Vector Involving (RJM2, Y, Ri, E, and USFED)

Unrestricted		RJM2	Y	RI	E	USFED
Vector	β_s	1.00	1.81	-0.027	1.42	-0.065
	α_s	-0.198	-0.038	-3.411		
Restricted		RJM2	Y	RI	E	USFED
Vector	β_s	1.00	-0.18	0.49	5.44	0.12
	α_s	-0.030	0.0	0.00		

3.7 Conclusion

This chapter has attempted to investigate the existence of a stable demand for money relationship in Jordan, a small open developing country with a relatively shallow financial market. Using annual data for the period 1970 through 2004, this chapter utilized the cointegration analysis and the equilibrium-correction model (ECM), which has been the most powerful technique for modelling the demand for money over the last two decades. The objective was to determine whether such a relationship exists and, if so, what are the determinants in both the short-run and the long-run, giving special attention to the role of the exchange rate.

Since the choice of the variables representing the monetary aggregate and the arguments of such a relationship have proved to be an empirical issue, the analysis took the form of experimental work. Several systems of equations featuring three monetary aggregates, two scale variables, and two definitions of the exchange rate have been analyzed. The failure to detect reasonable relationships when the nominal discount rate, the inflation rate, and the change in the exchange rate were used, among other variables, as arguments for the money demand led to modification of model specification, by replacing the former two with real interest rate, and replacing the third with the level of the exchange rate, restricted to the cointegration space as an exogenous variable.

When the broadly defined monetary aggregates RM2 and RJM2 were used to represent the quantity of money demanded, cointegration analysis failed to detect any reasonable long-term relationship for the demand for money, regardless of the variables considered as arguments. In most cases, more than one cointegrating vector existed, but none could be identified as a demand for money. In the few cases where only one cointegrating vector was detected, the statistical properties of the resulting cointegrating vector were found to be unsatisfactory for two main reasons. First, most of them had a positive adjustment factor, so contradicting the notion of the existence of a cointegrating vector. Second, at least one variable among the arguments had the wrong sign.

In the case of the narrowly defined monetary aggregate (RM1), a reasonable relationship, although not straightforward, was found. Using the original specification with nominal interest rate, the inflation rate, and the change in the exchange rate among the arguments of the demand for money, the analysis failed also to detect any reasonable relationship. However, when the new specification with real interest rate and the level of exchange rate was tested, a plausible long-term relationship featuring the demand for the narrow money was detected regardless of the scale variable used. According to the final restricted relationships, the demand for narrow money in Jordan is positively related to the scale variable and the exchange rate of the Dinar in terms of the US dollar, and negatively related to the domestic real interest rate (measured by the difference between the discount rate and the inflation rate) and the foreign interest rate measured by the US federal funds rate.

In terms of magnitude, the resulting money demand elasticities with respect to different arguments came in general in line with the findings of several empirical studies over the last two decades. Regardless of using real GDP or the total final expenditure as the scale variable, their money demand elasticities were quite high and well above unity. Elasticity with respect to the exchange rate was found also to be relatively high; being unity when real GDP was the scale variable and 0.50 when real total final expenditure was the scale variable. On the other hand, the negative elasticity with respect to the interest rate variables was found to be quite low in magnitude. It ranged between 0.026 and 0.048 between the two interest variables and the two relationships depending on the scale variable used.

The high elasticity with respect to the scale variable and the low ones with respect to interest rates are typical of the demand for narrowly defined money because it is more associated with the transaction demand, which is not expected to vary significantly in response to changes in the interest rates. The most interesting part of the findings of this research, however, is the magnitude of the exchange rate elasticity. Such a high elasticity is expected in the case of the broader definition of the monetary aggregate where capital gains or losses in the savings, part of which is due to changes in the exchange rate, make a difference. One explanation that comes to mind in the case of Jordan is the need to finance imports, which ratio to GDP has averaged at 75% over the last two decades.

In the short-run, the factors that determine the variation in the demand for narrow money differ significantly between the two models. First, the magnitude of the feedback on the equilibrium-correction term is significantly higher when real total final expenditure, rather than real GDP is used as the scale variable. During any year, about 40% of the previous year's disequilibrium is corrected for in the model involving the total final expenditure compared to 25% in the model involving real GDP. Second, the only variable other than the feedback of the equilibrium-correction term that is important in determining the short-run variation in the demand for money in the model involving real GDP, is the change in the exchange rate. On the other hand, both the change in the scale variable and the change in the foreign interest rate play a role in determining that variation in the model involving real total final expenditure.

Having in mind that changes in the exchange rate have been historically limited, the latter model looks more tempting. Third, although both models passed all the diagnostic tests, the statistical properties of the latter look more appealing with a relatively higher coefficient of determination, lower standard error, and higher Durbin-Watson statistic. And fourth, the signs of instability in the latter model are less than the former.

In summary, the findings of this research confirm the following hypotheses: First, a long-term relationship featuring the demand for the narrowly defined money exists, while such a relationship does not exist within the framework of our model specification for broad money definitions. Second, both the scale variable and the opportunity cost variables are important in determining the long-run demand for money in Jordan. Third, the level of the exchange rate of the Dinar in terms of the US dollar plays a significant role in determining the long-run demand for money in Jordan. Fourth, although small in magnitude, both the domestic real interest and the foreign interest rate are important in determining the long-run demand for money in Jordan. And fifth, the feedback from the previous period's disequilibrium and the scale variable are the main determinants of the short-run variations in the demand for money in Jordan.

Statistical Appendix

Table A3.1: Results of the Perron Unit Root Test with a Trend-Break
[Model (IO1)]

Variable	Method UR			Method STUD		
	Test Statistic	Break Time	Number of Lags (k)	Test Statistic	Break Time	Number of Lags (k)
Rm1	-4.7970	1994	9	-4.7970	1994	9
Rm2	-5.5412*	1984	8	0.3542	1988	10
Rjm2	-4.4104	1984	8	-2.7743	1987	0
Y	-5.0100	1977	5	-5.0101	1977	5
Ex	-4.8035	1994	6	-3.44115	1987	0
I	-4.1856	1998	2	-4.1856	1998	2
USFED	-7.1078**	1988	9	-7.1078**	1988	9
P	-2.6271	1996	1	-2.6271	1996	1
ΔP	-5.0263	1986	1	-4.9411	1987	1
E	-8.9924**	1987	1	-8.9924**	1987	1
Ne	-9.5949**	1987	10	-9.5949**	1987	10
Re	-4.4164	1993	7	-4.4164	1993	7
RI	-3.9680	1987	1	-3.9123	1984	10
95% C.V	*-5.23*			*-5.18*		
99% C.V	*-5.92*			*-5.85*		

"*" and "**" mean rejection of the null hypothesis of a unit root at the 5% and 1% level of significance respectively.

Table A3.2: Results of the Perron Unit Root Test with a Trend-Break
[Model (IO2)]

Variable	Method UR			Method STUD		
	Test Statistic	Break Time	Number of Lags (k)	Test Statistic	Break Time	Number of Lags (k)
Rm1	-4.4074	1989	9	1.3899	1996	10
Rm2	-5.2419	1985	8	0.1404	1996	8
Rjm2	4.1122	1985	8	2.3995	1987	0
Y	-5.0205	1977	6	-2.9219	1981	0
Ex	-4.9525	1987	0	-3.1498	1979	0
I	-4.7255	1996	2	-3.4221	1994	8
USFED	-4.3158	1988	9	-3.4767	1993	9
P	-3.2744	1989	1	-3.2744	1989	1
ΔP	-8.8745**	1987	8	-8.8745**	1987	8
E	-8.2511**	1987	1	2.6877	1995	6
Ne	-10.0517**	1987	10	-4.6180	1993	8
Re	-4.4414	1993	7	-4.0550	1987	9
RI	-4.0611	1987	10	-4.0611	1987	10
95% C.V	*-5.59*			*-5.33*		
99% C.V	*-6.32*			*-6.07*		

"*" and "**" mean rejection of the null hypothesis of a unit root at the 5% and 1% level of significance respectively.

Table A3.3: Results of the Phillips- Perron Unit Root Test with a Trend-Break [Model (AO)]

Variable	Method UR			Method STUD		
	Test Statistic	Break Time	Number of Lags (k)	Test Statistic	Break Time	Number of Lags (k)
Rm1	-2.5796	1975	3	-1.2768	1983	10
Rm2	-3.5156	1994	4	-2.8120	1985	4
Rjm2	-3.6442	1978	6	-2.5917	1985	1
Y	-3.8823	1980	5	-3.4169	1982	5
Ex	-3.7755	1981	0	-3.7628	1982	0
I	-3.8232	2001	2	-3.0721	1998	6
USFED	-4.4825	1988	10	-2.2814	1980	10
P	-3.4488	1994	1	-2.7876	1992	7
ΔP	-4.2270	1971	1	-3.9633	1974	1
E	-3.0733	1971	1	-2.9340	1978	1
Ne	-3.7415	2000	1	-2.8928	1996	1
Re	-3.2782	1977	3	-3.1437	1981	3
RI	-4.0729	1971	1	-3.7671	1974	1
95% C.V	*-4.83*			*-4.67*		
99% C.V	*-5.45*			*-5.38*		

"*" and "**" mean rejection of the null hypothesis of a unit root at the 5% and 1% level of significance respectively.

Table A3.4: Finite Sample Size Critical Values of Trace Statistic for Johansen Cointegration Test Calculated Using the Monte Carlo Simulation by Santoso (2001)

NO. of Observations	No. of Endogenous Variables	No. of Exogenous Variables	Deterministic Variables	Rank	95% C.V.	99% C.V.
32	4	0	C	0	53.889951	61.822858
				1	27.357332	32.128716
				2	12.252289	15.069063
				3	3.9831670	5.5144176
32	4	1	C	0	55.007079	62.713020
				1	27.528086	32.215513
				2	12.168935	15.028506
				3	3.9647858	5.3124423
32	5	1	C	0	81.407903	90.965326
				1	46.375922	52.901872
				2	25.017234	29.168345
				3	11.449191	14.024613
				4	3.7581716	5.1854783
32	4	0	C and T	0	69.288534	78.226331
				1	37.959762	43.245537
				2	19.135208	22.390659
				3	7.3226831	9.0464781
32	4	1	C and T	0	71.371294	80.416337
				1	38.948994	44.345855
				2	19.438253	22.712965
				3	7.4338779	9.0766211
32	5	1	C and T	0	101.58149	112.22842
				1	61.638826	68.486326
				2	35.841863	40.482416
				3	18.548325	21.464455
				4	7.2623606	8.7577281
33	4	1	C	0	54.951252	62.949688
				1	27.630797	32.305524
				2	12.305757	15.225626
				3	4.0281810	5.5017629
33	4	1	C and T	0	70.622494	79.627497
				1	38.798125	44.043869
				2	19.320748	22.386786
				3	7.3160808	8.9462376
34	3	2	C	0	35.017159	41.885881
				1	14.185890	17.653544
				2	4.3132968	6.0516560
34	4	0	C	0	53.557651	61.415473
				1	27.138059	31.852112
				2	12.027828	14.846347
				3	3.9727647	5.4166080

*: C and T refer to the unrestricted constant and the restricted time trend to the Cointegration space respectively.

Table A3.4: Finite Sample Size Critical Values of Trace Statistic for Johansen Cointegration Test Calculated Using the Monte Carlo Simulation by Santoso (2001)

NO. of Observations	No. of Endogenous Variables	No. of Exogenous Variables	Deterministic Variables	Rank	95% C.V.	99% C.V.
34	5	1	C and T	0	100.57026	112.01293
				1	61.368412	67.767518
				2	35.734937	40.339529
				3	18.471421	21.408538
				4	7.1606547	8.7084367
35	3	0	C	0	33.556750	39.565171
				1	13.789963	16.971372
				2	4.2768211	5.9010935
34	4	1	C	0	54.543593	62.872138
				1	27.478929	32.372383
				2	12.202739	15.024553
				3	3.8879174	5.3962474
34	5	0	C	0	78.764492	87.569220
				1	45.391834	51.140886
				2	24.516539	28.348356
				3	11.309736	13.815063
				4	3.7625527	5.0710265
34	5	1	C	0	80.679501	90.552040
				1	46.225416	52.469752
				2	24.788836	29.037616
				3	11.374571	14.044624
				4	3.7414796	5.1781652
34	3	2	C and T	0	47.237699	54.922850
				1	21.889776	25.920943
				2	7.9659341	9.9690159
34	4	0	C and T	0	68.737819	77.651405
				1	37.913196	43.335934
				2	19.070847	22.176517
				3	7.3447191	8.8903617
34	4	1	C and T	0	70.548944	78.905791
				1	38.777485	43.996078
				2	19.400152	22.732183
				3	7.4077116	9.0519680
34	5	0	C and T	0	98.262720	108.09283
				1	60.168930	66.822544
				2	35.058995	39.782333
				3	18.228401	21.040002
				4	7.1821654	8.6855177
35	3	1	C	0	34.005982	41.130106
				1	13.821451	17.654864
				2	4.2774292	5.9578800

*: C and T refer to the unrestricted constant and the restricted time trend to the Cointegration space respectively.

Table A3.4: Finite Sample Size Critical Values of Trace Statistic for Johansen Cointegration Test Calculated Using the Monte Carlo Simulation by Santoso (2001)

NO. of Observations	No. of Endogenous Variables	No. of Exogenous Variables	Deterministic Variables	Rank	95% C.V.	99% C.V.
35	4	1	C	0	54.264738	62.222903
				1	27.515946	32.240723
				2	12.159212	15.174326
				3	3.9581041	5.4309735
35	3	0	C and T	0	45.078417	51.715740
				1	21.105469	24.661212
				2	7.8016280	9.5248785
35	3	1	C and T	0	45.981924	53.002587
				1	21.246220	25.153829
				2	7.7641668	9.5785150
35	4	1	C and T	0	70.159406	79.100521
				1	38.434679	43.760930
				2	19.183245	22.295551
				3	7.3130499	8.9362655

*: C and T refer to the unrestricted constant and the restricted time trend to the Cointegration space respectively.

CHAPTER FOUR

MONETARY POLICY TRANSMISSION MECHANISM IN JORDAN

4.1 Introduction

The aim of this Chapter is to investigate the nature of transmission mechanism of monetary policy in Jordan and to assess the efficacy of monetary policy. There is a substantial consensus in modern macroeconomics that monetary policy has little impact on real economic activities in the long-run, while it has a considerable impact on the price level. In the short-run, however, monetary policy has some impact on real economic activity. This short-run effect stems from the fact that monetary shocks affect market interest rates and asset prices in the economy and, therefore, the magnitude and the structure of the aggregate demand (Grossman and Weiss 1983 and Meltzer 1995). The effects of monetary policy actions could work through one, or more of the following four channels (See Mishkiin (1995) and MPC (2003)).

4.1.1 Interest rate or money channel

The transmission of monetary policy decisions via this channel works through the effects that monetary policy shocks have on market interest rates and the subsequent reaction to changes in these rates. In general, monetary authorities generate policy shocks by changing the official short-term interest rate (the rate they charge private sector lending institutions on their borrowed reserves). Changes in the official interest rate lead to similar changes in other market short-term interest rates such as the interbank lending (deposit) rate. Regardless of their magnitude, changes in market short-term interest rates will also be transmitted, totally or partially, to market interest rates on deposits and different types of credit. Consequently, changes in these interest rates affect individuals' decisions with regard to saving, spending, and investment. Finally, changes in investment and spending will be transmitted into both income and/or the price level (MPC[1] 2003 online).

A similar chain of effects could occur when policy shocks are experienced through changes to reserve required ratios. Such measures have direct effects on excess reserves of lending institutions on the one hand, and on the relative cost of different funds for these institutions on the other. Accordingly these institutions have to adjust their interest rates on both deposits and credit which, in turn, affect demand for credit and, consequently, aggregate demand, real economic activities and the price level (Loungani and Rush 1995).

The final quantitative effect of monetary policy shocks on the price level and/or income depends, largely, on the public's interpretation of monetary policy actions and on their expectations about the future course of these actions and economic activity (MPC 2003 online). The public might interpret a rise in the short-term interest rates as a sign of a faster than anticipated economic growth and, therefore, they might expect a relatively longer period of high rates of growth. On the other hand, they might interpret such a rise in the short-term interest rate as the first step of a contractionary monetary policy to combat inflation and, therefore they might expect a future downward trend in the economic rate of growth.

4.1.2 Credit channel

As explained above, monetary policy shocks push banks and other lending institutions to adjust interest rates on credit as well as their supply of credit. This, in turn, will affect the public's demand for credit. A rise in lending rates leads to a decline in demand for credit and, if investors could not resort to another source of financing, this could lead to a decline in investment. Mishkin (1995) and Bernanke and Gertler (1995) argued that the role of banks' credit in the transmission of monetary policy shocks stems from its impact on the bank

[1] Monetary Policy Committee in Bank of England.

lending and on the firms' balance sheets. First, monetary policy shocks affect the amount of bank lending available for the economy, especially for small businesses and consumers, which in turn has a direct impact on the volume of investment and income. Second, monetary policy shocks affect firms' balance sheets and, consequently, their net worth and cash flows. Changes in firms' net worth and their cash flow are proportionally correlated to the ability of these firms to get new loans and have direct impact on their investments. The decline in investment could be translated into a decline in aggregate demand and, consequently into a decline in income and inflationary pressures.

4.1.3 Asset price channel

The impact of monetary policy shocks on market interest rates is not usually constrained to short-term interest rates. Usually, individuals do not expect monetary policy actions to be reversed so soon and, therefore, the impact of these actions is more likely to spread to long-term interest rates. Changes in long-term interest rates could have an impact on asset prices to an extent that depends on the expectations of other variables affecting those prices and on expected future policy actions (MPC 2003 online). For simplicity, and other things being equal, prices of financial assets such as bonds and equities are negatively related to the long-term interest rates. Thus, an increase in the interest rates because of contractionary monetary policy would lower the prices of such assets. Taylor (1995) argued that changes in long-term interest rates do not affect the price of financial assets only, but they affect the price of physical assets such as durable consumption goods, real estates, and business equipment also. Changes in asset prices, whether financial or physical, will affect the individuals' spending and savings decisions and, therefore, will affect real income and the inflation rate.

4.1.4 Exchange rate channel

The resultant changes in the market interest rates after a monetary policy shock might have an effect on the exchange rate especially in a world of flexible exchange rates. The final impact will depend on the degree of flexibility in the exchange rate regime, the degree of capital mobility, expectations with regard to both domestic and foreign interest rates, and inflation (Taylor 1995 and MPC 2003 online). However, other things remaining unchanged, a rise (fall) in domestic interest rates tends to cause domestic currency to appreciate (depreciate). Changes in exchange rates will affect the relative prices of domestically produced and imported goods and, hence, the structure of domestic demand. Exchange rate appreciation could enhance the demand for imports and lower that for exports. This, of course, has a negative impact on real economic activities, and might push the inflation rate up depending on import and export elasticities, the relative importance of imports in the measure of domestic inflation, and the degree of exchange rate pass-through to the domestic price level (See McKinnon (1982) and Ambler and McKinnon (1895)) .

The importance of the above-mentioned four channels for the transmission mechanism varies between different countries, or even over time in the same economy, depending on the state of development and the degree of diversification of the financial system in the economy (See Bernanke and Blinder (1988) and McCoy and McMahon (2000)). In developed countries, where investors can easily raise funds through issuing bonds or rearranging their portfolios, and where exchange rates are relatively flexible, the last two channels are expected to be more relevant. In developing countries, where the financial structure is shallow and financial services are less diversified, investors' options to raise funds are limited to their borrowings from banks or to liquidation of their deposits with banks. This, in addition to the commonly constrained exchange rate flexibility means that the first two channels are expected to be more relevant in developing countries.

4.2 Monetary policy in Jordan

The financial market in Jordan is characterized by limited financial services and dominated by traditional banking institutions. Other than government bonds and treasury bills, securities did not exist until the late 1970s and early 1980s, when a few corporate bonds were issued and sold, mainly, to banks and financial companies. The secondary market for bonds has been almost non-existent because banks and financial institutions usually buy such bonds and hold them until maturity date. Prior to the establishment of the Amman Stock Exchange[1] in 1978, the secondary market for equities was limited to a number of non-regulated commission agents and at a relatively high cost. This meant that investors were almost restricted to self-financing or borrowing from the banking sector when it comes to raising capital.

Until the late 1980s, the financial sector was relatively heavily regulated. Banks' lending and deposit interest rates had been regulated by the CBJ until 1989. The management of licensed banks' portfolios was also subject to regulation beyond the prudential effect. Licensed banks were required to allocate a certain minimum percentage of their total assets to be invested in government bonds, treasury bills, and stocks, while investments in some other instruments were subject to certain limitations (CBJ 1981).

Given the above-mentioned shortcomings of the Jordanian financial sector, monetary policy in Jordan has been mainly directed towards influencing banks' ability through influencing the amount of their excess reserves and/or their access to the discount window at the central bank. Until 1993, the Central Bank of Jordan (CBJ) relied mainly on changing the

[1] Originally, it was called Amman Financial Market and then changed to the current name (Amman Stock Exchange) since 1997 in accordance with the provisions of the Temporary Securities Law No. 23 for 1997.

discount rate (I) and the required reserve ratios on deposits as policy tools to achieve its objectives. In September 1993, the CBJ resorted to indirect monetary control in managing its monetary policy and, thus, started manipulating short- term interest rates to achieve its monetary indicative quantitative targets. Since then, certificates of deposits (CDs) of three and six-month maturity have been auctioned on a fortnightly basis for this purpose (CBJ 1993). Repurchase agreements (REPOs) were introduced in April 1994, giving licensed banks more flexibility to manage their liquidity (CBJ 1994).

Exchange rate stability has always been a key factor in the planning and conduct of monetary policy in Jordan. Effectively, and with the exception of a very short period (October 1988 through February 1989), the Jordan dinar has been pegged either to a single currency or to a basket of currencies. In practice, and regardless of the state of inflationary pressures in the economy, the stability of the exchange rate has been, in certain cases, defended by resorting to a contractionary monetary policy. A clear example of this was the surge of interest rates on CDs in the mid-1990s and in the second half of 1998 to enhance the return on deposits denominated in domestic currency compared to those denominated in foreign currencies and, consequently, to curb the sharp increase in demand for foreign currencies; mainly the US dollar (CBJ 1995 and 1998). Between 1993 and 1996, the interest rate on the three-month CDs rose by 6 percentage points to reach 9.25%. After easing down to 6.25% in 1997, it surged again to 10.20% in October 1998 before starting to decline gradually.

4.3 Methodology and data

To evaluate the monetary policy transmission mechanism in Jordan, the vector autoregressive (VAR) approach is used in this chapter. The choice of this approach for the purpose of this chapter was influenced by two factors. First, this approach has been widely used in empirical studies that address the issue of monetary policy impact on real economic activities and inflation (See for example: Kahn et al 2001, Fuhrer and Moore 1995, McCoy and McMahon 2000, and Ford, Agung et al 2003). Second, and although all the variables considered for the analysis of monetary policy transmission mechanism in Jordan proved to be I(1), the cointegration analysis performed on the systems comprising these variables produced unsatisfactory results regardless of the policy variable used (See table 4.3 bellow). This suggests that the Vector Equilibrium Correction model is not attainable in this case.

As introduced by Sims (1980), VAR is a system of dynamic linear equations where all the variables in the system are treated as endogenous and, therefore, the reduced form of the system gives one equation for each variable, which specifies that variable as a function of the lagged values of its own and all other variables in the system.

A key advantage of the VAR methodology is that one does not necessarily need to distinguish between endogenous and exogenous variables in the system and all variables are effectively treated as endogenous (Sims 1980). Thomas (1996) argued that, in most cases, such a distinction is arbitrary and highly correlated with the number of variables included in the model. Another advantage of the VAR formulation is the high possibility of assuming that all variables in the system are contemporaneously uncorrelated with the disturbance term and, therefore, each equation is estimated by using ordinary least squares method (Thomas 1996). This plausibility stems from the fact that all variables in the right-hand side of each equation in the standard reduced form of the VAR are lagged variables.

A third advantage of the VAR analysis is that one does not have to worry about the non-stationarity of the variables. Enders (1995) quoted several econometricians who have argued that the main objective of the VAR analysis is to determine the interrelationship between the variables of the model and not to worry about individual parameter estimates. Thus, they recommend not differencing the variables even if they are non-stationary.

However, in addition to being helpful in examining the interrelationships between the endogenous variables, Enders (1995) argued that the resulting estimates of VAR parameters could also be helpful for forecasting purposes. He stated:

"*Even though the model is under identified, an appropriately specified model will have forecasts that are unbiased and have minimum variance"*

On the other hand, Rudebusch (1998) has criticized the VAR approach and argued that it is misspecified and it does not make sense when it comes to measuring the impact of monetary policy shocks on real economic variables. According to Rudebusch (1998), the VAR analysis suffers from several shortcomings. First, it ignores the structural interpretation of individual equations although some of these equations do have such an interpretation. Second, it ignores the instability of the estimated parameters of individual functions over the long-term. This instability sheds some doubt on the validity of the individual reaction functions of the variables included in the VAR. Third, the VAR analysis ignores the statistical insignificance of the estimated parameters; a fact that could raise questions about the variables included in the model and the lag length used in the estimation process. Furthermore, Rudebusch (1998) questioned the use of a final and revised data available on the respective variables in the estimation of monetary VARs, while at the time of the policy action such information is not available for the policy maker. In a reply to Rudebusch, Sims (1998) argued that these criticisms are of marginal importance, simply because they are universal across the board in macroeconomic modelling and not only limited to the VAR estimation.

As quoted by several researchers, the majority of empirical studies on monetary policy transmission mechanism has focused on developed countries; mainly the United States, Japan and European countries (See for example: Loungani and Rush 1995, Fuhrer and Moore 1995, Ford, Agung and et al 2003). Furthermore, the focus of the majority of empirical studies has been on the aggregate level; with the aim of estimating the impact of monetary policy actions on real output and inflation (King 1986, Christiano and Eichenbaum 1992 are examples).

The focus on the aggregate analysis has been criticized to the effect that it could lead to misleading inferences since it relies on the assumption that monetary policy actions have a universal impact across the board in the economy (See Ford, Agung and et al 2003). In practice, the response to monetary policy actions is a behavioural issue and it differs among different economic agents. The magnitude by which large banks may adjust their lending rates in response to the initial shock to the monetary policy tool may differ from that by which small banks adjust their rates. On the other hand, different borrowers and depositors may react differently to changes in the market deposit and lending interest rates as a result of any monetary policy action. Their reaction would certainly depend on what other options they have to raise funds and/or to adjust their portfolio structure. Accordingly, more empirical studies have been recently directed towards micro analysis, addressing the cross-sectional responses to monetary policy actions in the economy.

With regard to variables included in the system, most of empirical studies on the monetary transmission mechanism, especially those studies focused on the analysis of aggregate impact of monetary policy on real economic activity and inflation, have used three or four variables. These variables include: the policy indicator variable (interest rate on banks' borrowed reserves, reserve requirements, or monetary growth), banks' credit to private sector, a measure of domestic real economic activity (real gross domestic product, real gross national product, or real investment), and price level or inflation rate (See Chrestiano and Eichenbaum 1992, McCoy and McMahon 2000, and Fuherer and Moore 1995). Bernanke and Blinder (1992) used multiple interest rates and monetary aggregates. Other studies, especially those focused on assessing the importance of different channels of transmission mechanism, used up to seven or eight variables. In addition to the above-mentioned variables, this group of studies included deposits, securities, stock price index, and exchange rate (See Ford, et al (2003) and King (1986)).

The choice of a policy indicator variable that correctly identifies the innovations resulted from changes in the monetary policy instruments has taken much of the discussion in the literature on the monetary policy transmission mechanism (See Kahn et al 2002, Christiano and Eichenbaum 1992, and Rudebusch 1998). However, this choice is most probably an empirical issue and depends, to great extent, on the state of development and diversification of the financial sector in the respective economy (See Ford et al 2003).

In the context of Jordan, and given the pro fixed exchange rate regime stand and the resultant inability to affect the outcome of the balance of payments directly, the expansion of domestic credit has been the operational medium target for monetary policy in practice. For this purpose, excess reserves of the banking system and the cost of credit have always been under scrutiny by the Central Bank of Jordan. Prior to September 1993, the discount rate and the reserve-required ratios were the main instruments used by the CBJ to affect the cost of domestic credit and the volume of excess reserves. Since September 1993, the CBJ relied mainly on open market operations, through the auctions of certificates of deposits, to affect the volume of excess reserves directly and, consequently, the market interest rates. Nevertheless, it continued to change the discount rate as a key tool for monetary policy. Accordingly, the market interest rates, the volume of excess reserves, and interest rates on the successful bids of certificates of deposits are assumed three alternative indicators to reflect the stance and the actions of monetary policy in Jordan. However, and due to the unavailability of reliable data on the market interest rates in Jordan, this variable is replaced by the discount rate, which is a monetary policy instrument.

Another issue that attracted much interest in the monetary transmission literature, especially when addressing the lending channel, is whether the amount of banks' credit is, effectively, demand or supply determined. While this issue might have more importance in studies focused on the cross sectional effects of monetary policy actions such as Ford et al (2003), it is probably safe to assume that it should not cause real problems when the focus is directed towards aggregate analysis to checking which channel is more relevant in the economy (See Bernanke and Blinder 1992).

Bearing in mind the above-mentioned limitations of the aggregate analysis approach, the focus of this research will be on aggregate analysis for two reasons. First, the lack of information on individual bank's credit and individual or cross sectional borrowings makes it almost impossible to conduct studies at the micro level. Second, the aim of this research is not to estimate detailed and precise relationships for the impact of monetary policy actions, but to check the importance of different channels in order to evaluate the effectiveness of monetary policy in affecting the real economic activities and/or inflation.

4.3.1. The VAR model

Following Ford, Agung et al (2003), a semi-structural VAR model is used to capture the impact of monetary policy shocks in Jordan. The matrix representation of such a linear dynamic system is of the form:

(4.1) $$\beta y_t = A(L) y_t + \varepsilon_t$$

where y is (n x 1) vector of endogenous variables in the system, β is an (n x n) matrix of structural parameters on contemporaneous endogenous variables, $A(L)$ is the ith degree matrix polynomial in the lag operator (if i lags were in the system, then $A(L)= A_1L+A_2L^2+\ldots\ldots+A_iL^i)$, and ε_t is (n x 1) vector of uncorrelated structural shocks with zero means and fixed variances. The reduced form of the VAR system could be represented in the form (See Hamilton 1994):

$$(4.2) \qquad y_t = C(L)y_t + \beta^{-1}\varepsilon_t = C(L)y_t + \eta_t$$

where, $C(L) = \beta^{-1}A(L)$ and $\eta_t = \beta^{-1}\varepsilon_t$. Since the current values of endogenous variables do not appear in the right-hand side of the equations, it is safe to assume that the error term is uncorrelated with the regressors. Thus, the reduced form representation of (4.2) could be safely estimated by OLS.

Provided that the matrix polynomial *C(L)* can be inverted[1], the VAR in (4.2) can be transformed into a moving average (MA) formulation represented by equation (4.3).

$$(4.3) \qquad y_t = D(L).\eta_t$$

where $D(L) = [I-C(L)]^{-1}$.

This form is known as the impulse response function, where each endogenous variable is determined by accumulation of a series of white noise shocks, and *D(L)* is the lag operator of the responses of endogenous variables (y_t) to a disturbance shock (εt) (See Hamilton 1994

[1] The mathematical condition for invertibility of the polynomial *C(L)* is that all the roots of [*I-C(L)*]lie outside the unit circle and, therefore, all the roots of the companion matrix lie within the unit circle (See Diebold 1998 for more details). However, the reason for the invertibility condition in transforming the reduced form of VAR into a moving average representation does not stem from the mathematical condition but from a practical perspective. As explained by Hamilton (1994), if the moving average is invertible, it is possible to find the value of the disturbance η at date t (η_t) from the current and past values of the respected variable (y). Otherwise, one needs all of the future values of (y) to calculate the value of (η_t). The implausibility of having these future values of (y) makes the noninvertible representation of moving average non-feasible to calculate the innovation to any economic variable at any certain point of time.

and Enders 1995). The mathematical derivation and economic interpretation of the impulse response function are summarized in Appendix A4.1.

A necessary condition to get a plausible structural economic interpretation from the moving average representation of the VAR, is the stability of the system, i.e all the roots of *D(L)* lies outside the unit circle (as per footnote (1))with all the moduli less than unity (Enders 1995). If one or more of the moduli are larger than unity, the system will be explosive, which means that no long-run (equilibrium) relationship exists and certain results (such as impulse responses) are not valid.

As pointed out by Sims (1980), the parameters estimated in the reduced form VAR are not suitable to make inferences about the long-run relationships. However, Sims (1980) argued that a reasonable economic interpretation (identification of structural innovations) is plausible from the estimated reduced form VAR by exploiting the long-term structural disturbances through the analysis of the system's responses to typical random shocks after transforming the residuals to an orthogonal form. For this purpose, Sims (1980) made a simple assumption about the structural innovations. He assumed that $E(\varepsilon_t \varepsilon'_t) = I$, which is equivalent to assuming that $E(\eta_t \eta'_t) = I$ in our notation.

Cholesky decomposition of the disturbance term in the moving average representation has been widely used to decompose the covariance matrix of the reduced form residuals in order to get the impulse response and the variance decomposition functions of the structural system (Ford, Agung et al (2003) and King et al (1991)). This is equivalent to recovering the matrix β in equation (4.1) from the information on β^{-1} that can be obtained from decomposing the disturbance term in the moving average representation of the VAR. (See Ford, Agung et al 2003).

The use of the Cholesky decomposition imposes a restriction on the ordering of the variables in the VAR. The policy indicative variable should be placed first in the system if it is assumed not to have instant feedbacks from the innovations of other variables, while it should be placed last if it has instant feedbacks from those innovations. This is due to the sequential nature of responses in the system, where each variable responds only to changes in the innovations of those variables that precede it, while the shock to that variable affects only the innovations of the variables that succeed it (Ford, Agung et al 2003).

To avoid the impact of the ordering restriction, some researchers introduced the generalized impulse response as an alternate tool to the traditional Cholesky impulse response and variance decomposition (Koop et al (1996) and Pesaran and Shin (1998)). Koop et al (1996) argued that the traditional Cholesky impulse response and variance decomposition is only applicable to the linear multiple time series models, while the generalized impulse response analysis can be used in both the linear and the nonlinear multivariate models. Nevertheless, they only discussed its application in the case of nonlinear models. Pesaran and Shin (1998) suggested using the generalized impulse response in the analysis of the linear multivariate models.

The main advantage of the suggested generalized approach is that it does not need orthogonalisation of shocks and, therefore it is not affected by the ordering of the variables used in the VAR model. Pesaran and Shin (1998) argued that while there are many re-parameterization alternatives to calculate the orthogonalised impulse responses without clear guidance to the preferable one, the generalized impulse responses are unique and take full account of the historical patterns of correlations between different shocks. Pesaran and Shin (1998) showed also that in a non-diagonal error variance matrix, the orthogonalised and the generalized impulse responses are equivalent only for the first equation in the VAR. One major disadvantage of the generalized impulse response approach, however, is that one could not obtain the variance decomposition for any single equation of the system, which makes it impossible to distinguish between the direct impact of the policy shock on any single variable in the system and the impact resulted from innovations in other variables of the system.

4.3.2 The data

For the purpose of this Chapter, a system of seven variables is used to identify different channels of monetary transmission using quarterly data for the period 1971 through 2004. These variables include a policy indicator variable, a set of variables representing the potential channels of monetary transmission mechanism, and a set of variables representing the final objectives of the monetary policy. As mentioned earlier, the alternatives for the policy indicator variable are the discount rate, the volume of excess reserves, and the interest rates on the successful bids of certificates of deposits. The variables representing the different channels are real total banks' investments in securities (rgs), real total banks' domestic direct credit (rcr), real total deposits with licensed banks (rdep), and the depreciation (appreciation) of the Jordan Dinar measured by the change in the nominal effective exchange rate index (dne). Real gross domestic product (y), and the consumer price level (p) represent the economic activity variables.

All variables but the interest rates are transformed into the log form. Because the analysis involved quarterly data, all the variables other than the discount rate have been seasonally adjusted before being entered in the VAR analysis. The quarterly data for the period 1971 through 2004 were extracted from the *Statistical Bulletins* of the CBJ. For the period prior to 1989, the data were extracted from a special issue of *Quarterly Statistical Series (1964-1989)*. Starting 1989, the data were extracted from several issues of the *Monthly*

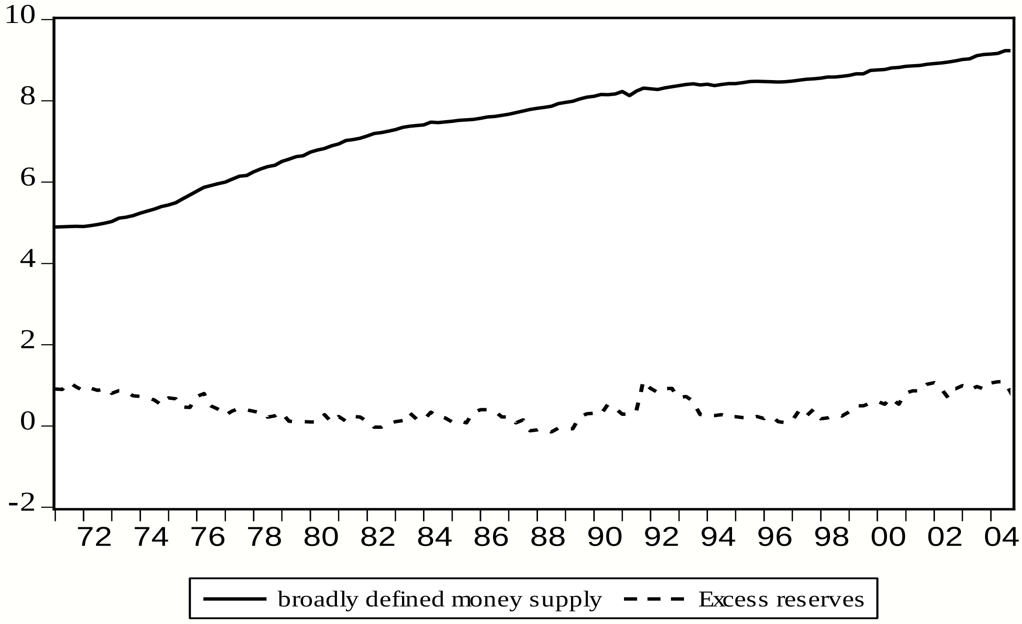
Statistical Bulletin of the bank. The following is a brief discussion of the variables used in the VAR model.

The policy shock variable: Between the three alternatives of the policy indicator variable, it is assumed that banks' excess reserves are more relevant when it comes to identifying monetary policy shocks in Jordan rather than the discount rate or the interest rates on the auctioned certificates of deposits. This assumption is based on the following facts. First, The regulation of market interest rates during the 1970s and 1980s has impeded the impact that changes in the discount rate or the reserve required ratios might have on the market interest rates and, therefore on both the supply of and the demand for credit. Second, banks in Jordan traditionally have maintained a relatively high level of liquidity to the extent that they rarely resorted to borrowing from the CBJ. This suggests a lower sensitivity of market reactions to changes in any single monetary policy instrument. The third important factor that works in favour of choosing the volume of excess reserves, rather than other indicators is consistency and continuity. On the one hand, interest rates on the successful bids of the CDs are only available for the period 1993 through 2004, which sheds some doubt on any statistical inferences based on empirical analysis for such a short period. On the other hand, the available data on market interest rates for the period prior to 1992 represent the maximum or minimum rates set by the CBJ rather than the actual rates applied by banks, which makes these rates inconsistent with the data available for the rest of the sample period.

In practice, however, variation in excess reserves could be attributed not only to policy actions, but also to the banks' attitude towards extending credit. Nevertheless, the fact that this attitude could not be formulated without taking into consideration the actions of monetary policy makes excess reserves an acceptable proxy to represent the monetary policy actions and stance. The fact that excess reserves of the banking institutions have been always under direct scrutiny by the CBJ because of their potential role in the future monetary growth gives additional evidence in favour of this conclusion.

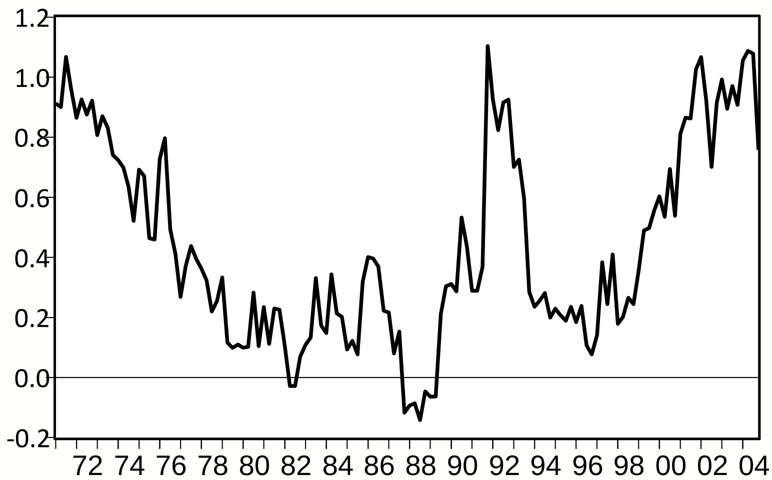
Because excess reserves have been negative in certain periods, it was mathematically inappropriate to transfer them into the log-form. Thus, the ratio of total banks' reserves to required reserves has been used instead to capture the variation in excess reserves implicitly and, consequently monetary policy shocks. In theory, the lower are the excess reserves, the less potential is there for credit expansion and, therefore, the lower is the expected monetary growth. This means that, other things being equal, a positive shock to excess reserves is a signal of expansionary monetary policy and vice-versa. However, from a contemporaneous perspective, a rise in excess reserves could be interpreted as a sign of less credit expansion during the current period, which means a lower monetary growth during the same period. Figure 4.1 shows the time paths of the broadly defined money supply (M2) and banks' excess reserves (r). The relationship looks clearly a negative one especially for the period prior to 2000, where the coefficient of correlation between the two variables amounted to -0.4825.

Figure 4.1: Broadly defined money supply and excess reserves
(Seasonally adjusted and trasformed int logarithms)



Although excess reserves fluctuated in the short-term, they have been on a downward trend over the sample period except in the early 1990s and the period 1999 through 2004. The sharp increase in excess reserves during the first couple of years of the 1990s could be explained by the high degree of uncertainty that engulfed the whole region during and in the aftermath of the first Gulf War, which led to a considerably lower credit growth compared to the surging growth of deposits. On the one hand, the repatriation of large number of Jordanians, who used to work in the Gulf countries, has resulted in a sharp increase in deposits during that period. Total banks deposits had almost doubled during a period of two years to amount at JD 4.75 billion by the end of 1992. On the other hand, and because of the high degree of uncertainty, total banks' credit grew during the same period by only 19%; rising from JD 1.86 billion to JD 2.22 billion (CBJ Dec. 1993). As for the period 1999 through 2004, the upward trend of excess reserves could be mainly attributed to the easy monetary policy during that period, where the interest rate on the three months CDs declined from 9.45% at the end of 1998 to 2.10% at the end of 2003 (CBJ 1989a). Figure 4.2 shows the time path of excess reserves as measured by the ratio of total reserves to required reserves.

Figure 4.2: Banks' Excess reserves measured by the ratio of total reserves to required reserves
(Seasoanally adjusted and transformed into logarithms)



* The negative points represent logarithms of the ratios less than unity.

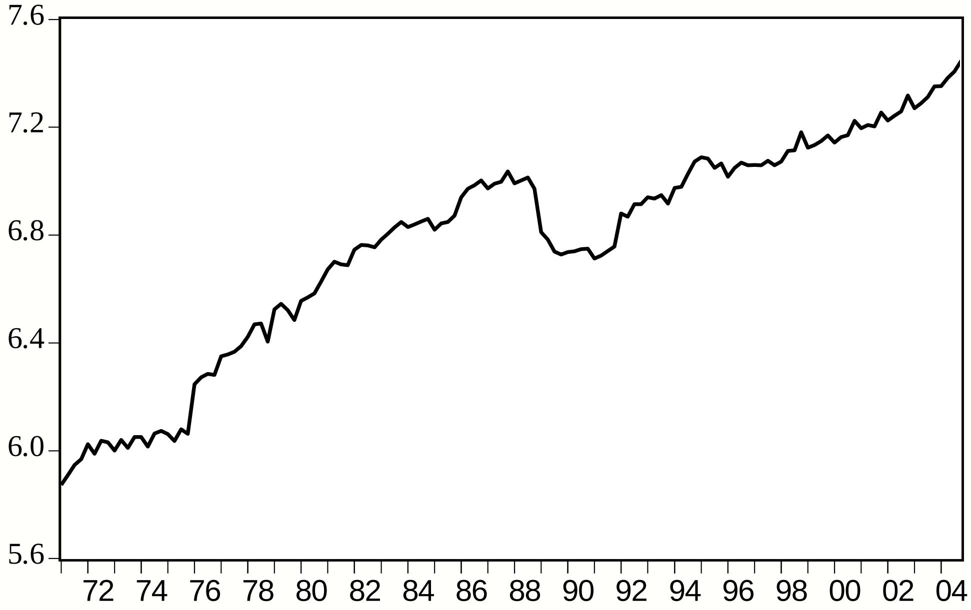
Although the discussion above goes in favour of using the excess reserves as a policy indicator variable, the intention here is to follow the experimental approach and perform the VAR analysis using each of three variables; the interest rate on the three months CDs, the discount rate, and the excess reserves as the policy indicator variable, one at a time. This procedure stems from the exploring nature of the objective of this chapter, whether in the process of investigating the appropriateness of the different transmission channels or in the process of evaluating the efficacy of different monetary policy tools. Such an objective would not be met without exploring the analysis using all the three alternatives.

The economic activity variable: The choice of the right variable to measure domestic real economic activity has been subject to a great deal of disagreement in empirical studies on the monetary transmission mechanism. The majority of such studies have used a measure of national output, such as gross domestic (national) product (For example Campel (1978), Meltzer (1995), Friedman and Kuttner (1992) and King (1986)). Others, however, opted for different measures such as investment and output (Loungani and Rush 1995), consumption (Christiano and Eichenbaum 1992), and industrial production, employment and other variables (Bernanke and Blinder (1992) and Ford, Agung et al (2003)).

In the case of Jordan, where no data on employment and real investment have been published to date, a measure of national output is the most likely to be appropriate. However, no data on real output in Jordan have been compiled prior to 1986 and no quarterly data have been officially published on national accounts so far. National accounts have been prepared and published only on an annual basis. Prior to 1986, they were prepared in nominal terms and then deflated by the consumer price index (CPI). Since 1986, gross domestic product (GDP) has been compiled in both nominal and real terms and the GDP deflator, therefore, is implicitly calculated from the two series. Combining the new series of real GDP with the old one, which used to be calculated by deflating the nominal output by the CPI, could create some inconsistency in the series of real income. To avoid such inconsistency, it seems reasonable to use the old procedure of deflating the nominal GDP by the CPI to get the real gross domestic product at constant prices.

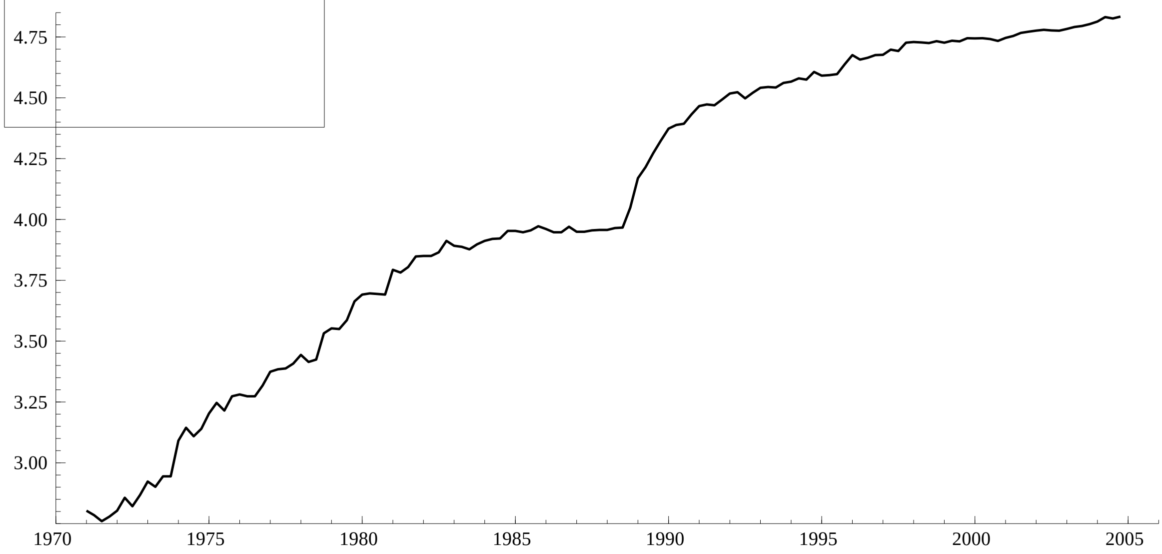
Two options were considered to provide a series of quarterly data on GDP. The first option was to estimate a quarterly series of GDP based on the actual quarterly values of a certain variable such as imports or the money supply and the annual ratios of that variable to GDP. The second option was to construct the quarterly nominal values of GDP on the basis of the quarter to annual ratio of the actual (although not published) quarterly series of GDP provided by the Department of Statistics in Jordan for the period 1992 through 2004. The former option relies, implicitly, on the assumption of a stable relationship between real GDP and the suggested variable. Taking into consideration that such a stable relationship has not been assured yet and the fact that this relationship is subject to great deal of volatility due to the continuous regional instability on the one hand and to the liberalization process on the other, the first option was abandoned. The second option, which relies on the seasonal effect on GDP, has been adopted based on the assumption that such effect stems mainly from domestic factors related to the structure of the economy and do not change considerably over time. The resulted quarterly nominal values were deflated by the price level (CPI) to get the quarterly real GDP values, which were then smoothed through calculating the seasonally adjusted values based on the ratio of the actual values to the moving averages trend. Figure 4.3 shows the time path of the constructed seasonally adjusted quarterly real GDP series.

Figure 4.3: Real gross domestic product (Seasonally adjusted and transformed into logarithms)



The price level: Three measures of the price level are currently published in Jordan; namely the Consumer Price Index (CPI), the Wholesale Price Index (WPI), and the GDP deflator. As mentioned earlier, the GDP deflator was published for the first time in 1986. This makes it available for only the second half of the sample period, which is relatively short for reliable statistical inference. The WPI was published by the CBJ for the first time in 1976 covering the city of Amman only. The CBJ continued to publish this index until the end of 1992, when the Department of Statistics started to publish a new index in 1993. The weights and the components of the two indices are quite different, which makes combining them into one series unrealistic. The CPI has been published since the late 1960s, and changes in it, have been used as the official measure of inflation since then. In addition to these advantages over the other two measures, the CPI has been commonly used in empirical economic studies. Accordingly, the CPI is used for the purpose of this chapter to represent the price level in Jordan. Figure 4.4 shows the time path of that index.

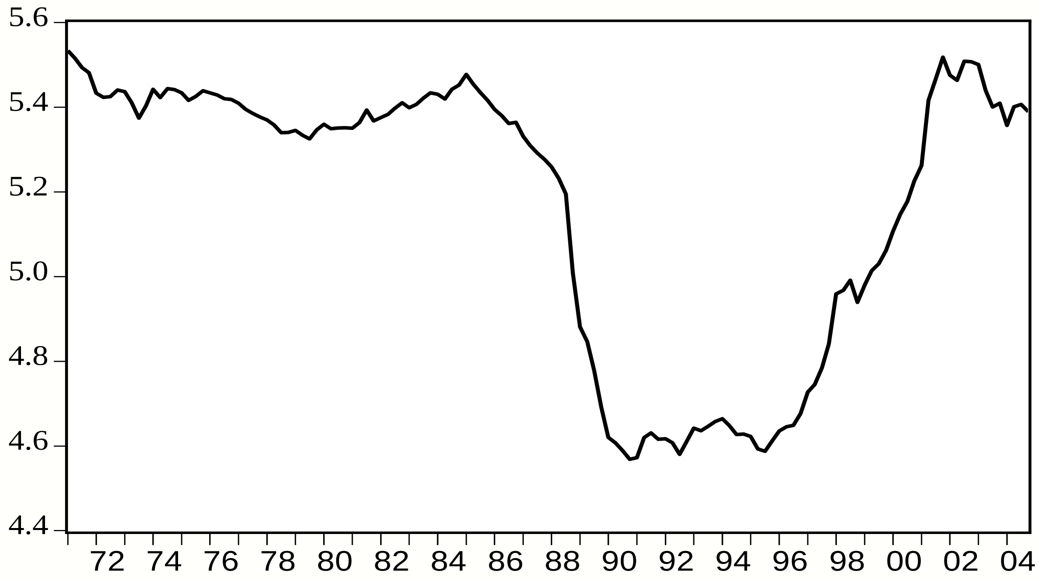
Figure 4.4: Consumer price index in Jordan (Seasonally adjusted and transformed to logarithms)



Exchange rate variable: The Jordan Dinar exchange rate in terms of the US dollar has been either fixed or suppressed to ensure a minimum variation. Even when it was not literally fixed, variations in the Dinar/Dollar exchange rate were most likely to be determined by the CBJ rather than being determined endogenously within the system. This fact suggests that exchange rate is more likely to be treated as exogenous rather than endogenous variable. In practice, the CBJ used the US dollar as a median currency to determine the Dinar exchange rate against other currencies and the practice was to minimize the fluctuations in the Dinar/Dollar rate. The fact that the actual variations in the Dinar/Dollar rate were usually minimal makes it even impractical to use this rate as a representative of the exchange rate in the system. Instead, we have constructed a Nominal Effective Exchange Rate index (NE)[1] to represent the exchange rate level. Figure 4.5 shows the time path of the constructed quarterly nominal exchange rate index.

[1] For more details on the construction of this index, see the detailed discussion in Chapter 3.

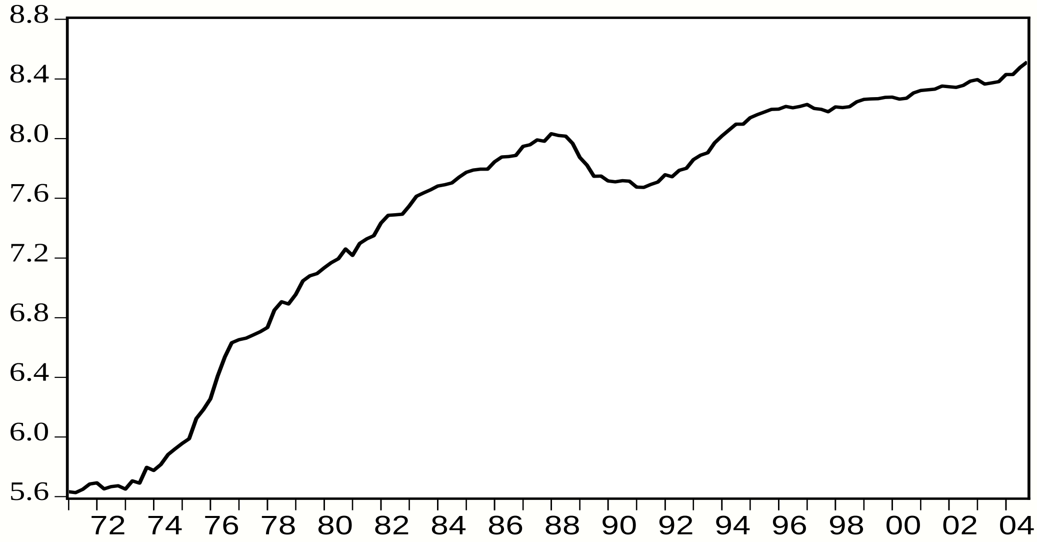
Figure 4.5: Nominal effective exchange rate index of the Jordan dinar
(Seasonally adjusted and transformed into logarithms)



As explained in Chapter 3, this index is the exchange rate of the Dinar weighted by the relative share of Jordan's external trade (exports plus imports) with the countries whose currencies are included. In other words, it measures the number of a composite foreign currency units per the Jordan Dinar. Thus, an increase (decrease) in this index represents an appreciation (depreciation) of the Dinar.

The credit variable: This variable is represented by the outstanding balance of total real direct credit facilities extended by licensed banks to residents in Jordan (The nominal outstanding balance is deflated by the price level). It consists of loans, overdrafts and discounted commercial papers and bills. Although borrowers from banks are mainly private households and businesses, this variable includes, however, small amounts of credit to the government (2.2% of total banks' credit to residents at the end 2004). Figure 4.6 shows the time path of total banks' real credit.

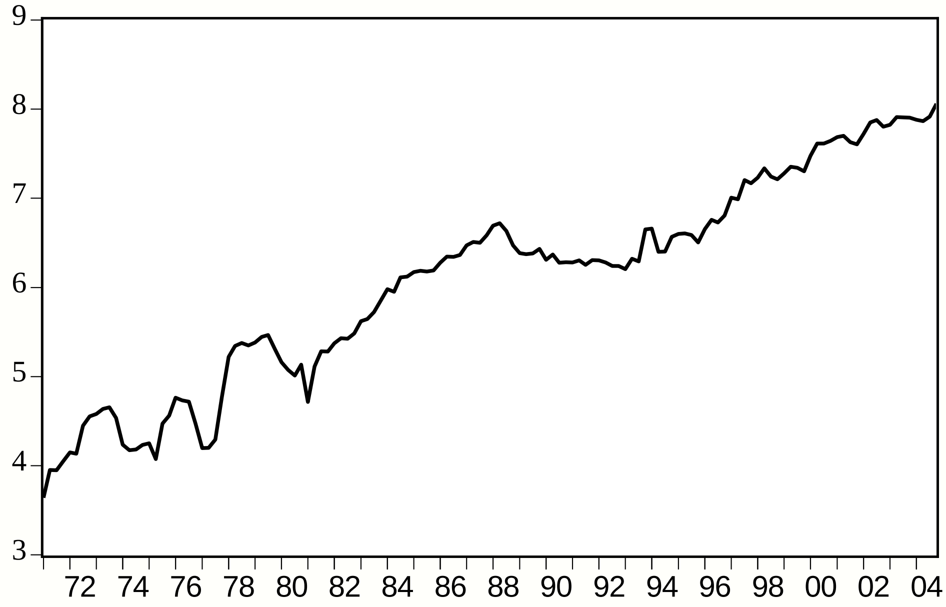
Figure 4.6: Total real banks' credit to residents
(Seasonally adjusted and transformed into logarithms)



Securities: This variable consists of total banks holdings of securities, including government bonds and bills, corporate bonds, corporate stocks, certificates of deposits issued by the CBJ, and interest-bearing deposits with the CBJ. Being a perfect substitute for liquid reserves, securities are a buffer stock for banks' financial intermediation during the interim period between raising deposits and extending credit. On the one hand, interest earned from these securities helps in minimizing the opportunity cost of holding large amounts of idle liquid reserves whenever banks withhold from extending credit for any reason. On the other hand, these securities could easily be liquidated when banks decide to extend more credit.

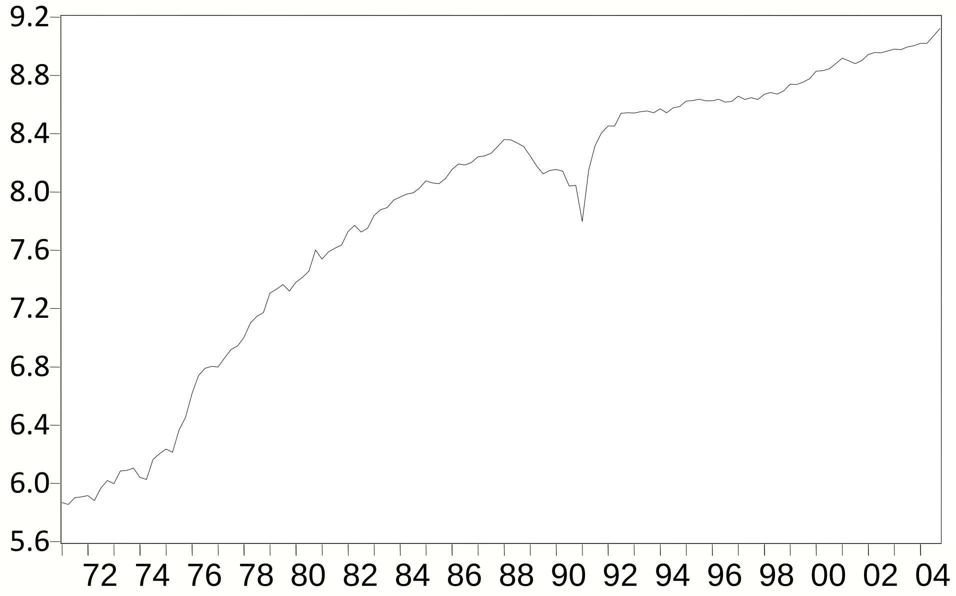
Unlike the well-developed financial markets, the secondary market for securities other than stocks has been almost non-existent in Jordan. Nevertheless, banks, in practice, could liquidate these securities easily by reselling them to the CBJ, which acts as an underwriter for government bonds and bills (CBJ 1989). Moreover, banks were allowed to borrow from the CBJ up to 90% of the face value of their holdings of government and corporate bonds; using these bonds as collateral (CBJ 1989). Figure 4.7 shows the time path of banks' holdings of securities.

Figure 4.7: Banks' holdings of securities (Seasonally adjusted and transformed into logarithms)



Deposits: This variable consists of total customer's deposits, including government institutions and non-residents, with licensed banks in Jordan. At the end of 2004, the share of government deposits was relatively small (2.9%) while that of non-residents' deposits was 18.7%. The inclusion of government and non-residents' deposits is based on the assumption that banks do not take into account the ownership of deposits when taking investment and portfolio decisions. In theory, what matters for banks when deciding upon the distribution of their investments between loans and securities, is the availability of excess reserves on the one hand, and the maturity structure of deposits on the other. Figure 4.8 shows the time path of total deposits with banks in Jordan.

Figure 4.8: Total deposits with banks in Jordan
(Seasonally adjusted and transformed into logarithms)



4.4 Empirical Analysis

The importance of banks' assets and liabilities in the process of monetary transmission stems from the banks' function as financial intermediaries between savers and investors. From this role comes the importance of excess reserves as an indicator of banks' ability to meet any instantaneous demand for credit and, consequently, to feed the process of money creation. This is why excess reserves have been the most likely to become the first intermediate target that central banks usually try to affect in pursuing monetary policy, especially in countries where the financial market is not well developed and where other options for raising funds are limited. By affecting the level of excess reserves, central banks usually aim at affecting the supply of credit and, consequently, the market interest rates. This will affect private household and business decisions with regard to spending, borrowing and saving. Changes in spending and saving of private sector households and enterprises should have an impact on the ultimate targets of monetary policy; real economic activity and the price level. Within this framework, a positive shock to excess reserves is considered an indicator of an easier monetary policy and, therefore, is expected to create a chain of future positive disturbances to banks' credit and, consequently, to deposits, income and the price level.

On the other hand, the discount rate and the interest rate on the CDs are the tools used by the central bank to affect the market interest rates and, consequently, the cost of credit. When the CBJ raises the discount rate or issues less amounts of CDs and, consequently, raises the interest rate on the newly issued CDs, it in fact raises the cost of loanable funds for banks, which in turn try to transfer this, totally or partially to the borrowers who are expected to respond by decreasing their demand for credit. Accordingly, a positive shock to the discount rate or the interest rate on the newly issued CDs is interpreted as a sign of contractionary monetary policy and, therefore, is expected to result in a chain of negative impact on the volume of credit, the volume of deposits, the real GDP, and the inflation rate.

Following Sims (1980), and based on assumption that the policy indicator variable has no contemporaneous feedbacks from other variables in the system, it is placed first in the estimated VAR. The magnitude of the future disturbances (the time effect multipliers) that any current shock to policy indicator variable might result in for the other variables in the system depends on the impulse responses. The summation of these effects over the time horizon (accumulated impulse responses) results in the long-run multiplier (See Ford, Agung et al 2003).

On the other hand, the direction of contemporaneous variations in the policy indicator variable and the other variables in the system are most likely to be different from that of future variations. For example, an increase in excess reserves is most likely to be associated with a contemporaneous decrease in banks' credit, deposits, income and a slower increase or even a decrease in the price level. The contemporaneous correlation between the policy indicator variable on the one hand and the banks' holdings of securities on the other could be either way depending on the market conditions and the level of liquidity that banks have. Since the issues of the CDs are designed mainly to absorb the extra amount of excess reserves, the correlation coefficients between the interest rate on the CDs on the one hand and the other variables in the system on the other are expected to be similar to those of the excess reserves. Table 4.1 shows that all the contemporaneous coefficients of correlation between the policy indicator variables on the one hand and all the other variables in the system conform to this contention.

In terms of magnitude, the correlation coefficients between the discount rate and all the other five endogenous variables in the system are found to be considerably higher than those coefficients between excess reserves and the other variables. Interestingly, and regardless of the policy indicator variable used, Table 4.1 reveals is the relatively low correlation coefficients when calculated over the full sample (1971-2004) compared to those coefficients calculated over a slightly shorter sample period (1971-2000).

Table 4.1: Correlation coefficients between the policy variables and the other endogenous variables in the VAR system over different sample periods

	1971q1-2004q4		1971q1-2000q4		1993q4-2004q4
Variables	Excess reserves	Discount rate	Excess reserves	Discount rate	Interest rate on CDs
Gross Securities	0.0119	0.2892	-0.3770	0.8296	-0.6494
Credit to residents	-0.1421	0.3967	-0.4742	0.8371	-0.5019
Deposits	-0.0903	0.3912	-0.4244	0.8532	-0.7188
Real GDP	-0.1166	0.2499	-0.5108	0.7306	-0.6378
Price level	-0.0278	0.4258	-0.3439	0.9025	-0.4969

Further examination of the time path of the variables under consideration indicates that the low rates of correlation resulted from the longer sample period could be explained by the dramatic change of the monetary policy stance since mid-1999 while uncertainties related to the political situation in the region were on the rise. After a relatively long period of restrictive monetary policy to defend the exchange rate of the Dinar, and in line with the declining trend in the US interest rates, the CBJ practiced an easy monetary policy over the period mid-1999 to 2004. This policy resulted in a decrease in the discount rate from 9% in mid-1999 to 2.5% by the end of the first quarter of 2003. At the same time, political developments in the region, especially in Palestine and Iraq, raised the degree of uncertainty regarding the prospects for the war and its economic consequences. The rising uncertainties must have negative impact on the volume of investments and, consequently on the volume of credit and income. Nominal growth rate of total banks' credit averaged at 3.6 percent during the years 2000-2003.

4.4.1 Unit root tests

As a first step, and to check the time series properties of the variables included in the system, two kinds of tests have been used to test for unit roots, namely the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test as both tests are utilized in the Eviews software. As could be noticed from Figures 4.2 through 4.8 above, all variables have some kind of trend over time. Given the fact that all the variables had started from a positive finite value at the beginning of the sample period, a constant and trend have been included in the equations used to perform both tests. In other words, we assume that each variable is generated by a first order autoregressive AR (1) of the form

$$(4.4) \qquad X_t = \alpha + \beta T + \lambda X_{t-1} + u_t$$

where X_t is a vector of n x 1 of observations of the respected variable, T is the time trend, u_t is the disturbance term. In such a model, X_t is stationary if the value of λ (the coefficient of the lagged variable) is less than unity. If (λ=1), then the process has a unit root and, therefore the variable X_t is not stationary. In performing the tests for stationarity, the null hypothesis in both tests (the ADF and the PP tests) is that the process has a unit root; that is (λ=1) against the alternative hypothesis that the process does not have a unit root; that is (λ<1). The rejection of the null hypothesis means that the variable is stationary while accepting the null hypothesis means that the variable is non-stationary (Hamilton 1994).

Table 4.2: ADF and PP Unit Root Tests for the Individual Variables Included in the VAR (1971:1-2004:4)

Variable	Levels		First Difference	
	ADF	PP	ADF	PP
Discount rate	-2.2939	-1.3259	-4.8203**	-8.8273**
Excess reserves	-2.7399	-2.4824	-12.974**	-12.9896**
Gross securities	-3.0851	-3.2176	-9.9834**	-10.0360**
Credit volume	-1.4735	-1.5412	-9.6078**	-9.8531**
Deposit volume	-0.9420	-0.9386	-6.2209**	-10.8391**
Real GDP	-2.5324	-3.3020	-2.9660*	-13.5762**
Price level	-1.9409	-0.9410	-3.7874**	-10.7274**
Nominal effective exchange rate index	-0.7844	-0.8832	-6.6506**	-7.1525**
95% Critical Value	*-3.4437*	*-3.4434*	*-2.8836*	*-2.8831*
99% Critical Value	*-4.0279*	*-4.0275*	*-3.4808*	*-3.4796*

"*" and "**" mean the null hypothesis is rejected at the 5% and 1% level of significance respectively.

Table 4.2 shows the test results of both the ADF and the PP tests for unit roots along with the 99% and 95% critical values. Both tests reveal that the null hypothesis of the unit root for the level of all variables could not be rejected, while the null hypothesis of the unit root was rejected in the case of the first difference of all variables. These results suggest that all the variables included in the system are I(1).

However, further investigation of the time path of the variables considered for the VAR analysis suggests the existence of a structural break in the trend of most of the variables (See Figures 4.2 to 4.8). Perron (1989) argued that the existence of a trend break sheds some doubts on the reliability of the PP test for the unit root, where the test lacks power to reject the hypothesis of the unit root in this case. To ensure that the acceptance of the unit root hypothesis in the previous two tests was not influenced by the existence of the trend break, the Perron test for unit root with a trend break point, as utilized in the RATs, has been also performed.

The formal representation of the Perron test[1] with a structural change in the trend is

(4.5) $$y_t = c + \alpha y_{t-1} + \varphi T + \theta DU + \gamma D(TB) + \varepsilon_t$$

where *T* is the time trend variable, *DU* is a dummy to capture the change in the level of trend, *D(TB)* is a dummy to capture the change in the slope of the trend, ε is a normally distributed error term with zero average and fixed variance, and c, α, φ, θ, and γ are parameters. The null hypothesis of a unit root is ($H_0 : \alpha = 1$) against the alternative hypothesis of ($H_1 : \alpha < 1$). The rejection of this null hypothesis means that the variable under investigation is stationary (See Noriega and De Alba 2001). Table A4.1 in the appendix shows the test results of the Perron test for a unit root with a trend break, using the three models (IO1, IO2, and AO). Since the results of both the STUDABS and STUD statistical methods were identical in each model, only the results of the method STUD are reported along with the results of the method UR.

Regardless of the model or the statistical method used, the test results show that the unit root hypothesis could not be rejected in for any of the variables even when the trend break was taken into consideration. This complements the results of both the ADF and the PP tests in this regard. Accordingly, we can conclude that it is safe to assume that all the variables considered in the system are I(1) and we can proceed to the VAR analysis.

4.4.2 Cointegration Analysis

Since all the variables included in the systems proved to be I(1), cointegration analysis was performed on the three systems of variables to test for cointegration. Table 4.3 bellow shows the Johansen cointegration test results for the three systems of variables considered for the analysis of monetary policy transmission mechanism in Jordan using the three different policy variables.

[1]For further technical discussion on this test, see the earlier discussion on the subject in Chapter three.

Table 4.3: Johansen cointegration test results for the variables considered for the analysis of monetary policy transmission mechanism in Jordan using different policy variables

Policy variable	No. Of Observations	Rank	Trace Statistic(1)	95% Critical Value(2)
CDI	44	0	122.04**	107.79
		1	71.421**	67.52
		2	42.959*	41.05
		3	27.004**	22.80
		4	15.699**	10.71
		5	7.290**	3.60
R	135	0	195.56**	99.96
		1	109.58**	63.41
		2	70.43**	38.76
		3	39.88**	21.53
		4	18.38**	10.15
		5	1.41	3.45
I	135	0	179.55**	99.96
		1	93.79**	63.41
		2	55.91**	38.76
		3	26.65**	21.53
		4	7.92	10.15
		5	0.85	3.45

When the interest rate on the three month CDs is used as a policy variable all the hypotheses of no cointegration up to the existence of five cointegrating vectors were rejected at least at the 5% level of significance, which indicates either the non-existence of a relationship between these variables or the existence of instability if a relationship between these variables exists. When the discount rate and the excess reserves were used as policy variables, the test results revealed the existence of at least four cointegrating vectors in the case of the former and five cointegrating vectors in the case of the latter. This, of course, suggests that a unique relationship between any subset of these variables is implausible and, therefore, raises the identification issue.

4.4.3 The VAR model specification

Following several empirical studies on the analysis of monetary policy transmission mechanism, the VAR system should include a variable representing the monetary policy actions, a set of variables representing the different channels of transmission to be examined, and a set of variables representing the ultimate objectives of the monetary policy. In the context of Jordan, and given the wide-scale of structural reforms and liberalization measures that took place during the period of study, the choice of the policy indicator variable is not a strait forward task. As discussed earlier, there are three possible alternatives for this variable; namely the discount rate (i), the interest rate on the successful bids for the three months CDs (cdi), and a proxy for excess reserves represented by the ratio of total banks' reserves to total banks' required reserves (r). Regardless of the earlier discussion, which supported the choice of excess reserves as the appropriate indicator of monetary policy actions and status, and for the sake of comparison, the intention is to experiment the three alternatives via including each of them as the policy indicator variable in the VAR system one at a time.

Regarding the possible channels of monetary policy transmission, the interest rate channel had to be excluded because of the absence of viable market interest rates. Total banks' holdings of real securities (rgs) is used as a proxy for banks' portfolio management, real total credit (rcr) is used to represent the credit channel, real total deposits (rdep) is used to represent the money channel. The nominal values of the relevant variables were deflated by the consumer price index to get the real values. Given the fact that the exchange rate of the Dinar has not, in practice, been determined endogenously, the change in the exchange rate measured by the change in the nominal effective exchange rate index (dne) is included in the system as an exogenous variable. On the economic activity side, real GDP is used to represent income (y), and the consumer price index (p) is used to represent the price level.

An important issue that arises when it comes to the specification of the VAR system is whether to use the variables in levels or in the differenced form. This issue stems from the fact that most economic variables are, in practice, non-stationary, which sheds some doubts on the estimated parameters using the standard OLS procedure (See Granger and Newbold 1974 and Phillips 1986). The choice between the level variables and differenced variables, however, is not a clear cut case. In principle, this choice depends on the cointegration analysis of the system. If the system of a set of non-stationary variables is cointegrated, it is recommended to perform the VAR analysis using the level variables, while it is recommended to use the differenced variables if no cointegrating vectors exist in the system (See Madala 2001 and Thomas 1996). However, Enders (1995) argued that while the above mentioned worries are valid in the case of estimating a single structural equation, one should not to worry about the non-stationarity implications when performing the VAR analysis and, therefore, the VAR system could be estimated using the variables in levels. Quoting several empirical studies, Enders (1995) argued that the VAR analysis is mainly used to evaluate the interrelationship between the variables included in the system, which means that one should not to worry about individual parameter estimates. Since there is no clear cut reference on this issue, the VAR analysis of the monetary policy transmission mechanism in Jordan will be performed using both the level variables and the first differences.

All the systems to be tested consist of six endogenous variables including the policy indicator variable and one exogenous variable, namely the exchange rate depreciation (appreciation) measured by the change in the nominal effective exchange rate index (dne). As noted earlier, all variables are transformed into logarithms and seasonally adjusted except for the interest rates.

To choose the appropriate lag length for the VAR system, several criteria were applied. These include: meeting the mathematical stability condition, the Hendry's general to specific approach, the four criteria of the built in lag length test in the GiveWin2 software [the Akaike Information Criterion (AIC) , the Schwarz Information Criterion (SIC), the Hannan-Quinn information criterion (HQ), and the final prediction error (FPE)], and the misspecification tests such as autocorrelation, normality, and heteroscedasticity.

Regardless of the policy indicator variable used in the VAR analysis, it is assumed that variations in this variable capture the policy shocks and that there is no contemporaneous feedback from other variables to that variable. Accordingly, as noted earlier, the policy indicator variable will be ordered first in the system. The order of the rest of the endogenous variables in the system will be banks' holdings of securities, volume of credit, volume of deposits, real GDP and the price level. This order is based on economic theory and follows several empirical studies (See Ford et al 2003).

4.4.4 Empirical results of VAR analysis

Before discussing the empirical results of the VAR systems used for the purpose of this thesis, it is worth mentioning that I recently became aware of a new IMF working paper by Poddar et al (2006) on the monetary transmission mechanism in Jordan. Poddar et al estimated five VAR systems to check different channels of monetary transmission mechanism in Jordan using three variables each time. Starting from a basic system that consists of output, international reserves, and the spread between interest rate on the three months CDs and the U.S. federal funds rate (FED) as a policy indicator variable, Poddar et al (2006) estimated another four VARs to check the importance of different channels of monetary transmission by adding the appropriate representative variable to their basic model. The variables they have added to the basic model are the real lending rate, the seasonally adjusted real domestic credit, the stock market index, and the real effective exchange rate index to check the importance of interest rate, credit, equity prices, and exchange rate channels respectively.

Poddar et al (2006) concluded that none of the four channels tested proved to be a good vehicle for the monetary transmission mechanism in Jordan. In addition to this, no significant effect of monetary policy shocks has been found on real output, the volume of credit, or the stock market index, on the one hand, and of bank credit on output, on the other.

However, Poddar et al found that monetary policy shocks have significant impact on foreign reserves and on market deposit and lending rates. Furthermore, when they changed their basic model and used broad money instead of foreign reserves they found that the monetary aggregate has a positive impact on output in the second quarter, but they attributed this impact to a third unspecified factor because neither the interest rate channel nor the credit channel shows significant impact on output.

Poddar et al (2006), however, made it very clear that their results should be interpreted with caution due to several drawbacks; the most important of which is the fact that the period of study has witnessed large-scale structural changes, especially in the financial sector. Such changes are expected, of course, to cause a lot of noise to the data. Another drawback mentioned by Poddar et al, which usually sheds some doubt on any long-term inferences from the results, is the short time span of their study (1995 q4-2003 q4).

In addition to these drawbacks, one could also argue about their choice of the policy indicator variable. Although the CBJ is maintaining the spread between domestic interest rates and the FED rate within a certain corridor, this margin might not be the right representative of the monetary policy stance for two reasons. First, and given the custom of the CBJ to change the discount rate and the rates on the newly issued CDs in line with the changes in the FED rate, the monetary policy stance could in practice change considerably, while the variation in the margin, if observed, is very limited. Second, the variation in the margin by itself might have a more direct impact on the composition of a portfolio (the relative share of foreign to domestic financial assets), but not on the volume of certain domestic aggregates such as total bank credit or output. In my opinion, it is because of this effect they have found the monetary policy shocks having a significant impact on the level of official foreign reserves. For the impact of monetary policy actions on domestic economic aggregates, I believe the level of the interest rate is more relevant.

4.4.4.1 Results of VAR analysis using the first differences

4.4.4.1.1 Changes in the interest rate on the three months CDs as the policy indicator variable

Using the first differences and the change in the interest rate on the three months CDs (CDI) as the policy indicator variable, a VAR system of six endogenous variables (the first differences of CDI, real banks' holdings of securities (rgs), real credit volume (rcr), real volume of deposits (rdep), real GDP (y), and the price level (p)) and one exogenous variable (dne) is tested with the lag length setting from 1 lag up to 5 lags. The choice of five lags was constrained by the limited number of observations available on the cdi (q3 1993 – q4 2004). Given the relatively large number of variables in the system, the number of observations is not sufficient to estimate any VAR system with more than five lags.

This VAR system proved to be mathematically stable for the first three lags but not for the fourth and the fifth lags, where some roots of the companion matrix lied outside the unit circle. Accordingly, the VAR systems with lag settings from one up to three lags were evaluated to identify the right lag length. Table 4.4 shows the four information criteria statistics for the VAR system with one up to three lags utilizing the lag selection test incorporated in the Givewin2 software.

Table 4.4: Information criteria for the lag order selection for the VAR system of the first differences of (CDI, RGS, RCR, RDEP, Y, P/DNE)

	1 lag	2 lags	3 lags
Akaike information criterion	-20.95	-21.45	-22.27*
Schwarz information criterion	-18.98	-18.00	-17.26*
Hannan-Quinn information criterion	-20.22	-20.1	-20.45*
Final prediction error criterion	-1.563e-009*	-2.581e-011	-1.238e-12

*: Indicates the best lag selected according to each criterion.

The results reveal that the best lag length was found to be three lags according to three information criteria; namely the Akaike Information Criterion, Schwarz Information Criterion, and Hannan-Quinn information criteria. According to the fourth criterion, the Final Prediction Error criterion, the best lag length was found to be one lag.

When other diagnostic tests were implemented at different lag lengths[1], the test results for one lag revealed that the null hypothesis of no autocorrelation is rejected at the 5% level of significance in one individual equation; the equation representing the change in the price level. The null hypothesis of normal distribution is rejected at the 5% level of significance in the case of the equation representing the change in the real GDP and at the 1% level of significance for the vector and for the equation representing the change in the interest rate on the three month CDs. The null hypotheses of no autoregressive conditional heteroscedasticity, and no heteroscedasticity could not be rejected either at the vector level or at any single individual equation level.

When the lag length was set at three lags, as indicated by the above-mentioned three criteria, none of the null hypotheses of no autocorrelation no autoregressive conditional heteroscedasticity, and no heteroscedasticity could be rejected at either the 5% or the 1% level of significance for any individual equation or at the vector level. The null hypothesis of normal distribution, however, was rejected only for the individual equation representing the change in the interest rate on the three months CDs, where it was rejected at the 1% level of significance. Therefore, the lag length is set at three lags, which has the least problematic statistical properties and conforms to the selection by three out of four lag length selection criteria.

[1] A summary of these diagnostic tests is available from the author on request.

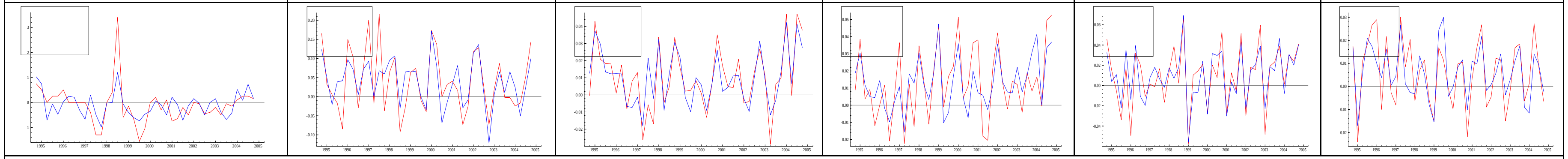
Graphic analysis of the VAR system involving the first differences with the change in interest rate on three months deposits representing the policy variable dose not perform well enough. With a clear quite high discrepancies, the actual and fitted values and the cross plot of actual and fitted values (panels A and B of Figure 4.9) reveal that all individual equations lack the goodness of fit. This conclusion is clearly supported by the scaled residuals shown in panel D of Figure 4.9, where the residuals are relatively high in magnitude and several outliers existed in each individual equation. Similar to the statistical diagnostic tests, panel C of Figure 4.9 shows clearly that the residuals are normally distributed for all individual equations except for the equation of the change in the interest rate on three months CDs.

Nevertheless, recursive analysis gives clear evidence for the stability of the system at both the individual equations and the vector's levels, which is not uncommon when one models a set of stationary variables (Figure 4.10). The one-step residuals test $\pm 2\sigma$ (Panel A) shows that residuals have remained within the confidence band of 95% in all individual equations. The One Step Chow test, The Break Point test, and the Forecast Chow test (Panels B, C, and D) show clear evidence of stability, where all the individual equations and the vector are free of outliers at the 5% level of significance except for the equation of the change in the volume of credit, which witnessed a single outlier around the first quarter of 2003 in the case of One Step Chow test.

Figure 4.9 : Graphic Analysis for the VAR system of (CDI, RGS, RCR, RDEP, Y, and P)
(First Differences)

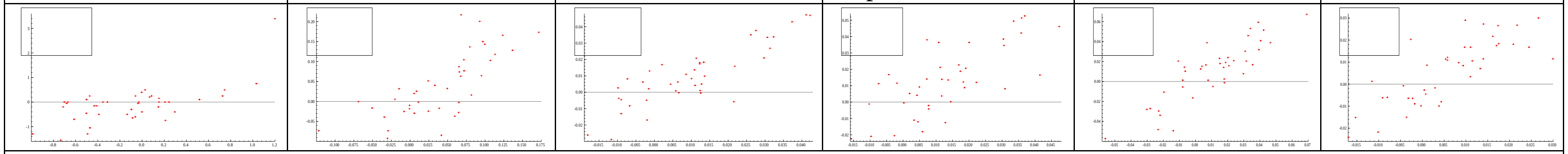
Panel A: Actual and Fitted Values

Interest Rate on CDs	Securities	Credit Volume	Deposit Volume	GDP	Price Level



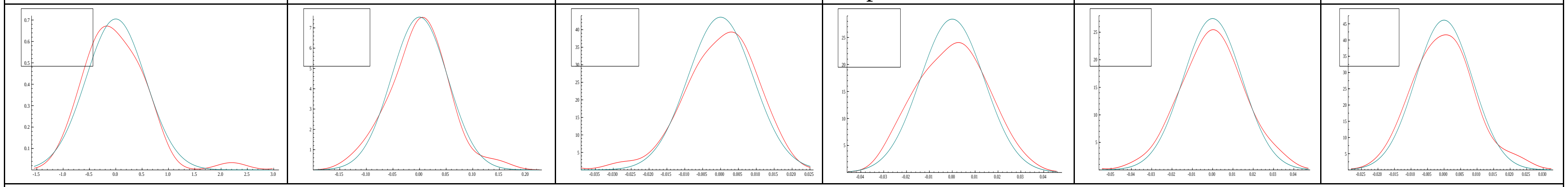
Panel B: Cross Plot of Actual and Fitted

Interest Rate on CDs	Securities	Credit Volume	Deposit Volume	GDP	Price Level



Panel C: Residual Density Normal

Interest Rate on CDs	Securities	Credit Volume	Deposit Volume	GDP	Price Level



Panel D: Residual Scale

Interest Rate on CDs	Securities	Credit Volume	Deposit Volume	GDP	Price Level

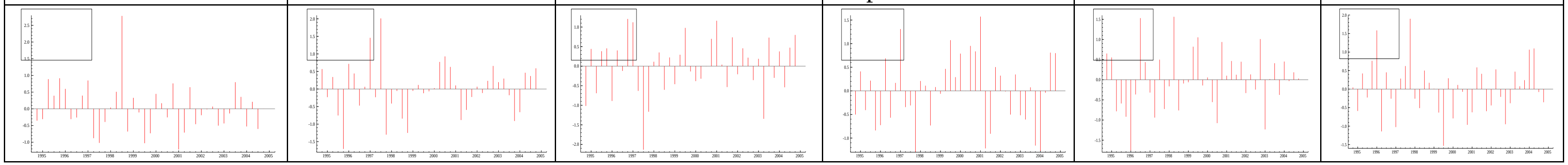
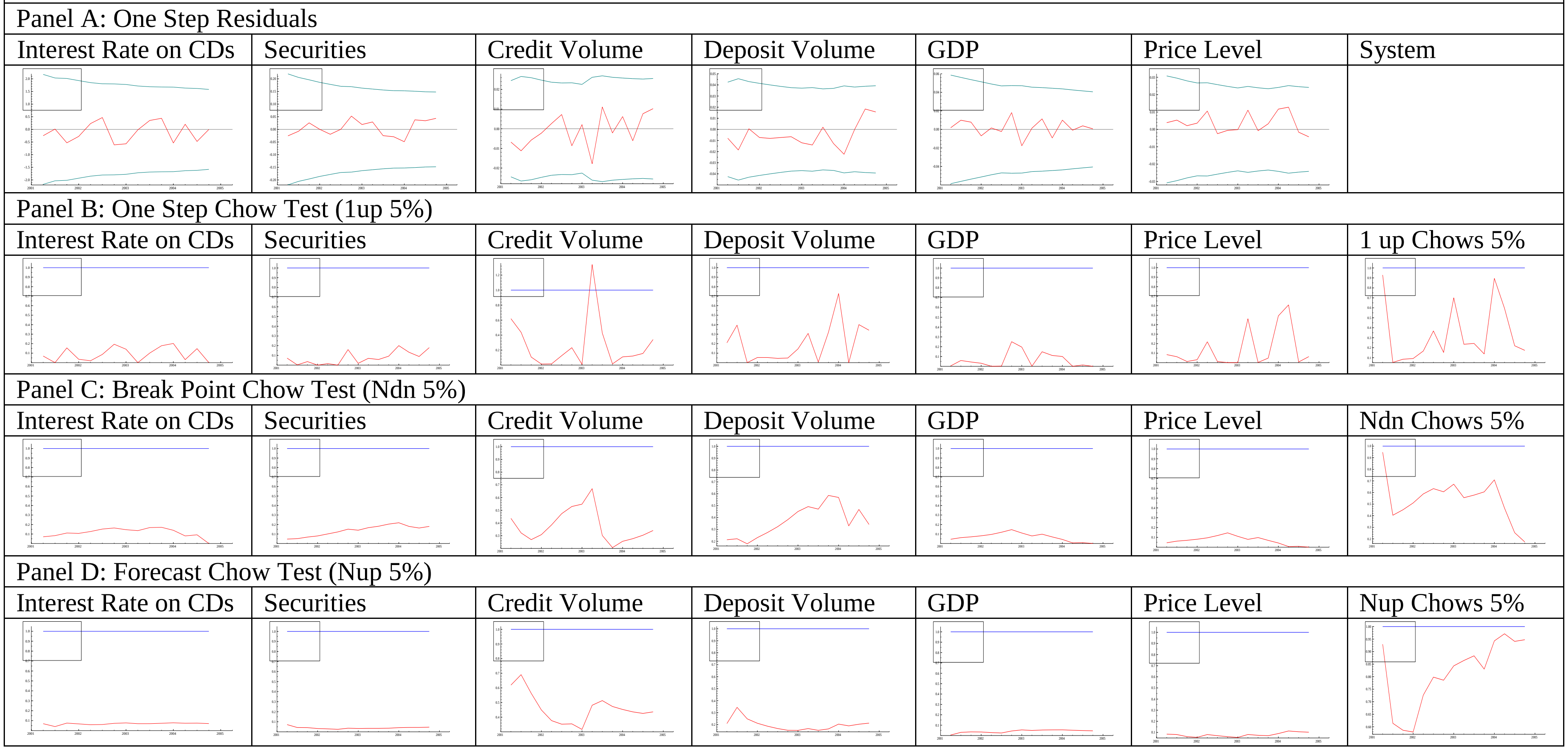


Figure 4.10 : Recursive Analysis for the VAR system of (CDI, RGS, RCR, RDEP, Y, P)
First Differences



On the other hand, recursive analysis gives clear support for the stability of the system at both the individual equations level and the vector level, which is not uncommon when one models a set of stationary variables. In panel A of Figure 4.10, the one-step residuals test $\pm 2\sigma$ shows that although varied considerably, residuals have remained within the confidence band of 95% over the sample period in all individual equations. As shown in panel B, the One Step Chow test shows clear evidence of stability, where all the individual equations and the vector are free of outliers at the 5% level of significance except for the equation of the change in the volume of credit, which witnessed a single outlier around the first quarter of 2003. This outlier, however, could be explained by the high level of uncertainties that engulfed the whole region during that period because of the war in Iraq. The Break Point, and Forecast Chow tests, depicted by panels C and D of Figure 4.10 clearly support the evidence of stability, where all the individual equations and the vector are free of outliers at the 5% level of significance.

Based on the Cholesky decomposition, the impulse response functions to a one standard deviation positive innovation to the change in the interest rate on the three months CDs shows that changes in this rate have no clear impact on either the variables representing the channels for monetary policy transmission or the variables representing the end targets of monetary policy actions. On the one hand, all the responses are small in magnitude, where a one standard deviation shock to the change in the interest rate explains at best only less than 2 percent of the standard deviation in the change of any other variable in the system (See Figure 4.11). On the other hand, the direction of responses to such a shock does not clearly conform to the economic theory behind monetary policy. A restrictive monetary policy, represented by a positive shock to the interest rate on the CDs is expected to encourage banks to buy more CDs and, therefore, to have a positive impact on the banks' holdings of securities. This positive impact on the banks' holdings of securities is expected to be transmitted to a negative impact on the volume of credit, the volume of deposits, and, consequently, on aggregate demand (Loungani and Rush 1995). The negative impact on aggregate demand is expected to be transmitted into a lower economic growth rate and a lower inflation rate.

Figure 4.11: Responses to Cholesky One S.D. Innovations to Change in the interest rate on 3-months CDs

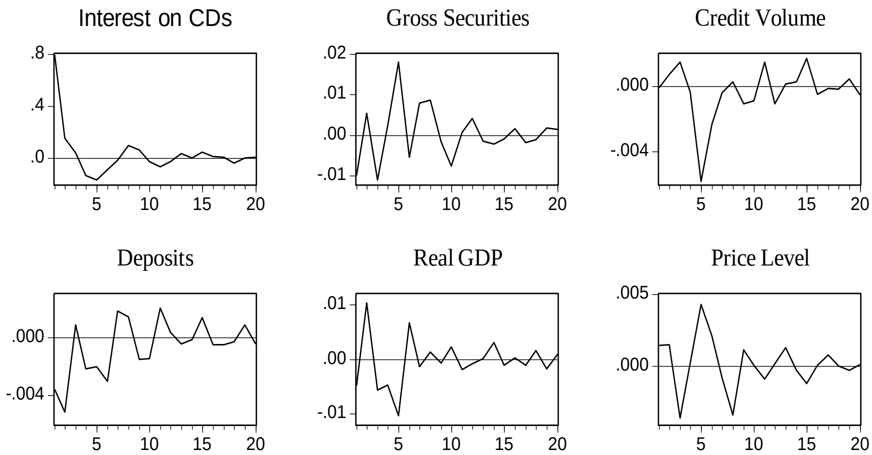


Figure 4.11 shows that the responses of the changes in deposits and real GDP, although negligible in magnitude, come in the desired direction during the first period that follows the shock to the interest rate on the CDs, while the responses of the changes in securities, credit volume and the price level are in the wrong direction. Furthermore, the path of the response functions over the successive periods that follow the time of the shock, which alternates constantly between positive and negative responses, give clear evidence that changes in the interest rate on CDs have no clear impact on any of the variables included in the system. Figure 4.12 shows that the generalized impulse responses are identical to those based on the Cholesky decomposition in terms of both the direction and magnitude.

Figure 4.12: Responses to Generalized One S.D. Innovations to Changes in the interest rate on 3-months CDs

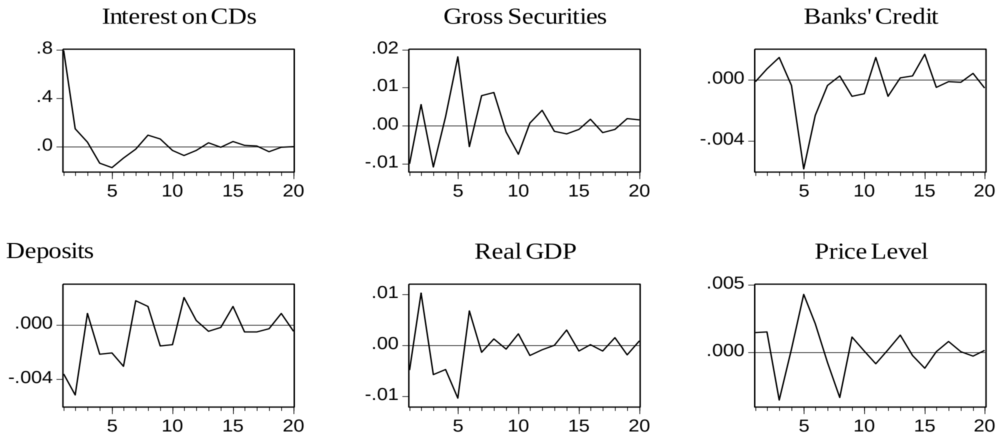
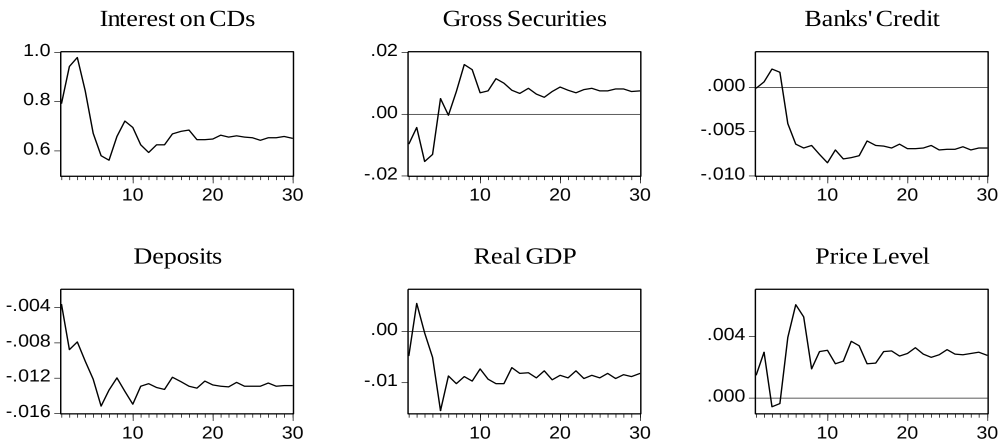


Figure 4.13 shows the accumulative responses to the one standard deviation shock to the interest rate on CDs. With the exception of the responses of changes in the price level, all the long term responses of such a shock conforms to the economic theory behind monetary policy when it comes to the direction of the change. However, the accumulated responses of all the variables in the system are considerably low in magnitude. After thirty quarters of the initial shock to the interest rate on CDs, the accumulated response of any individual variable in the system did not reach 2 percent of its variation.

Figure 4.13: Accumulated Response to Cholesky One S.D. Innovations to changes in the interest rate on CDS



The above conclusion is supported to a large extent by the analysis of variance decomposition of individual equations in the system. Table 4.5 shows the variance decomposition of the three intermediate variables (Banks' holdings of securities, Banks' Credit, and Total Deposits) which are expected to work as the vehicles in the process of transmitting the impact of monetary policy actions to the two end target variables after 50, 100, and 1000 steps. On the one hand, and for each of the three variables, the ratio of the variance that is explained by the change in the interest rate on the three months CDs was fixed regardless of the number of steps. On the other hand, the highest ratio of the variance explained by the change in the interest rate on CDs was achieved in the case of total deposits and was less than 10 percent. The steady low magnitudes of these ratios indicate that changes in the interest rate on CDs have low impact on the three variables in both the short and long-run.

Table 4.5:Variance decomposition of the banks' holdings of securities, banks' credit and total deposits
(Using the interest rate on three months CDs as policy indicator variable)

	Banks' holdings of securities			Banks' Credit			Total Deposits		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
CD rate	6.95	6.95	6.95	7.62	7.62	7.62	9.86	9.86	9.86
Securities	48.62	48.62	48.62	13.98	13.98	13.98	20.73	20.73	20.73
Banks' credit	5.37	5.37	5.37	30.05	30.07	30.07	24.71	24.73	24.73
Deposits	28.38	28.38	28.38	9.09	9.08	9.08	28.21	28.20	28.20
Real GDP	5.64	5.64	5.64	10.23	10.23	10.23	6.79	6.80	6.80
Price level	5.05	5.05	5.05	29.03	29.01	29.01	9.70	9.69	9.69
Standard Error	*0.11*	*0.11*	*0.11*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*

Table 4.6 shows the variance decomposition of the two end target variables (Real GDP and Inflation). Similar to the transmission vehicle variables, the ratio of the variance explained by the change in the interest rate on the three months CDs was fixed regardless of

the number of steps, although it was slightly higher in magnitude. The ratio of the variance of real GDP that is explained by the change in the interest rate on CDs amounted to 21 percent, while that of the variance of inflation amounted to just above 16 percent. This supports the conclusion that changes in the interest rate on CDs have low impact on the end targets of monetary policy.

Table 4.6: Variance decomposition of the real GDP and the price level
(Using the interest rate on three months CDs as policy indicator variable)

	Real GDP			Price level		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
CD rate	21.04	21.00	21.00	16.18	16.18	16.18
Securities	7.86	7.87	7.87	16.72	16.72	16.72
Banks' credit	22.19	22.31	22.32	21.90	21.90	21.90
Deposits	10.54	10.50	10.50	14.89	14.89	14.89
Real GDP	31.41	31.36	31.36	12.66	12.66	12.66
Price level	6.97	6.95	6.95	17.64	17.64	17.64
Standard Error	*0.04*	*0.04*	*0.04*	*0.02*	*0.02*	*0.02*

4.4.4.1.2 Changes in the discount rate as the policy indicator variable

Replacing the interest rate on the three months CDs with the discount rate (i) as the policy indicator variable and using the variables in the first difference, a standard VAR system of six endogenous variables (di, drgs, drcr, drdep, dy, and dp) and one exogenous variable (dne) was examined with lag settings from 1 lag up to 4 lags. With none of the roots of the companion matrix lying outside the unit circle, all the standard VAR systems with lag length settings 1 up to 4 lags proved to be mathematically stable, which suggests that it is safe to proceed in the VAR analysis (See Hamilton 1994).

The same procedure was followed to choose the best lag length. As shown in Table 4.7, two information criteria statistics; namely the Akaike Information Criterion and Schwarz Information Criterion reveal that the best lag length was found to be two lags, while the Hannan-Quinn information criteria indicated that the best lag length is one lag and the Final Prediction Error criterion indicated the best lag length to be four lags.

Table 4.7: Information criteria for the lag order selection for the VAR system of the first differences of (I, RGS, RCR, RDEP, Y, P/DNE)

Number of lags	AIC	SIC	H-QIC	FPE criterion
1	-34.1750	-33.1000	-33.7383*	1.49e-015
2	-34.2032*	-32.3220*	-33.4389	1.82e-015
3	-34.1262	-31.4388	-33.0344	8.05e-015
4	-34.0065	-30.5129	-32.5871	-1.42e-015*

*: Indicates the best lag selected according to each criterion.

When other diagnostic tests were implemented at different lag lengths[1], the test results for one lag, as indicated by H-QIC, revealed that the vector equation did not pass any of diagnostic tests statistics and the null hypothesis of normal distribution is rejected at the 1% level of significance in the case of all individual equations. The null hypothesis of no autocorrelation, however, is rejected at the 1% level of significance only in the individual equation representing the first difference of domestic credit. The null hypotheses of no autoregressive conditional heteroscedasticity is rejected at the 5% level of significance in the individual equation for banks' holdings of securities and at the 1% level of significance in the equation for total deposits, while the null of no heteroscedasticity is rejected at the 1% level in the equation for total deposits.

When the lag length was set at two lags, as indicated by the AIC and SIC criteria, all individual equations and the vector equation easily passed the null hypotheses of no autocorrelation. In contrast, the null hypothesis of normal distribution is rejected at the 1% level of significance for all the individual equations and the vector equation. The null hypothesis of no autoregressive conditional heteroscedasticity, was rejected at the 1% level of significance in the individual equation for total deposits and the vector equation, while that of no heteroscedasticity was only rejected at the 5% level of significance in the equation for GDP.

[1] A summary of these diagnostic tests is available from the author on request.

Setting the lag length at 4 lags, as indicated by the FPE criterion, the null hypothesis of no autocorrelation could not be rejected at either the 5% or the 1% level of significance in any of the individual equations or the vector equation. While the null hypothesis of normal distribution, however, was rejected at the 1% level of significance for all individual equations and the vector equation, the null hypotheses of no autoregressive conditional heteroscedasticity and no heteroscedasticity were only rejected in the equation of total deposits. Therefore, the lag length is set at 4 lags, which has the least problematic statistical properties and conforms to the selection by the FPE criterion.

Graphic analysis reveals that all individual equations in the system lack the goodness of fit. Panels A and B of Figure 4.14 show quite significant discrepancies and the absence of any plausible relationship between the actual and fitted values. Panel D of this figure shows the existence of several outliers among the scaled residuals. Similar to the statistical diagnostic tests, panel C of Figure 4.14 shows clearly that the residuals are lacking the normal distribution by having a clear kurtosis for all individual equations.

Furthermore, several signs of instability are detected through recursive analysis. As shown in the last column of Figure 4.15, the vector failed to pass any of the One-step Chow test, the Break Point Chow test, and the Forecast Chow test. At the individual equations level, the one-step residuals test $\pm 2\sigma$(panel A of Figure 4.15), shows that residuals of the change in discount rate equation has went beyond the confidence band of 95% several times. Depicted by panel B, the One Step Chow test shows clear evidence of instability in the equations representing the changes in discount rate, deposit volume, GDP, and price level. Several outliers at the 5% level of significance existed in these four equations. The Break Point, and Forecast Chow tests, depicted by panels C and D of Figure 4.15 clearly support the evidence of instability in the case of the discount rate and the deposit volume equations.

Figure 4.14 : Graphic Analysis for the VAR system of (I, RGS, RCR, RDEP, Y, P)
First Differences

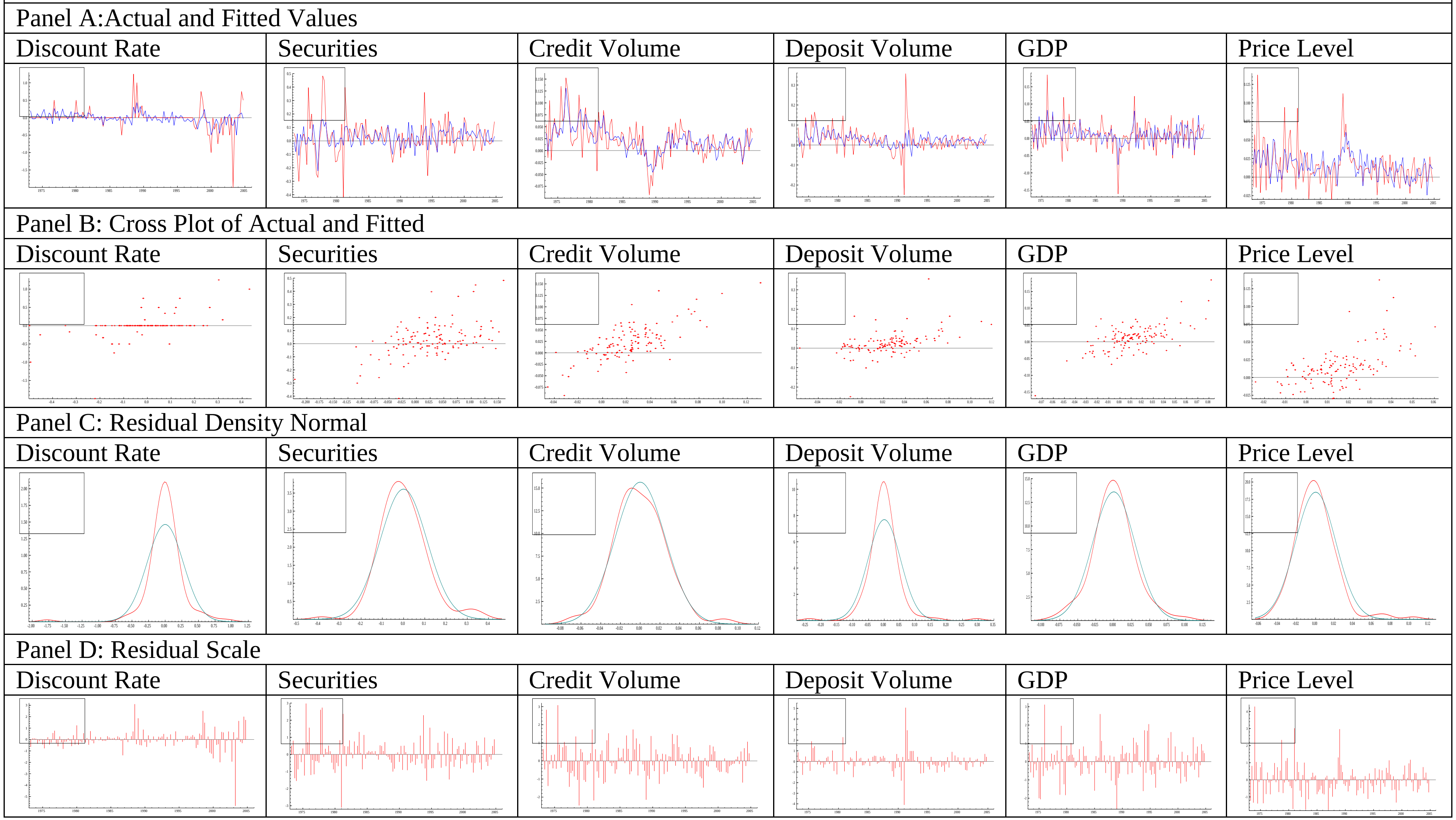
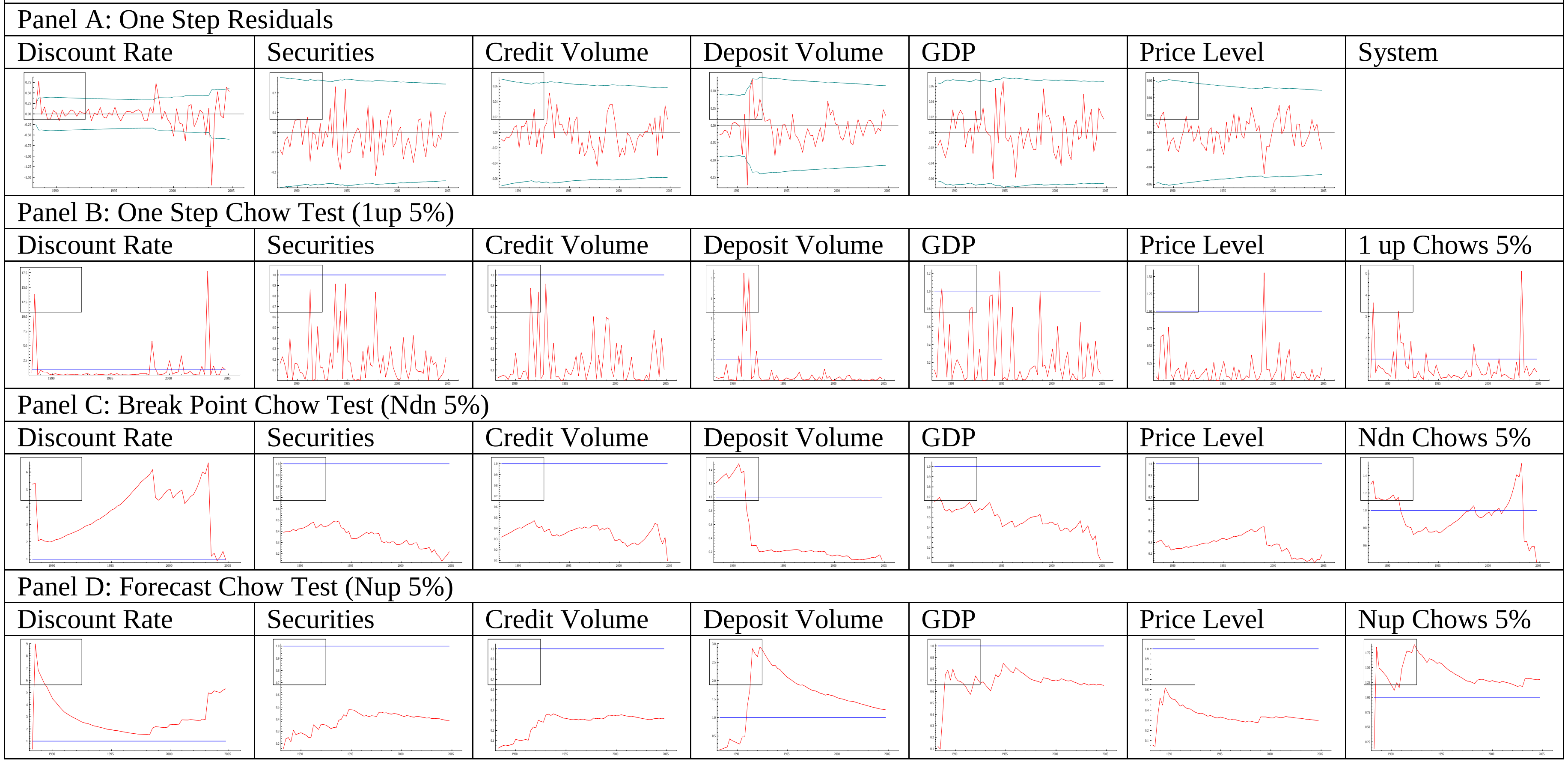
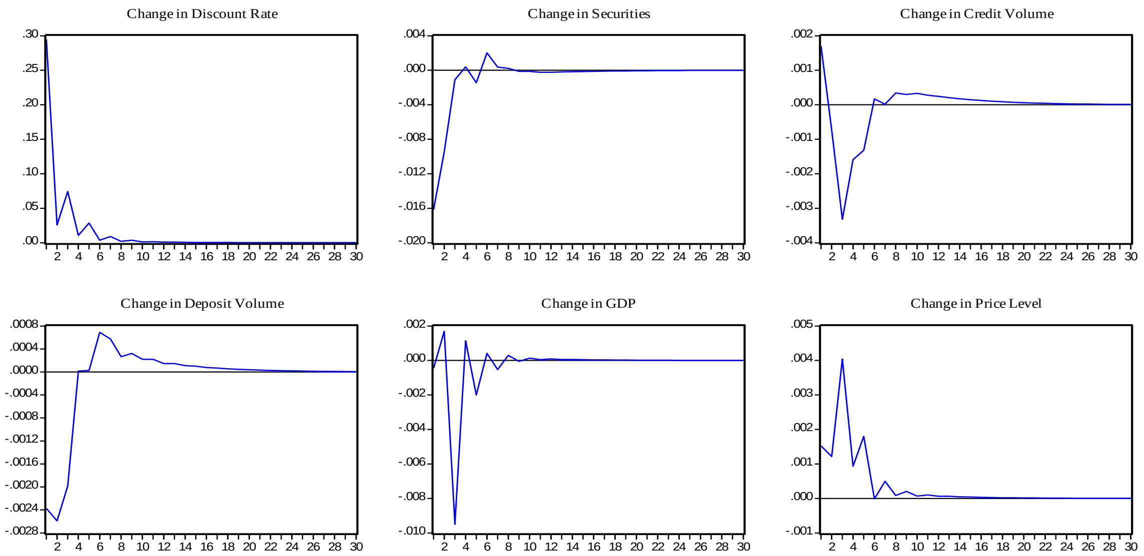


Figure 4.15 : Recursive Analysis for the VAR system of (I, RGS, RCR, RDEP, Y, P)
First Differences



Based on the Cholesky decomposition, the impulse response functions to a one standard deviation positive innovation to the change in the discount rate reveal that changes in the discount rate have very little impact on either the variables representing the channels for monetary policy transmission or the variables representing the end targets of monetary policy actions. On the one hand, all the responses are small in magnitude, where a one standard deviation shock to the change in the discount rate explains at best only less than 2 percent of the standard deviation in the change of any other variable in the system (See Figure 4.16).

Figure 4.16: Responses to Cholesky One S.D. Innovation to Change in The Discount Rate



On the other hand, the direction of responses to such a shock does not clearly conform to the economic theory behind monetary policy. A restrictive monetary policy, represented by a positive shock to the discount rate is expected to have a positive impact on the change in banks' holdings of securities and a negative one on the changes in credit volume, deposit volume, GDP, and price levels (Loungani and Rush 1995). Figure 4.16, however, shows that responses of banks' holdings of these securities and the price level are on the wrong side, while the response of GDP is changing alternatively between positive and negative responses. Although the responses of changes in credit and deposit volumes have the right directions at the beginning, they quickly move to the wrong side just after five periods from the time of the shock. This gives clear evidence that changes in the discount rate have no clear impact on any of the variables included in the system. Figure 4.17 shows that the generalized impulse responses are identical to those based on the Cholesky decomposition in terms of both the direction and magnitude.

Figure 4.17: Responses to Generalized One S.D. Innovation to Change in the Discount Rate

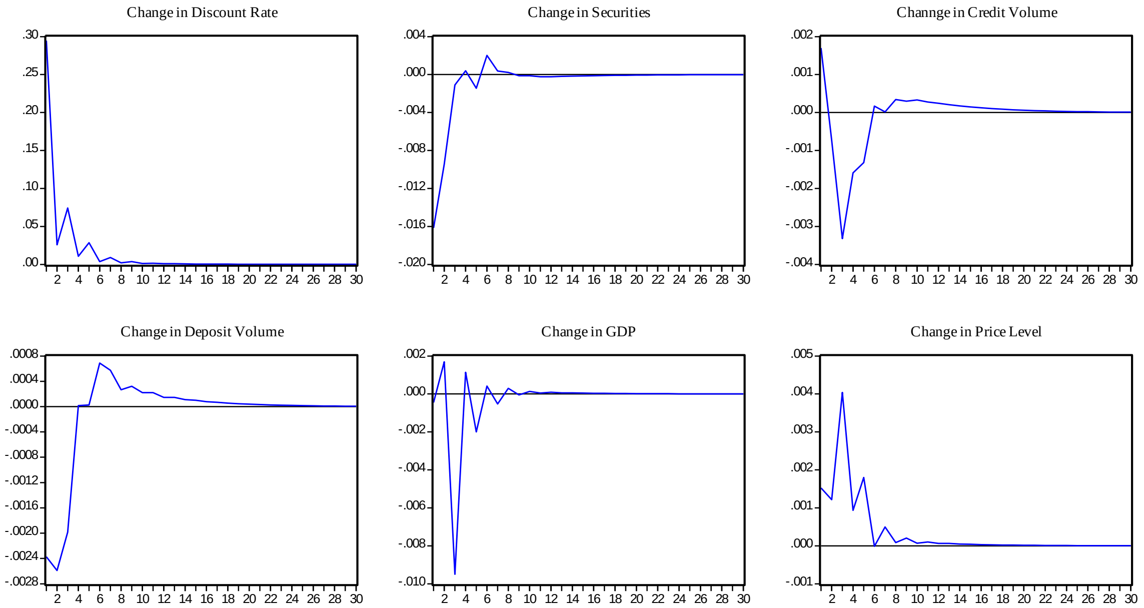
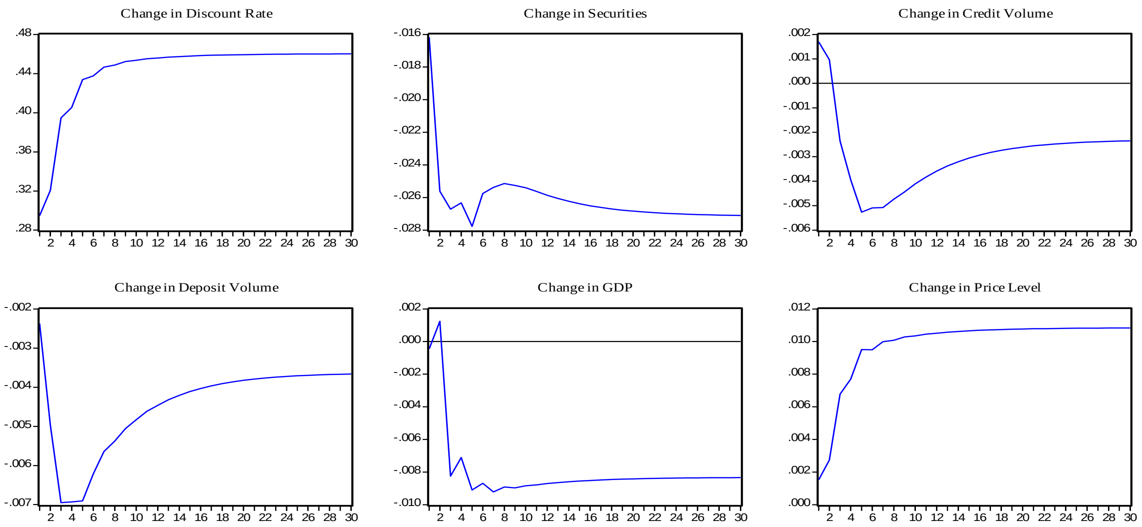


Figure 4.18 shows the accumulative responses to the one standard deviation shock to the change in the discount rate. The accumulative responses support the above conclusion that changes in the discount rate have little impact on all other variables in the system. On the one hand, the accumulative responses of changes in banks’ holdings of securities and in changes in the price level do not conform to the theory behind monetary policy. On the other hand, and regardless of the direction of the responses, all the long term responses of such a shock are considerably low in magnitude and peak after a relatively short period (5 to 7 quarters after the time of the shock). The long term impact of a shock to the change in the discount rate on any of any individual variable in the system does not reach 3 percent of its variation.

Figure 4.18: Accumulated Responses to Cholesky One S.D. Innovation to Change in the Discount Rate



The above conclusion is supported to a large extent by the analysis of variance decomposition for individual equations in the system. Table 4.8 shows the variance decomposition of the first differences of the three intermediate variables (Banks' holdings of securities, Banks' Credit, and Total Deposits) which are expected to work as the vehicles in the process of transmitting the impact of monetary policy actions to the two end target variables after 50, 100, and 1000 steps.

Table 4.8:Variance decomposition of the first difference of the banks' holdings of securities, banks' credit and total deposits
(Using the first difference of discount rate as policy indicator variable)

	Banks' holdings of securities			Banks' Credit			Total Deposits		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
Discount rate	2.01	2.01	2.01	1.31	1.31	1.31	0.47	0.47	0.47
Securities	88.98	88.98	88.98	12.24	12.24	12.24	8.96	8.96	8.96
Banks' credit	4.88	4.88	4.88	55.17	55.17	55.17	14.05	14.05	14.05
Deposits	0.89	0.89	0.89	5.54	5.54	5.54	67.35	67.35	67.35
Real GDP	1.92	1.92	1.92	2.97	2.97	2.97	0.83	0.83	0.83
Price level	1.32	1.32	1.32	22.77	22.77	22.77	8.34	8.34	8.34
Standard Error	0.13	0.13	0.13	0.04	0.04	0.04	0.06	0.06	0.06

On the one hand, and for each of the three variables, the ratio of the variance that is explained by the innovation to the change in the discount rate is fixed regardless of the number of steps. On the other hand, the ratio of the variance explained by innovation to the change in the discount rate was extremely low in magnitude. The highest ratio is achieved in the case of banks' holdings of securities and does not exceed 2 percent. The low and steady magnitudes of these ratios indicate that changes in the discount rate have low impact on the three variables in both the short and long-run.

Table 4.9 shows the variance decomposition of the first differences of the two end target variables (Real GDP and Inflation). Similar to the transmission vehicle variables, the ratio of the variance explained by the change in the discount rate was fixed regardless of the number of steps, although it was slightly higher in magnitude. The ratio of the variance of the first difference of real GDP that is explained by the innovation to the change in the discount rate amounted to just above 6 percent, and that of the variance of the first difference of inflation amounted to just above 3 percent. This supports the conclusion that changes in the first difference of the discount rate have low impact on the end targets of monetary policy.

Table 4.9: Variance decomposition of first differences of real GDP and the price level
(Using first difference of the discount rate as policy indicator variable)

	Real GDP			Price level		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
Discount rate	6.24	6.24	6.24	3.33	3.33	3.33
Securities	2.27	2.27	2.27	15.07	15.07	15.07
Banks' credit	10.86	10.86	10.86	32.69	32.69	32.69
Deposits	6.40	6.40	6.40	1.57	1.57	1.57
Real GDP	70.51	70.51	70.51	10.76	10.76	10.76
Price level	3.72	3.72	3.72	36.58	36.58	36.58
Standard Error	0.04	0.04	0.04	0.03	0.03	0.03

4.4.4.1.3 Changes in excess reserves as the policy indicator variable

Replacing the discount rate with the proxy for excess reserves as the policy indicator variable and using the variables in the first difference, a standard VAR system of six endogenous variables (dr, drgs, drcr, drdep, dy, and dp) and one exogenous variable (dne) was examined with lag settings from 1 lag up to 5 lags. All the tested VAR systems with lag length settings 1 up to 4 lags proved to be mathematically stable, which suggests that it is safe to proceed in the VAR analysis. Table 4.10 shows the four information criteria statistics for the lag order selection. The best lag length is found to be 1 lag according to SIC and H-QIC, 2 lags according to AIC, and 4 lags according to FPE Criterion.

Table 4.10: Information criteria for the lag order selection for the VAR system of the first differences of (R, RGS, RCR, RDEP, Y, P/DNE)

Number of lags	AIC	SIC	H-QIC	FPE criterion
1	-35.990	-34.937*	-35.562*	2.42e-016
2	-36.100*	-34.256	-35.351	2.66e-016
3	-36.097	-33.463	-35.027	7.69e-016
4	-36.015	-32.591	-34.624	-2.42e-016*
5	-35.795	-31.5604	-34.0747	-7.70e-017

*: Indicates the best lag selected according to each criterion.

When other diagnostic tests were implemented at the lag lengths[1] chosen by different information criteria , the test results for one lag, as indicated by SIC and H-QIC, revealed that the vector failed to pass any diagnostic test. At the individual equations level, the null hypothesis of no autocorrelation is rejected either at the 1% or the 5% level of significance for the individual equations of credit volume and deposit volume, the null hypothesis of normal distribution is rejected at the 1% level of significance in all individual equations except that of credit volume, the null hypotheses of no autoregressive conditional heteroscedasticity is rejected at the 5% level of significance in the individual equation for banks' holdings of securities and at the 1% level of significance in the equation for total deposits, and the null hypothesis of no heteroscedasticity is rejected at the 1% level in the equation for total deposits and at the 5% level of significance in the equation of GDP.

[1] A summary of these diagnostic tests is available from the author on request.

When the lag length was set at two lags, as indicated by the AIC, all individual equations and the vector equation easily passed the null hypothesis of no autocorrelation. The null hypothesis of normal distribution, however, is rejected at the 1% level of significance in four individual equations (equations for banks' holdings of securities, deposits, GDP, and price level) and in the vector equation. The null hypotheses of no autoregressive conditional heteroscedasticity and no heteroscedasticity were rejected at the 1% level of significance in the individual equation for total deposits and the vector equation.

When the lag length is set at 4 lags, as indicated by the FPE criterion, the test results reveal that this lag length is the least problematic. At the vector level, the null hypotheses of no autocorrelation and no heteroscedasticity could not be rejected at either the 5% or the 1% level of significance, while that of normal distribution is rejected at the 1% level of significance. At the individual equations level, the null hypothesis of no autocorrelation could not be rejected in any individual equation. The null hypothesis of normal distribution is rejected at the 1% level of significance in the same four individual equations mentioned in the case of 2 lags. The null hypothesis of no autoregressive conditional heteroscedasticity is rejected at the 5% level of significance in the equation for banks' holdings of securities and at the 1% level of significance in the equation for total deposits, while the null hypothesis of no heteroscedasticity is rejected only in the equation of total deposits. Therefore, the lag length is set at 4 lags, which has the least problematic statistical properties and conforms to the selection by the FPE criterion.

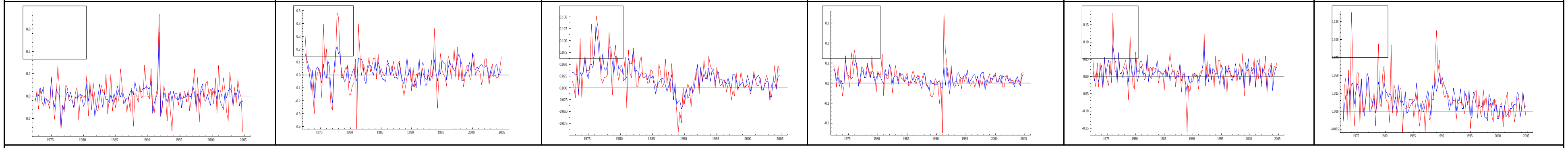
Graphic analysis shows that the system involving the change in excess reserves as the policy indicator variable dose not perform well enough and its results are almost identical to those of the system involving the change in the discount rate. With a clear quite high discrepancies, the actual and fitted values, the cross plot of actual and fitted values, and the scaled residuals (panels A, B, and D of Figure 4.19), graphic analysis reveal that all individual equations lack the goodness of fit. Similarly, panel C of Figure 4.19 shows that the residuals of all individual equations are lacking the normal distribution; mainly due to having a clear kurtosis.

Recursive analysis, though slightly better than the case of the change in discount rate, reveals several symptoms of instability of the system at both the individual equations level and the vector level. At the vector level, the last column of Figure 4.20 shows the test results of the One-step Chow test and the Forecast Chow test reveal that the vector lacks stability. At the individual equations level, panel A of Figure 4.20, which reflect the results of the one-step residuals test $\pm 2\sigma$, shows that residuals of the change in excess reserves equation has went beyond the confidence band of 95% twice and was on the boundaries for a couple of times during the sample period. As shown in panel B, the One Step Chow test shows clear evidence of instability in the equations representing the changes in excess reserves, banks' holdings of securities, deposit volume, and GDP, where several outliers at the 5% level of significance existed in these four equations. The Break Point Chow test depicted by panel C of Figure 4.20 shows that the equation representing the change in excess reserves lacks stability, while the Forecast Chow test depicted by panel D shows evidence of instability in the case of the deposit volume equation.

Figure 4.19 : Graphic Analysis for the VAR system of (R, RGS, RCR, RDEP, Y, and P)
(First Differences)

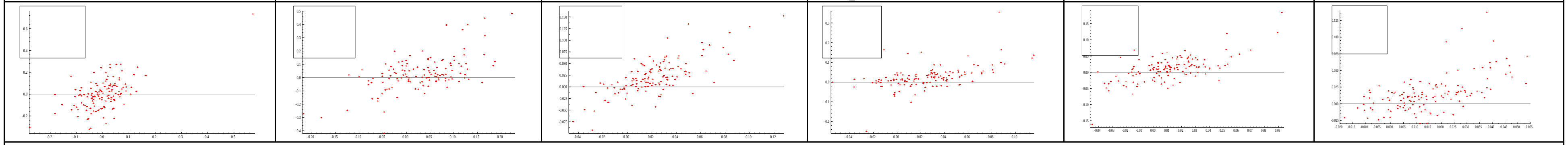
Panel A: Actual and Fitted Values

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level



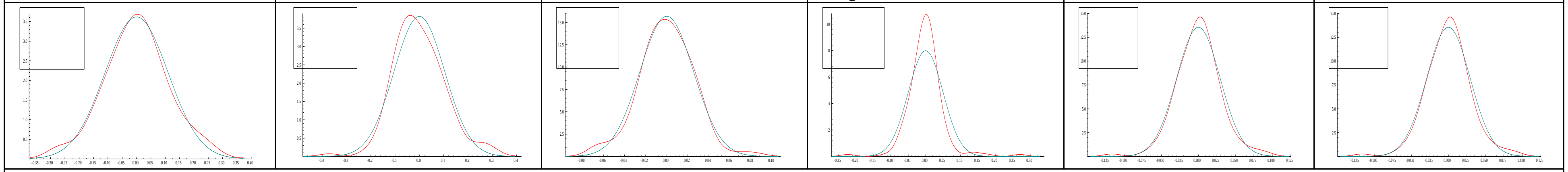
Panel B: Cross Plot of Actual and Fitted

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level



Panel C: Residual Density Normal

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level



Panel D: Residual Scale

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level

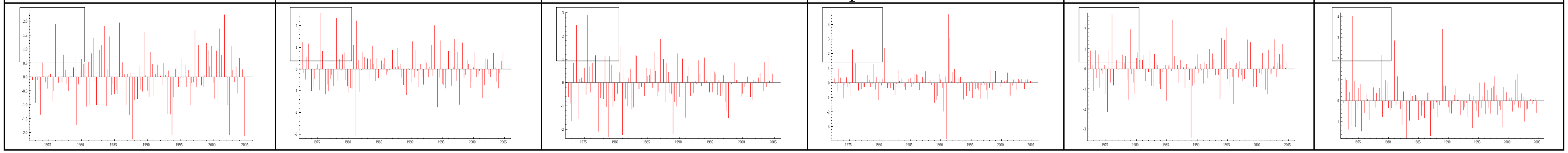
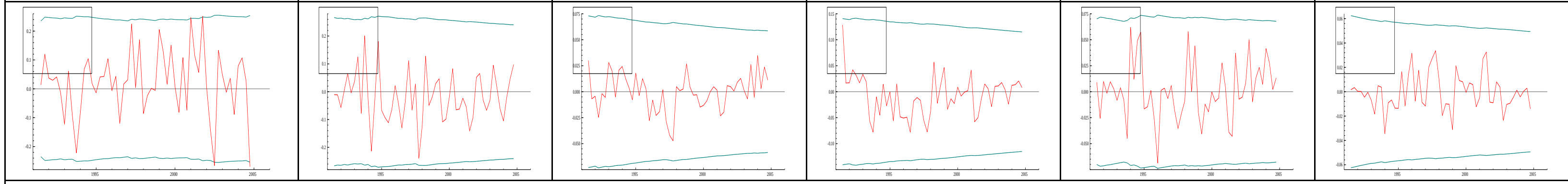


Figure 4.20 : Recursive Analysis for the VAR system of (R, RGS, RCR, RDEP, Y, P)
(First Differences)

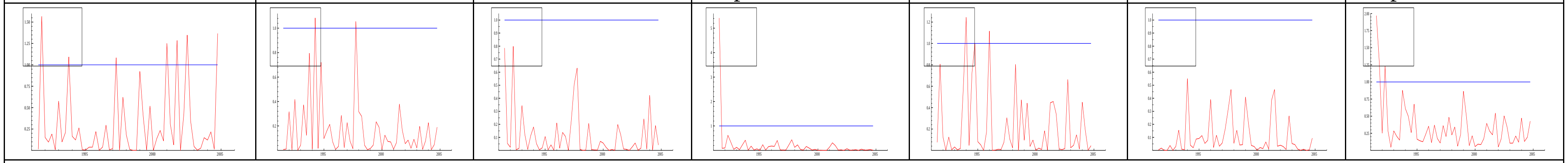
Panel A: One Step Residuals

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level	System



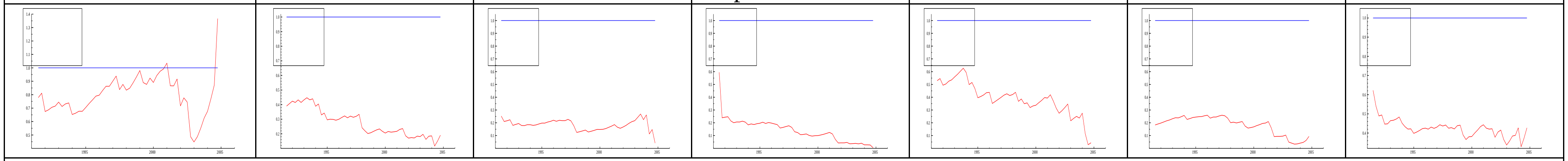
Panel B: One Step Chow Test (1up 5%)

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level	1 up Chows 5%



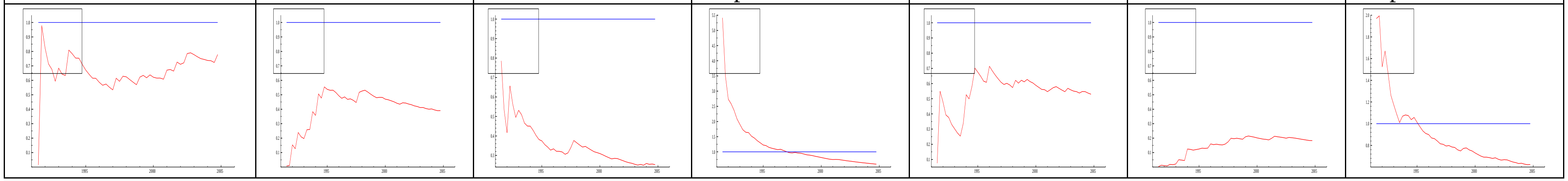
Panel C: Break Point Chow Test (Ndn 5%)

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level	Ndn Chows 5%



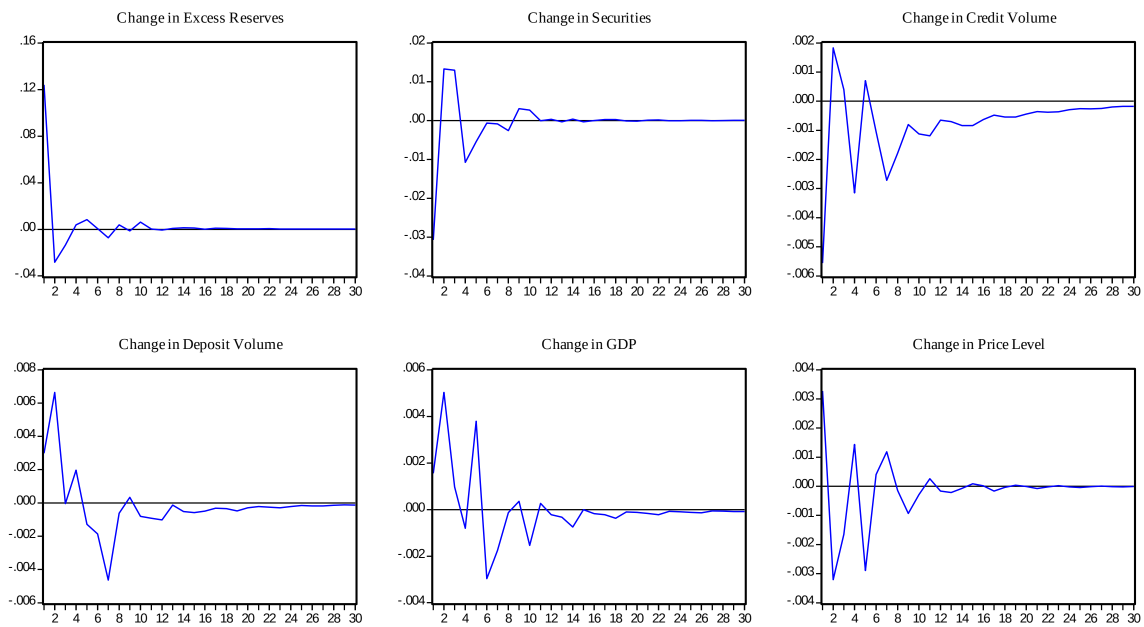
Panel D: Forecast Chow Test (Nup 5%)

Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level	Nup Chows 5%



Based on the Cholesky decomposition, and similar to changes in the discount rate, the impulse response functions to a one standard deviation positive innovation to the change in excess reserves reveal that changes in excess reserves have also very little impact on either the variables representing the channels for monetary policy transmission or the variables representing the end targets of monetary policy actions. All the responses are small in magnitude and vanish in a relatively short time after the time of the shock. A one standard deviation shock to the change in excess reserves explains at best only less than 3 percent of the standard deviation of the change in banks' holdings of securities and less than 0.6 percent of the change in any other variable in the system (See Figure 4.21).

Figure 4.21: Response to Cholesky One S.D. Innovation to change in Excess Reserves



The direction of responses to such a shock, however, does not clearly conform to the economic theory behind monetary policy. While the prompt responses conform to such a theory, the consecutive responses that follow do not give any clear evidence on this conformity. A positive shock to the change in excess reserves by Cholesky one S.D. innovations leads promptly to a decline in the banks' holdings of securities and the volume of banks' credit, and to a slight increase in the volume of deposits, real GDP, and the price level. These responses indicate that the monetary channel precedes the lending channel when it comes to transmitting the monetary policy actions onto the economy. Although small in magnitude, the prompt negative response of the volume of credit reflects the fact that banks need some time to adapt their strategies regarding the management of their liquidity and lending.

Starting the second quarter, the chain of consecutive effects does not provide conclusive evidence regarding conformity to the economic theory behind monetary policy. All the responses fluctuate alternatively between negative and positive except for the response of the change in deposit volume, which declines sharply during the second quarter and moves to the negative side from the fifth quarter. More interestingly, the response of the change in excess reserves it self changes from positive to negative during the second quarter, and follows the same pattern of all the other responses by fluctuating alternatively between positive and negative magnitudes. Although the response of banks' holdings of securities could be, in theory, either way depending on the market conditions and on banks attitude regarding their portfolio management (See Campbell 1978), the alternating fluctuation in the direction of responses gives evidence on the absence of a significant impact from the change in excess reserves onto the other variables in the system, especially in the long run.

This result dose not conform to theory, which indicate that an expansionary monetary policy, depicted by a positive shock to excess reserves, is expected to have a positive impact on the credit volume, the deposit volume, and income (See Brunner and Meltzer 1988). It also does not conform to the findings of Loungani and Rush (1995) who found that changes in the reserve requirement ratios have a significant impact on real activity. Figure 4.22 shows that the generalized impulse responses are identical to those based on the Cholesky decomposition in terms of both the direction and magnitude. This supports either that our assumption regarding the ordering of the variables in the system is right or that our conclusion of the low impact of changes in the excess reserves on the rest of the variables is valid.

Figure 4.22: Response to Generalized One S.D. Innovation to change in Excess Reserves

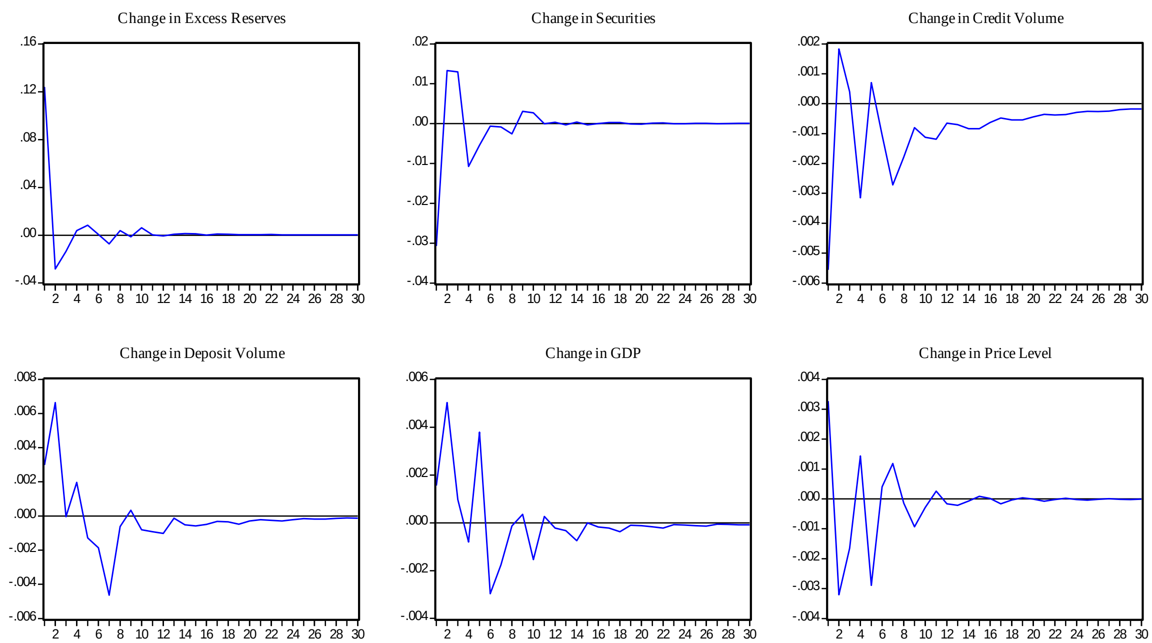
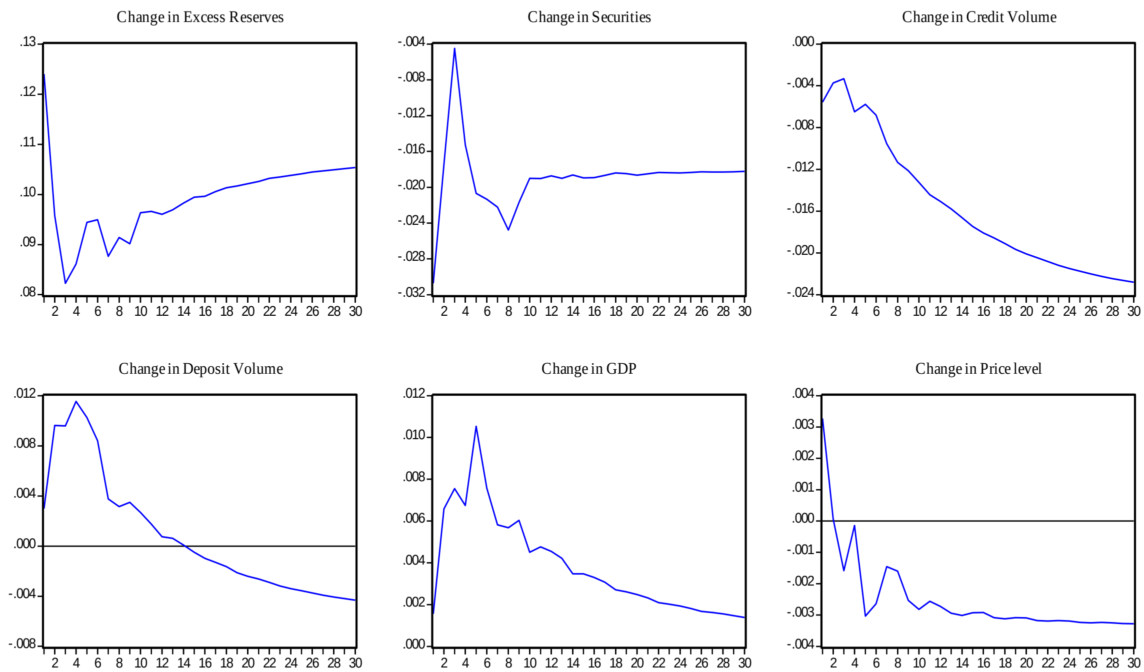


Figure 4.23 shows the accumulative responses to the one standard deviation shock to the change in excess reserves. The accumulative responses support the above conclusion that changes in excess reserves have little impact on all other variables in the system. On the one hand, the direction of the accumulative responses of changes in credit volume and the price level do not conform to the theory behind monetary policy. On the other hand, and regardless of the direction of the responses, all the long term responses of such a shock are considerably low in magnitude.

The long term impact of a shock to the change in excess reserves on any individual variable in the system does not reach 3 percent of its variation.

Figure 4.23: Accumulated Response to Cholesky One S.D. Innovation to change in Excess Reserves



This conclusion is supported, to a large extent, by the analysis of variance decomposition for individual equations in the system. Table 4.11 shows the variance decomposition of the first differences of the three intermediate variables (Banks' holdings of securities, Banks' Credit, and Total Deposits) which are expected to work as the vehicles in the process of transmitting the impact of monetary policy actions to the two end target variables after 50, 100, and 1000 steps. On the one hand, and for each of the three variables, the ratio of the variance that is explained by the innovation to the change in excess reserves is fixed regardless of the number of steps. On the other hand, the ratio of the variance explained by innovation to the change in excess reserves was extremely low in magnitude. The highest ratio is achieved in the case of banks' holdings of securities and was less than 8 percent. The low and steady magnitudes of these ratios indicate that changes in excess reserves have low impact on the three variables in both the short and long-run.

Table 4.11:Variance decomposition of the first difference of the banks' holdings of securities, banks' credit and total deposits
(Using the first difference of excess reserves as policy indicator variable)

	Banks' holdings of securities			Banks' Credit			Total Deposits		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
Excess reserves	7.32	7.32	7.32	3.82	3.82	3.82	2.09	2.09	2.09
Securities	74.38	74.38	74.38	12.00	12.00	12.00	9.42	9.42	9.42
Banks' credit	9.43	9.43	9.43	51.86	51.86	51.86	17.93	17.93	17.93
Deposits	3.28	3.28	3.28	2.93	2.93	2.93	62.31	62.31	62.31
Real GDP	2.13	2.13	2.13	1.44	1.44	1.44	1.21	1.21	1.21
Price level	3.45	3.45	3.45	27.95	27.96	27.96	7.04	7.04	7.04
Standard Error	0.14	0.14	0.14	0.04	0.04	0.04	0.07	0.07	0.07

Table 4.12 shows the variance decomposition of the first differences of the two end target variables (Real GDP and Inflation). Similar to the transmission vehicle variables, the ratio of the variance explained by the change in excess reserves was fixed and low in magnitude regardless of the number of steps. The ratio of the variance of the first difference of real GDP that is explained by the innovation to the change in excess reserves amounted to just above 3 percent, and that of the variance of the first difference of inflation amounted to about 4.5 percent. This supports the conclusion that changes in the first difference of excess reserves have low impact on the end targets of monetary policy.

Table 4.12: Variance decomposition of first differences of real GDP and the price level (Using first difference of excess reserves as policy indicator variable)						
	Real GDP			Price level		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
Excess reserves	3.35	3.35	3.35	4.50	4.50	4.50
Securities	7.09	7.09	7.09	14.06	14.06	14.06
Banks' credit	16.19	16.19	16.19	35.66	35.66	35.66
Deposits	6.28	6.28	6.28	2.41	2.41	2.41
Real GDP	58.66	58.66	58.66	9.82	9.82	9.82
Price level	8.42	8.42	8.42	33.55	33.55	33.55
Standard Error	0.04	0.04	0.04	0.03	0.03	0.03

4.4.4.2 Results of VAR analysis using the variables in levels

4.4.4.2.1 Interest rate on the three months CDs as the policy indicator variable

Using the interest rate on the three months CDs as the policy indicator variable (cdi), a standard VAR system of six endogenous variables (cdi, rgs, rcr, rdep, y, and p) and one exogenous variable (dne) was examined starting with five lags. With some roots of the companion matrix lying outside the unit circle, all the standard VAR systems with lag length settings 1 up to 5 lags proved to be mathematically unstable[1]. This suggests that any further analysis in this case would be inappropriate because the mathematical stability is not guaranteed (See Hamilton 1994). The reason for this instability could be attributed to the relatively short period given the large number of variables included in the system, which leaves only a few degrees of freedom. Besides, this relatively short period had witnessed several regional political shocks which had direct impact on the Jordanian economy and could have contributed to the instability of the system. On the one hand, the CBJ faced during this period two episodes of a

[1] The roots of the companion matrix for all the lag length settings are available from the author on request.

wide scale currency substitution generated from the fear of devaluation[1], which forced the CBJ to raise the interest rates sharply just to defend the exchange rate of the Dinar (CBJ 1995 and 1998). On the other hand the two wars on Iraq (early 1990s and in 2003) resulted in a wide scale immigration of people into Jordan (repatriates in the former and refugees in the latter). These two waves of immigration resulted a huge shift in the aggregate demand and were accompanied with a large capital inflows

4.4.4.2.2 The discount rate as the policy indicator variable

Replacing the interest rate on the three months CDs with the discount rate (I) as policy instrument variable, the lag length in the VAR system was set at eight lags as a starting point. The choice of eight lags is an arbitrary one based on the assumption that a period of two years is long enough to capture the impact of intra shocks between the variables in the system following the initial shock to the policy variable. The general to specific approach was followed by checking the system for different diagnostic tests at different lag lengths before dropping the longest lag at a time. The test results show that the system is mathematically unstable if the lag length was set at one lag or at all the lags six up to eight, while it is mathematically stable for two up to five lags[2].

Utilizing the lag selection test incorporated in the Givewin2 software, Table 4.13 shows the four information criteria statistics for the VAR system with two up to five lags. According to three information criteria; namely the Akaike Information Criterion, Schwarz Information Criterion, and Hannan-Quinn information criteria, the best lag length was found to be two lags, while it was found to be four lags according to the Final Prediction Error criterion.

[1] See footnote 1 on page 2 of chapter three.
[2] The roots of the companion matrix for all the lag length settings are available from the author on request.

Table 4.13: Information criteria for the lag order selection for the VAR system (I, RGS, RCR, RDEP, Y, P/DNE)

	2lags	3 lags	4 lags	5lags
Akaike information criterion	-15.6376*	-15.4348	-15.2241	-15.0674
Schwarz information criterion	-13.8121*	-12.8141	-11.8002	-10.8322
Hannan-Quinn information criterion	-14.8958*	-14.3699	-13.8329	-13.3465
Final prediction error criterion	2.02e-007	6.75e-007	-2.59e-007*	-7.74e-008

*: Indicates the best lag selected according to each criterion

When other diagnostic tests were implemented at different lag lengths, the test results did not clearly conform to the lag order selection according to the above mentioned criteria[1]. Except for the banks' credit and the real GDP, the null hypothesis of normality is rejected at either the 5% or the 1% level of significance for all lags two up to five at the individual variable level. At the vector level, the null hypothesis of normality is rejected at the 1% level of significance for all the lag length settings. If the lag length is set at two lags, as indicated by three out of four of the information criteria for the lag order selection, the test results show that the null hypothesis of no autocorrelation is rejected at the 5% level of significance for the discount rate and at the 1% level of significance for the banks' credit. The null hypothesis of no heteroscedasticity was also rejected at the 1% level of significance at the vector level as well as for real deposits and real GDP at the variable level. If the lag length is set at four lags, as indicated by the FPE criterion, the null hypotheses of no autocorrelation and no heteroscedasticity could not be rejected at both the vector level and the individual equations level. Therefore, the lag length is set at four lags, which has the least problematic statistical properties and conforms to the selection by the FPE information criteria.

Based on the graphic analysis, the VAR system performs well. The actual and fitted values and the cross plot of actual and fitted (Panels A and B of Figure 4.24) give some support

[1] A summary of these diagnostic tests is available from the author on request.

for the goodness of fit except for the discount rate equation and, to some extent, for the securities equation. However, the scaled residuals demonstrate a relatively different picture, where at least one residual outlier is noticed in each individual equation through our sample period (See panel D of Figure 4.24). Similar to the statistical diagnostic tests, panel C of Figure 4.24 shows clearly that the residuals are not normally distributed. However, the lack of normality is not expected to cause serious problems because it is caused by the presence of excess kurtosis rather than excess skewness (See Johansen and Juselius 1992).

In terms of recursive analysis, there are several signs of instability at both the vector level and the individual equations level (Figure 4.25). In panel A, the one-step residuals test $\pm 2\sigma$ shows that residuals have exceeded the confidence band of 95% for several times over the sample period in the case of the discount rate equation and the equation featuring the vector. It exceeded that band once in the cases of banks' holdings of securities, the volume of credit, the volume of deposits, and the price level, while it was so close to the edge for a couple of times in the case of real GDP.

The Chow tests, depicted by panels B, C, and D of Figure 4.25, show evidence of instability, where several outliers exist in every single individual equation and in the vector at the 5% level of significance. Nevertheless, these outliers have no specific pattern, which means that they do not occur at the same time across different individual equations but take place at different times. In other words, these outliers are associated with different emerging incidents rather than with a major structural break. This result conforms to the results of the unit root tests discussed earlier; where the time of the trend break varied from one variable to another.

Figure 4.24: Graphic Analysis for the VAR system of (I, RGS, RCR, RDEP, Y, and P)

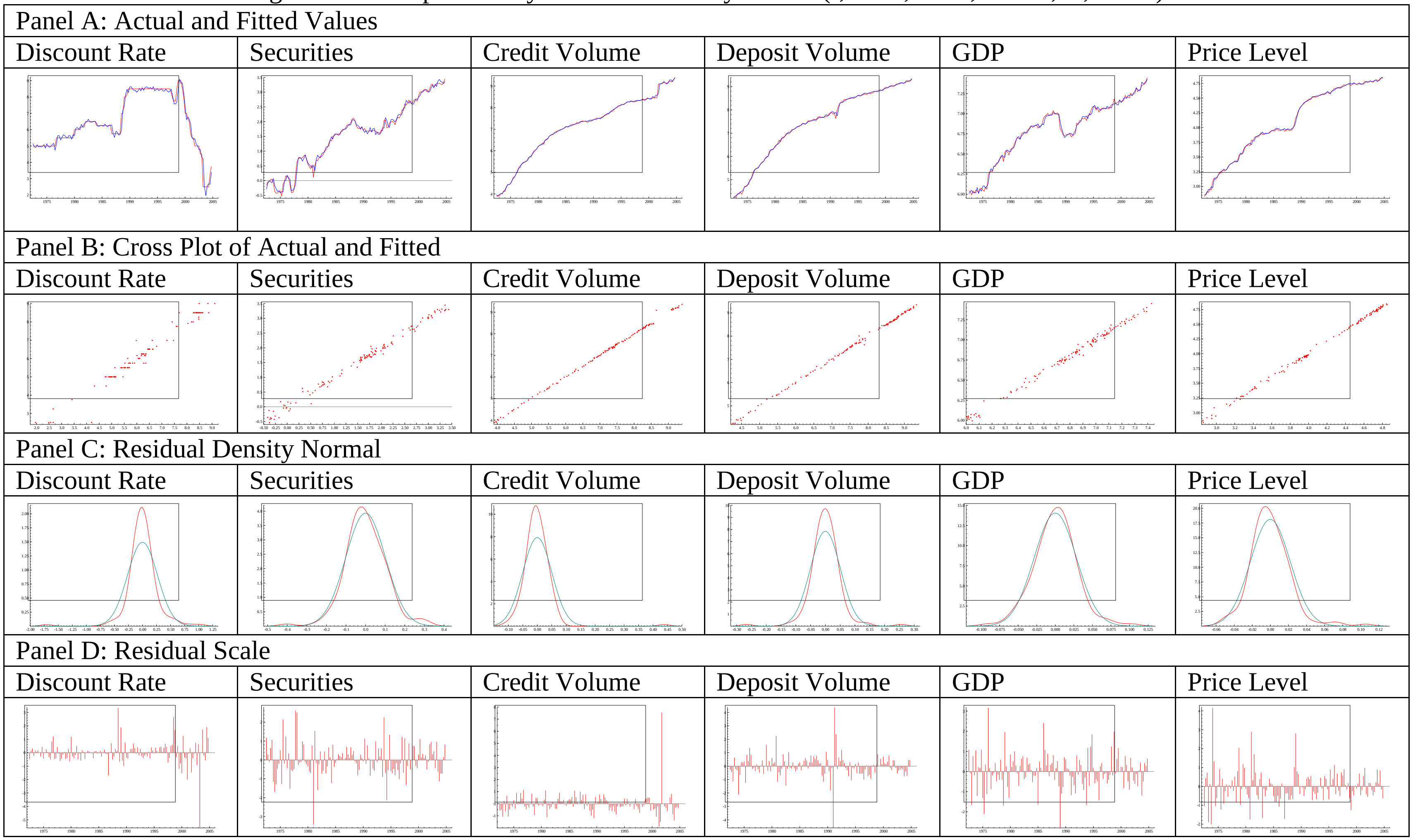
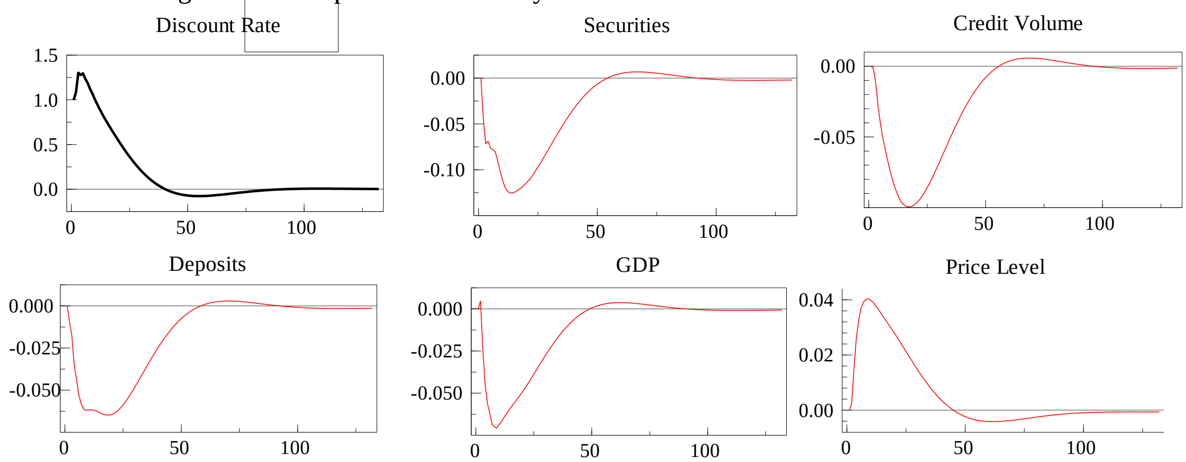


Figure 4.25: Recursive Analysis for the VAR system of (I, RGS, RCR, RDEP, Y, P)

The one-step Chow test presented in panel B of Figure 4.25 shows several outliers in the estimated parameters. In general, these outliers took the form of a one-off shock and do not indicate significant changes in the estimated parameters, except may be for the parameters of the discount rate and the volume of deposits equations. Nevertheless, the relatively large number of outliers sheds some doubt on the reliability of this system for statistical inferences. The break point Chow test presented in panel C shows a clear multiple trend-break points in the equations of the discount rate and the volume of deposits, which has been reflected on the whole vector. These trend-breaks have clearly affected the forecast ability of the system as depicted in panel D, which indicate instability of the forecasted values of the discount rate, the deposit volume, and the vector. Interestingly, the results of the break point and the forecast Chow tests at the vector level are relatively consistent with the test results pertaining to the equation of the volume of deposits, which indicates that the monetary channel is more relevant when it comes to monetary policy shocks.

Figure 4.26 shows the impulse response functions to a one standard deviation positive innovation to the discount rate based on the Cholesky decomposition. Although small in magnitude, all these responses conform to the economic theory behind monetary policy in terms of direction. A restrictive monetary policy, represented by a positive shock to the discount rate is expected to have a negative impact on the banks holdings of securities, the volume of credit, the volume of deposits, and, consequently, on aggregate demand (Loungani and Rush 1995). This negative impact on aggregate demand is expected to be transmitted into a lower economic growth rate and a lower inflation rate.

Figure 4.26: Responses to Cholesky One S.D. Innovation to the Discount Rate



The positive impact on the price level is also in line with these expectations for two reasons. First, the restrictive monetary policy is expected to have a negative impact on the inflation rate, which would be reflected in slower increases in the price level. Second, and due to the lag effect, the impact of a restrictive monetary policy on the inflation rate needs some time to materialize, which is the time needed for aggregate demand to adapt to such a policy. This lag effect is clear from the declining positive consecutive responses of the price level, especially after the fifth period that follows the time of the initial shock to the discount rate.

Regarding the responses of the final objectives of monetary policy, Figure 4.26 reveals that, both the response of real GDP and the response of the price level are in general consistent with those of total deposits and total banks' credit. However, the timing and the magnitude of these responses are clearly closer to the response of deposits rather than that of banks' credit. This, in addition to the fact that the response of deposits precedes that of banks' credit indicates that the monetary channel is more relevant than the credit channel when it comes achieving the monetary policy objectives.

Comparing the impulse response functions of the variables representing the channels for the monetary policy transmission, reveals that the fastest response and the highest in magnitude was that of the banks' holdings of securities. The magnitude of this response accelerates over the first three quarters that follow the time of the shock to the discount rate before it fluctuates over the next ten quarters, and declines constantly afterwards. This pattern could be explained by the fact that these securities play an important role as a cushion in the banks' management of liquidity. Banks tend usually to liquidate some of their securities holdings in response to any rise in the cost of funds to accommodate the withdrawals from the previously contracted loans, especially during the short and medium term while they are trying to adjust their market interest rates in line with the new level of the cost of funds they face.

Although very small in magnitude, the response of the volume of credit to the positive shock in the discount rate was at first positive. The clear negative response of the credit volume starts only after the second period and accelerates, in magnitude, until the fourth period before it starts decelerating until it peaks around the eighteenth quarter. The positive response of the volume of credit during the first two quarters that follow the time of the shock to the discount rate could be explained by withdrawals from the previously contracted loans. The evident negative response of the banks holdings of securities gives support to this explanation, where banks are expected to liquidate parts of their holdings of securities to finance such withdrawals when the cost of funds increases.

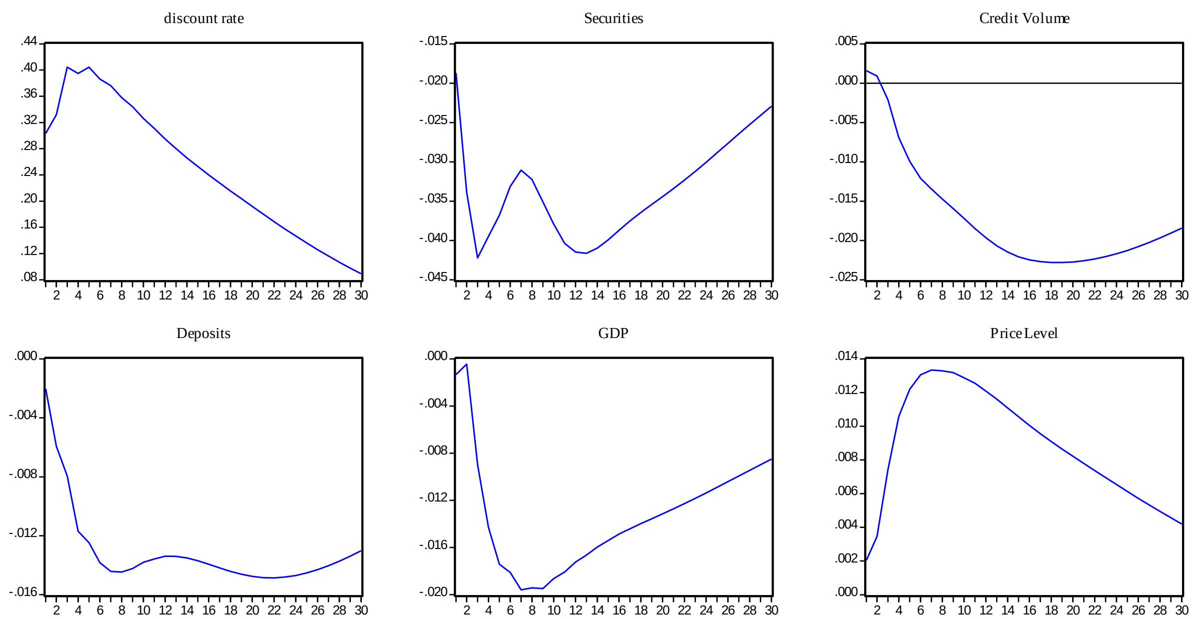
Similar to the response of the banks' holdings of securities, the negative response of deposits starts promptly from the first period that follows the time of the positive shock to the discount rate and increases in magnitude until the seventh quarter. Interestingly, the magnitude of this response flattens for a relatively long time before it starts declining constantly just a couple of periods after the response of banks' credit starts declining.

The fact that the negative response of deposits precedes that of total credit suggests that the monetary channel is more relevant to the monetary policy transmission mechanism in Jordan than that of credit. This suggestion conforms to the textbook monetary expansion mechanism, where deposits are the first step in the process of financial intermediation; the main function of banks. However, such a conclusion is not a clear-cut case because deposits and credit are interdependent and go in line with each other in the long-run. While innovations to deposits affect the banks' ability to extend new credit in the short-run, it is the volume of credit that feeds the growth of deposits on the long-run through the process of what is called money creation. This longer-term impact of innovation to banks' credit is clear in the impulse response functions of banks credit and deposits, the magnitude of the response of banks' credit starts declining before that of deposits and declines at a faster pace. This, in addition to the fact that the magnitude of the response of total banks' credit exceeds that of total deposits after the seventh period, makes determining which of the two channels leads the other inconclusive.

The generalized impulse responses, which measure the responses of the variables in the VAR system regardless of their order in the system, are almost identical to the responses based on the Cholesky decomposition (Figure 4.27). The similarity between the two measures of the response functions indicates that either our assumption regarding the ordering of the variables in the VAR system is not far from reality, or the discount rate has only little impact on the other variables included in the system. The former indication is supported by the fact that all the components of the covariance matrix of residuals shown in Table 4.13 below are almost zero.

Such a low covariance is in line with the assumption of orthogonal residuals, on which the Cholesky decomposition is based. The latter indication is supported by the low magnitude of the actual impulse responses and the non-conclusive evidence on the priority of the credit channel or the deposit channel.

Figure 4.27: Response to Generalized One S.D. Innovations to the discount rate



The relatively low magnitude of the impulse responses of all the variables included in the VAR system, gives evidence on the low impact of the discount rate either on the policy transmission vehicles or on the end objectives of the monetary policy. This evidence supports our original hypothesis in this regard. In the first period that follows the initial shock to the discount rate, the highest response was that of the banks' holdings of securities, which did not exceed 0.02 of the standard deviation of this variable. After twenty periods (five years after the initial shock), the accumulated responses are still considerably less than one standard deviation of any variable in the system. These accumulated responses amounted to 0.73, 0.31, 0.25, 0.29 and 0.20 of the one S.D of total banks' holdings of securities, volume of credit, volume of deposits, real GDP, and the price level respectively (See Table A4.2 in the statistical appendix).

Table 4.14: Covariance matrix of the VAR system involving the discount rate						
	I	RGS	RCR	RDEP	Y	P
I	0.092030	-0.005674	0.000485	-0.000616	-0.000403	0.000620
RGS	-0.005674	0.013592	0.000909	0.001850	0.000569	-0.001251
RCR	0.000485	0.000909	0.000870	0.000761	0.000347	-0.000512
RDEP	-0.000616	0.001850	0.000761	0.003041	0.000568	-0.000599
Y	-0.000403	0.000569	0.000347	0.000568	0.001053	-0.000430
P	0.000620	-0.001251	-0.000512	-0.000599	-0.000430	0.000597

The variance decomposition of the variables included in the system gives more evidence on the low impact that changes in the discount rate might have on these variables, whether they are the policy transmission variables or the end-target variables. At the policy transmission variables level, Table 4.15 shows that after 50 steps (the period after which the accumulated impulse responses almost flattens), the ratio of the variance that is explained by the shock to the discount rate did not exceed 27.5%, 20.5%, and 14.2% of the variance in banks' holdings of securities, the banks' credit and total deposits, respectively.

Interestingly, the ratio of the variance that is explained by variations in the policy transmission variable itself is found to be relatively high. This ratio amounted to 26.5% for the banks' holdings of securities, 30.9% for banks' credit, and 18.7% for deposits. This result suggests the existence of some variables other than those included in the system might have a significant impact on these three variables, especially banks' credit.

Table 4.15:Variance decomposition of banks' holdings of securities, total credit and total deposits (Using the discount rate as policy indicator variable)

	Banks' holdings of securities			Total Credit			Total Deposits		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
Discount rate	27.46	23.56	21.28	20.54	17.67	16.32	14.24	11.73	10.34
Securities	26.52	22.80	20.53	5.44	4.88	4.49	5.12	4.28	3.75
Banks' credit	20.60	29.23	34.23	30.89	37.16	40.50	22.23	33.18	38.99
Deposits	5.82	6.15	5.97	4.94	5.66	5.55	18.66	16.68	15.14
Real GDP	16.09	14.50	13.06	9.76	9.84	9.06	10.63	9.54	8.35
Price level	3.51	3.77	4.93	28.42	24.79	24.08	29.12	24.59	23.42
Standard Error	*0.38*	*0.41*	*0.43*	*0.25*	*0.27*	*0.28*	*0.22*	*0.24*	*0.26*

Contrary to the suggestion by the timing of the impulse response discussed earlier, the variance decomposition reveals that changes in the banks' credit play an important role in the variations of deposits and banks' holdings of securities, especially in the long-run. After 1000 steps, when the full impact of a shock to any variable can be gammed, variations in banks' credit explain more than one third of the variations in banks holdings of securities and almost two fifths of the variation in deposits.

At the level of the targets of monetary policy, shocks to the discount rate seem to explain a significant proportion of the variations in the real GDP and a quite lesser proportion of the variation in the price level. Table 4.16 shows that after 50 steps, changes in the discount rate explain up to 38.3% of the variation in real GDP and 16.9% of the variance in the price level. Again, the variance decomposition of real GDP and the price level reveals the significant impact that banks' credit has on these two variables, which increases over time. After 1000steps, changes in banks' credit explain up to 38.4% of the variation in real GDP and more than half of the variation in the price level.

Table 4.16: Variance decomposition of the real GDP and the price level
(Using the discount rate as policy indicator variable)

	Real GDP			Price level		
	50 Steps	100 Steps	1000 Steps	50 Steps	100 Steps	1000 Steps
Discount rate	38.31	33.08	30.19	16.91	13.96	11.87
Securities	3.32	3.07	2.80	4.09	3.37	2.83
Banks' credit	27.90	34.37	38.37	39.88	46.02	51.46
Deposits	4.85	5.40	5.31	0.36	0.91	1.51
Real GDP	13.21	12.61	11.49	15.13	12.52	10.55
Price level	12.40	11.47	11.83	23.63	23.22	21.78
Standard Error	*0.13*	*0.14*	*0.15*	*0.13*	*0.14*	*0.15*

These findings confirm the importance of the expansion of banks' credit as a medium target when it comes to achieving the end targets of monetary policy. Nevertheless, the low magnitude of the response of bank credit to the shocks of the discount rate emphasizes the need for finding a more effective policy tool or changing the criteria on which innovations to the discount rate are made. In other words, more emphasis should be given to other domestic economic objectives beyond defending the exchange rate of the Dinar, which means the possibility of more flexibility in conducting monetary policy partially away from American monetary policy.

Contrary to the impact of changes in banks' credit, the impact of deposits on both real GDP and the price level is quite low. Changes in deposits do not explain more than 5% of the variations in real GDP and not more than 1.5% of the variations in the price level. This result seems to contradict with the classical monetary analysis, which assumes the inflation rate (the change in the price level) to change proportionately with the expansion of the quantity of money (See Rasche 1980). However, this apparent contradiction is just on the surface because a quite high proportion of the variation of deposits could be accounted for through the variation in banks credit. Another explanation for this apparent contradiction is the fact that prices of a large number of commodities have been regulated over a period of two decades.

4.4.4.2.3 Excess reserves as the policy indicator variable

When the discount rate was replaced by the proxy for the excess reserves as the policy indicator variable, all the VAR systems with lag length settings one up to eight lags were found mathematically stable; where all the roots of the companion matrix lied within the unit circle[1]. Similar to the case involving the discount rate, the results of the information criteria for the lag order selection were found inconclusive. As shown in Table 4.17, two information criteria, namely the Schwarz information and the Hannan-Quinn information criteria indicated that the best lag length is one lag, while Akaike information criterion chose two lags and the Final Prediction Error criterion chose four lags.

Table 4.17: Information criteria for the lag order selection for the VAR system (R, RGS, RCR, RDEP, Y, P/DNE)

	1 lag	2 lags	3 lags	4 lags	5 lags	6 Lags
Akaike information criterion	-16.9951	-17.1936*	-17.0635	-17.0221	-16.9065	-16.6455
Schwarz information criterion	-15.9571*	-15.3681	-14.4428	-13.5982	-12.6713	-11.5909
Hannan-Quinn information criterion	-16.5733*	-16.4518	-15.9986	-15.6308	-15.1856	-14.5917
Final prediction error criterion	4.30e-08	4.27e-08	1.32e-07	-4.23e-08*	-1.23e-08	-6.20e-09

*: Indicates the best lag selected according to each criterion.

The results of other diagnostic tests were also inconclusive regarding the choice of the appropriate lag length[2]. At the vector level, the null hypothesis of joint normality was rejected at the 1% level of significance for all experimented lag lengths one up to eight. The null hypothesis of no autocorrelation was also rejected at the 1% level of significance when the lag length was set

[1] The roots of the companion matrix for all the lag length settings are available from the author on request.
[2] A summary of these diagnostic tests is available from the author on request.

at one, two, seven and eight lags, while the null hypothesis of no heteroscedasticity was rejected at the 1% level of significance for the lag length settings one and two lags.

At the individual variable equation level, the test results were also inconclusive. On the one hand, all the individual equations passed the test for no autocorrelation regardless of the lag length except for the volume of credit and real GDP. In the case of the former, the null hypothesis of no autocorrelation was rejected at the 1% level of significance if the lag length is set at two lags and at the 5% level of significance if it is set at one lag. In the case of the latter, the null hypothesis of no autocorrelation was rejected at the 5% level of significance when the lag length is set at two lags. On the other hand, the null hypothesis of normally distributed residuals from each equation was rejected at either the 1% or the 5% level of significance for all the individual variable equations and for all lag length settings except for the excess reserves and the volume of credit. Equations of the excess reserves passed the normality test for the lag length settings three to eight lags, while those of the volume of credit passed the test for the lag settings two to eight lags. When the null hypothesis of no heteroscedasticity was tested, all the individual variable equations passed the test when the lag length set at four up to eight lags, while for the lag settings one up to three lags, the null hypothesis was rejected at the 1% level of significance for one individual variable at least. Accordingly, it could be concluded that the best setting for the lag length is at four lags, which has the least misspecification possibilities and selected by at least one information criterion (FPE).

Graphic analysis of this VAR system shows similar results to those of the VAR system using the discount rate (Figure 4.28). Presented in panels A and B, the actual and fitted values and the cross plot of actual and fitted indicate that the estimated equations fit the system well except for the equation of the policy indicator variable; the excess reserves. The scaled residuals in panel D demonstrate the relatively high magnitude of residuals in the equation of excess reserves and the existence of residual outliers in every single equation. Panel C confirms the lack of normality depicted earlier from the diagnostic tests in most of the individual equations due to the presence of excess kurtosis.

Recursive analysis featured in Figure 4.29 provides similar results to those of the VAR system using the discount rate. The one-step residuals test $\pm 2\sigma$, featured in panel A, shows that residuals have exceeded the confidence band of 95% twice during the sample period in the equation of excess reserves and once in the equations of the banks' holdings of securities and the volume of credit. The results of Chow tests, presented in panels B, C, and D of Figure 4.14, provide more evidence on instability compared to the results pertaining to the VAR system involving the discount rate. The One-Step Chow test (panel B) indicates not only the existence of several outliers but also some evidence on a change in the value of the estimated parameters in most of the individual variable equations, especially in the equations of the excess reserves, securities, and the volume of credit. Similarly, the Break Point Chow test (panel C) shows multiple break points in the case of the excess reserves and the volume of deposits in addition to a one break in the case of the price level. Panel D provides clear evidence on the lack of reliability when it comes to the forecasting prospects of this system, especially in the cases excess reserves, volume of credit, volume of deposits, and the price level.

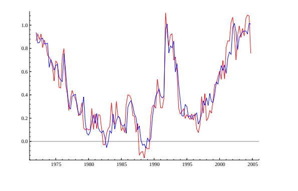
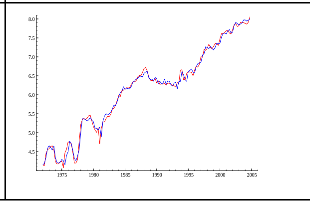
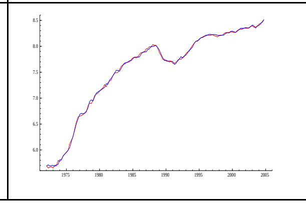
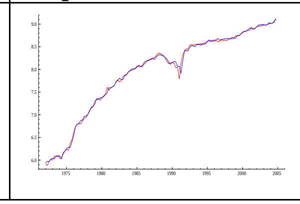
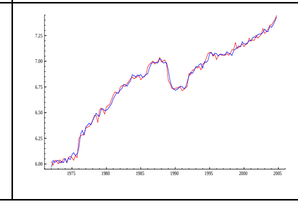
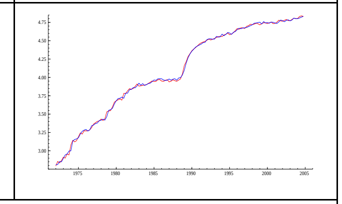
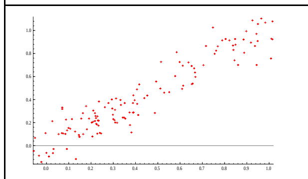
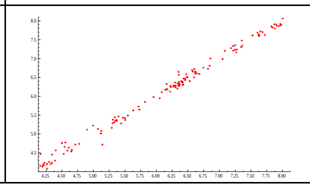
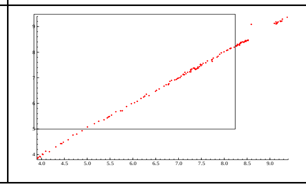
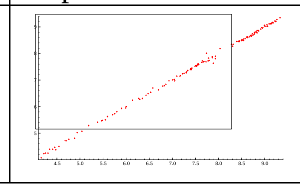
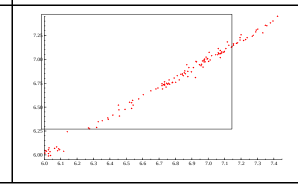
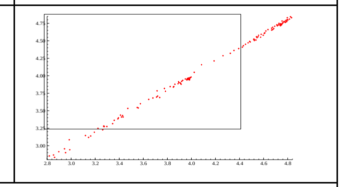
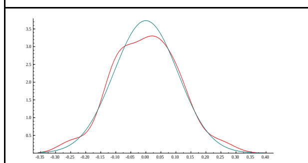
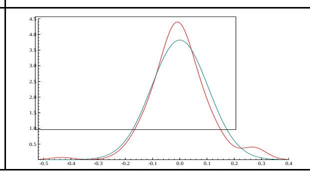
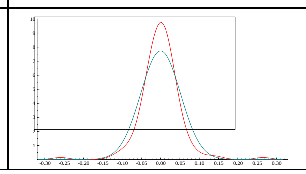
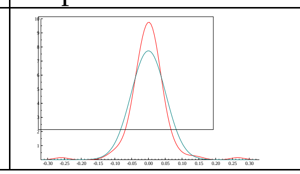
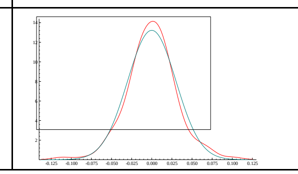
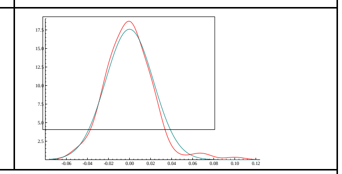
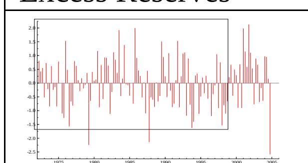
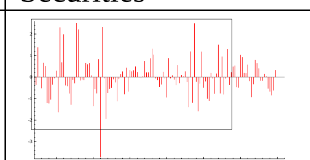
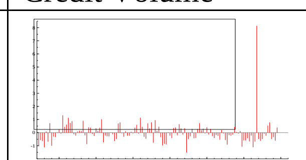
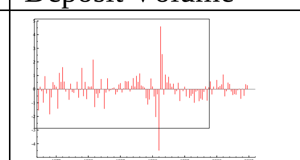
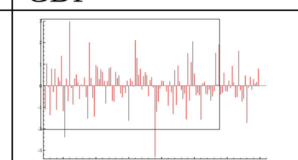
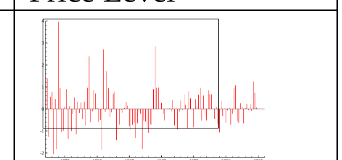
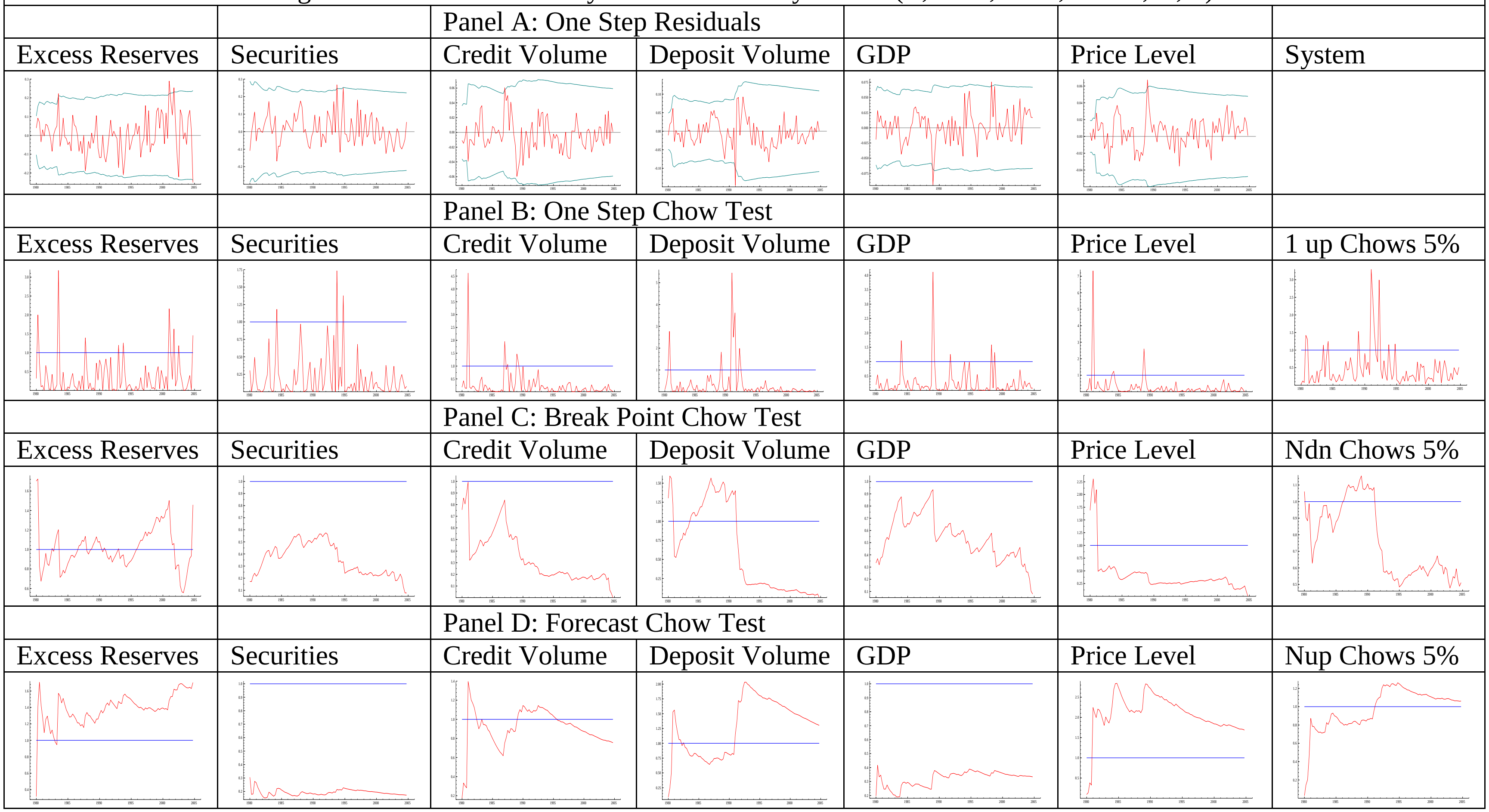
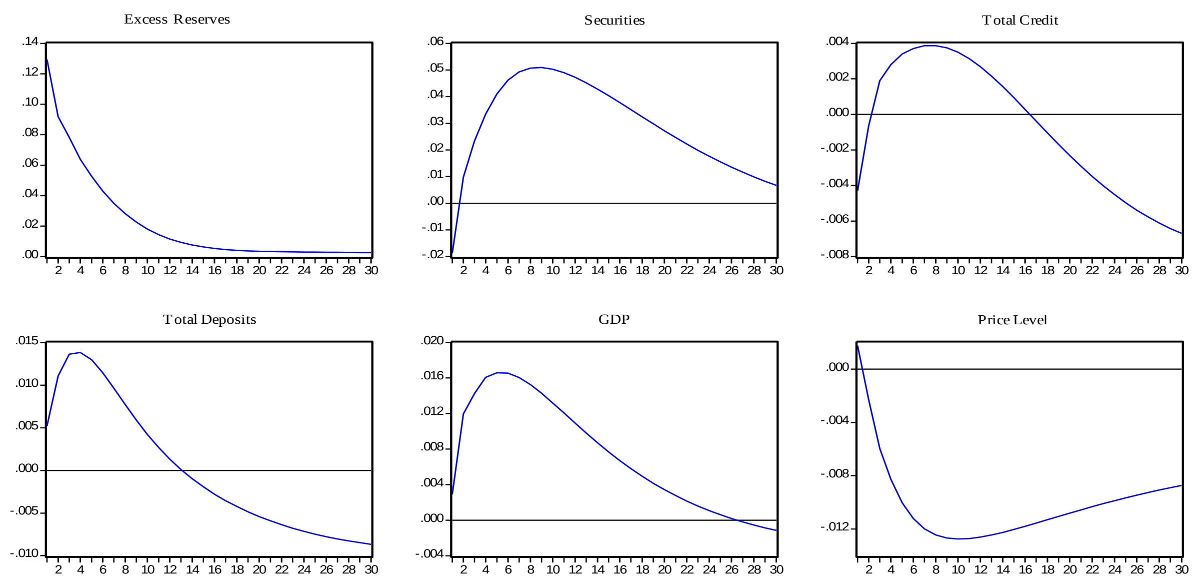
Figure 4.28: Graphic Analysis for the VAR system of (R, RGS, RCR, RDEP, Y, and P)					
Panel A: Actual and Fitted Values					
Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level
					
Panel B: Cross Plot of Actual and Fitted					
Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level
					
Panel C: Residual Density Normal					
Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level
					
Panel D: Residual Scale					
Excess Reserves	Securities	Credit Volume	Deposit Volume	GDP	Price Level
					

Figure 4.29: Recursive Analysis for the VAR system of (R, RGS, RCR, RDEP, Y, P)



Based on the Cholesky decomposition, Figure 4.30 shows the impulse response functions to innovations in the policy indicator variable; excess reserves. A positive shock to excess reserves by Cholesky one S.D. innovations leads promptly to a decline in the banks' holdings of securities and the volume of banks' credit, and to a slight increase in the volume of deposits, real GDP, and the price level. This kind of response confirms what was found earlier when the system involving the discount rate was analyzed, that the monetary channel precedes the lending channel when it comes to transmitting the monetary policy actions onto the economy. Although small in magnitude, the prompt negative response of the volume of credit reflects the fact that banks need some time to adapt its strategies regarding the management of their liquidity and lending.

Figure 4.30: Response to Cholesky One S.D. Innovations to Excess Reserves



For the following periods, the chain of consecutive effects seems consistent with the financial intermediation process. The response of banks' holdings of securities changes from negative to positive after the second quarter that follows the initial time of the shock, and continues to increase in magnitude until the sixth quarter. The positive response of deposits increases until the sixth quarter before starts declining until it becomes negative after more than years from the time of the initial shock. The initial negative response of the volume of credit changes to positive during the fifth quarter that follows the time of the initial shock to the excess reserve, and continues to increase in magnitude over the next four quarters before it starts declining. The positive response of real GDP looks consistent with those of the volume credit and the volume of deposits. The positive response of the price level changes to negative after the second quarter, and peaks around the tenth quarter that follows the initial shock.

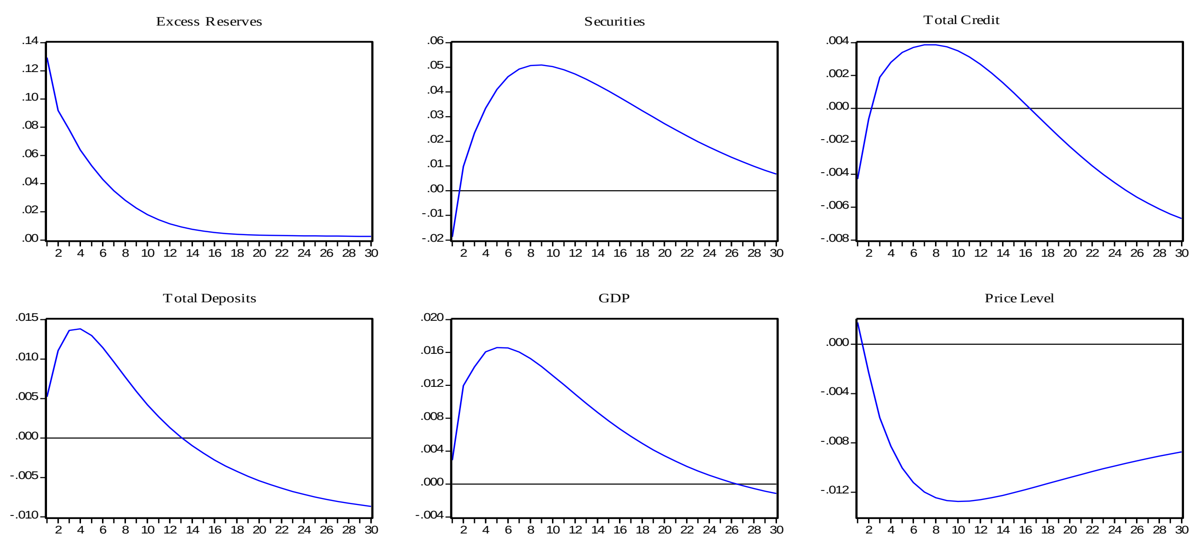
In terms of direction, the responses of banks' holdings of securities, the volume of credit, the volume of deposits, and real GDP conform to theoretical expectations, while that the price level is questionable. Expansionary monetary policy, depicted by a positive shock to excess reserves is expected to have a positive impact on the credit volume, the deposit volume, and income, which conforms to the positive responses of these three variables (See Brunner and Meltzer 1988). This result conforms to the findings of Loungani and Rush (1995) who found that changes in the reserve requirement ratios have a significant impact on real activity. The response of banks' holdings of securities could be, in theory, either way. Depending on the market conditions, banks may either invest the resulted excess liquidity in buying new securities or in extending new loans to the public (See Campbell 1978). The exact outcome depends on the reaction of the market interest rate and, consequently, on the demand for credit.

On the other hand, the negative response of the price level after the second quarter seems odd, because the expansionary monetary policy leads usually to a higher rate of growth in the quantity of money and, consequently, in the aggregate demand. In principle, this could not lead to disinflation under any circumstances. Such a negative response indicates only the weak dependency between monetary policy actions and the inflation rate in Jordan.

In terms of magnitude, and similar to case of the discount rate, all the responses to an impulse in the excess reserves are low. The maximum response to an initial Cholesky one S.D. innovation to the excess reserves, which was that of the response of banks' holdings of securities during the seventh quarter that follows the time of the initial innovation, did not exceed 5% of the standard error of that variable. The highest response of the volume of deposits, the volume of credit, and real GDP was quite less than 2% of the standard error of each of these variables.

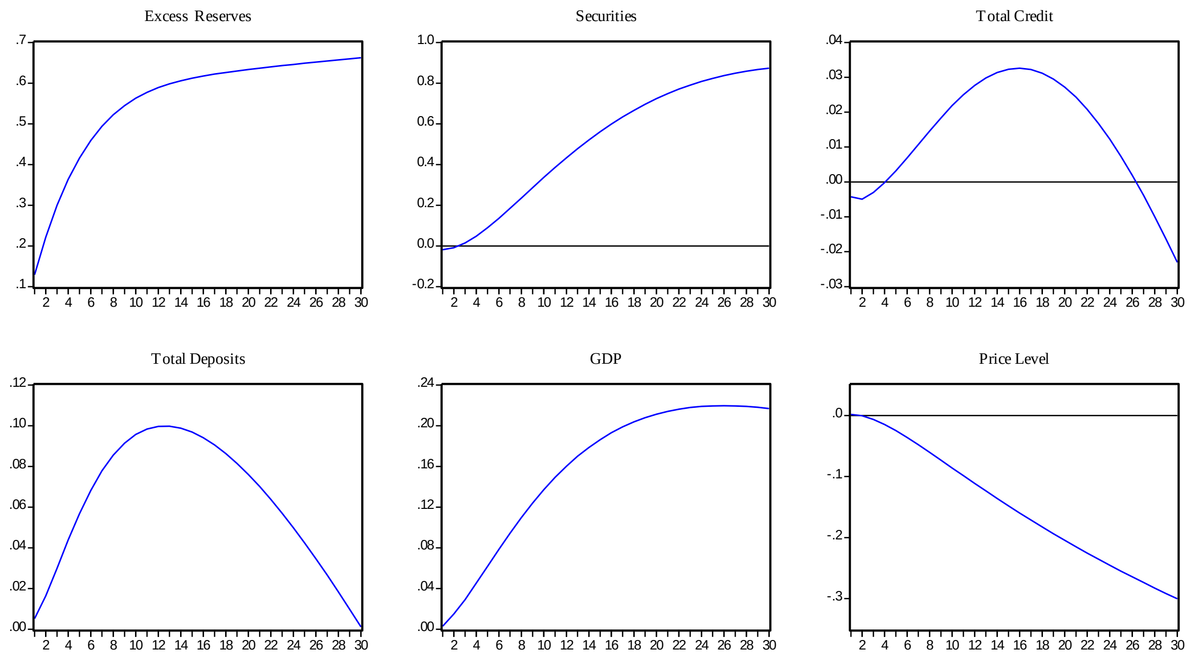
The generalized impulse responses to innovations in the excess reserves are also identical to those based on the Cholesky decomposition. This confirms the weak impact of monetary policy actions on either the policy transmission variables or the end targets variables. Figure 4.17 shows the responses to generalized one S.D. innovation in Excess reserves.

Figure 4.31: Response to Generalized One S.D. Innovations to Excess Reserves



Accumulated impulse responses to innovations in excess reserves suggest that monetary policy shocks have relatively equivalent longer-term effects on the volume of deposits, the volume of credit, and real GDP. Figure 4.32 shows that the accumulated effect on these three variables almost peaks at the same time. However, the low magnitude of the responses lies behind the fact that it takes the chain of responses more than 200 periods after the initial shock to stabilize.

Figure 4.32: Accumulated Response to Cholesky One S.D. Innovations to Excess Reserves



In summary, using excess reserves instead of the discount rate as the policy indicator variable does not make significant difference. In fact, and contrary to our original hypothesis that excess reserves is expected to perform better than the discount rate, the results of the diagnostic tests, graphic analysis, and recursive analysis in both cases are relatively similar. In both cases, clear evidence exists on instability due to multiple trend-breaks. The outliers in both cases are associated with different emerging incidents rather than with a major structural break. More important is the fact that both systems provide clear evidence on the low impact of monetary policy actions on the behaviour of different economic agents.

The question that might arise at this point is whether we have chosen the right policy indicator variables to represent the policy innovations in the VAR system we used. To ideally confirm the right choice of such variable, one needs to regress the residuals' series resulted from the policy indicator variable in the estimated VAR on the changes in the monetary policy tools used by the central bank to initiate exogenous shocks to the system. If a plausible relationship is found, the choice of the policy indicator variable would be right and vice versa. Unfortunately, such a procedure is not attainable in the case of Jordan because there has no one single variable being used constantly as the monetary policy tool to the extent that variations in that variable are totally exogenous to the systems we estimated.

In practice, the CBJ has used the discount rate, the required reserve ratio and the new issues of the certificate of deposits, but the emphasis between these three tools has changed over time, which makes it inappropriate to pick any of them to represent the exogenous shocks. Although changes in the discount rate are mainly determined by the CBJ and, therefore, could be treated as exogenous, it is inappropriate to use them in this procedure because the discount rate is used as the policy variable in one of our estimated VAR systems. Similarly, the use of the required reserve ratio is inappropriate also because of the complicated administration of these ratios in practice. For a relatively long time, multiple required ratios were applied to different types of deposits and to different types of institutions. Even when these ratios have been unified for all kinds of deposits and institutions, a new source of complication emerged when banks were allowed to meet these requirements on a daily average basis.

A final word should be said on the impact of exchange rate. As mentioned earlier, the exchange rate channel of monetary policy transmission has been not addressed because of the lack of flexibility in the exchange rate regime. Nevertheless, one could roughly have an idea about the importance of the exchange rate, which has been included in the system as exogenous, by looking at its coefficient in each individual equation. Bearing in mind the VAR system we estimated is not a structural one and the t-statistics do not follow the standard distribution, these coefficients, however, should be looked at with a great deal of caution. Having this in mind, the coefficient of the change in the nominal effective exchange rate proved to be not significant at the 5% level of significance in every single equation of the VAR system involving the discount rate as the policy indicator variable. In the case of excess reserves, the coefficient of the change in the nominal effective exchange rate was found statistically significant at the 5% level of significance in two equations only, namely the equation for the volume of credit and the equation for the price level. Table 4.18 shows the coefficients of the change in nominal effective exchange rate in individual equations of the two VAR systems.

Table 4.18: Coefficients of the change in the exchange rate in individual VAR equations

Policy indicator		RSA	RGSSA	RCRSA	RDEPSA	YSA	PSA
Excess Reserves	Coefficient	-0.503	0.376	0.168	0.043	0.079	-0.137
	SD Error	0.337	0.313	0.084	0.154	0.094	0.067
	T Statistic	-1.490	1.199	2.001*	0.282	0.837	-2.033*
Discount Rate	Coefficient	-0.419	0.276	0.160	0.102	0.125	-0.107
	SD Error	0.915	0.352	0.089	0.166	0.098	0.074
	T Statistic	-0.458	0.785	1.792	0.615	1.276	-1.449

4.5 Conclusion

This Chapter has looked at the monetary policy transmission mechanism in Jordan using the VAR analysis. The objective was to evaluate the interrelationship between the variables and not to get a structural relationship for forecasting purposes. Regardless of the policy indicator variable used, and regardless whether the VAR system is estimated using the variables in the first difference format or in the level format, the impact of monetary policy shocks on both the variables representing the channels of monetary transmission and the variables representing the economic activity are extremely low in magnitude. In terms of direction, the impacts of monetary policy shocks calculated from the models involving the first differences of the variables do not clearly conform to the theory behind monetary policy, while those calculated from the models involving the levels of the variables are conclusively in line with the theoretical expectations in terms of direction. In terms of the timing of responses, the monetary channel is found more relevant when it comes to kicking the system in response to any policy shock, while the credit channel is found to be more relevant when it comes to the long-run impact on the real GDP and the price level.

Some other important results, however, emerge. First, the discount rate is found more important in explaining the variance of banks' holdings of securities, the volume of credit, and the real GDP (See Table A4.7 in the appendix). Second, the discount rate explains higher ratio of the variance of the price level in the short and medium term (up to five years), while excess reserves explains higher ratio in the longer run. Third, although small in magnitude, the contribution of innovations to either policy indicator variable to the variance of deposits changes over time. In the short-term (the first two years), the ratio of the variance that is explained by changes in the excess reserves is higher than that explained by changes in the discount rate. The discount rate becomes more important in explaining the variance of deposits over the period of the next fifteen quarters before it retreats again afterwards.

Regarding the impact of each transmission channel on real GDP and the price level, and regardless of the policy indicator variable, the banks' portfolio channel proved to have little impact on real GDP all the time, while it has relatively reasonable contribution to the variance of the price level in the short-run. The credit channel contributes to a higher share of the variances of real GDP and the price level in the case of using the excess reserves than the case of using the discount rate. Although the monetary channel is found more relevant to kicking the system, the contribution of the credit channel to the variances of real GDP and the price level is greater than that of the money channel in the both the short and long-term. This is mainly because the response of credit is higher, in magnitude than that of deposits.

The exchange rate variable is found statistically insignificant for all individual equations of both systems except for two equations, which suggests that the exchange rate channel has no role in the process of monetary policy transmission. This result is not uncommon when the fixed exchange rate regime prevails as the case in Jordan is. By default, in such a system, the exchange rate channel for monetary policy transmission is hindered because the national currency is not allowed to vary against international currencies. In fact, and having in mind the well-known trilemma that any country can observe only two of fixed exchange rate, capital mobility, and monetary policy independence (See Bernanke 2005), the pro-fixed exchange rate practice in Jordan could be blamed for the extremely low impact of monetary policy in Jordan on either the policy transmission variables or the end target variables. In addition to losing the independence of monetary policy, and as mentioned earlier, maintaining the fixed exchange rate of the Dinar has been the main reason behind the contractionary monetary policy adopted by the CBJ to curb the waves of currency substitution in the early and late 1990s.

Appendix 4.1

Mathematical Solution[1] and Economic Interpretation of the Impulse Response Function

The reduced form VAR was transformed into a moving average representation in equation (3) in the form of:

$$y_t = D(L).\eta_t \tag{A1}$$

By factorizing *D(L)*, equation A1 can be rewritten in the form of

$$y_t = D_0\eta_t + D_1\eta_{t-1} + D_2\eta_{t-2} + D_3\eta_{t-3} + ... \tag{A2}$$

By differentiation, the matrix D_s is a matrix of the partial derivatives of the vector y_t with the interpretation of

$$D_s = \frac{\partial y_t}{\partial \eta_{t-s}} \tag{A3}$$

Considering forward expectations, A3 could be written in the form of

$$D_s = \frac{\partial y_{t+s}}{\partial \eta_t}. \tag{A3.1}$$

The element of the *ith* row and the *jth* column of D_s is $[\frac{\partial y_{i,t+s}}{\partial \eta_{jt}}]$, which identifies the impact of a one unit change in the innovation of the *jth* variable at date t (η_{jt}) on the value of the *ith* variable at date $t+s$ ($y_{i,t+s}$), while all other innovations at all dates are held constant. In other words, this element of D_s is nothing but the multiplier of the variable y_i at date $t+s$ with respect to the one unit change in the innovation of variable y_j at date t (η_{jt}). This means that the response of variable y_i at date $t+s$ to a certain shock in any of the variables of the system at date t is simply the multiplication of the respected multiplier by the shock in the respected variable.

[1] Extracted from Hamilton (1994).

Allowing for changes in the innovations of all the variables of the system at the date t, elements of the *ith* row of D_s represent the different multipliers of y_i at date ($s+t$) with respect to those changes that took place at date t. Accordingly, the total change in the variable y_i at date $t+s$ will be the sum of the multiplication of the individual multipliers of y_i with respect to the innovation of each other variable in the system by the change in that innovation. In formal representation, the combined change in the value of the vector y at the date $t+s$ would be

$$\Delta y_{t+s} = \frac{\partial y_{t+s}}{\partial \eta_{1t}} \delta_1 + \frac{\partial y_{t+s}}{\partial \eta_{2t}} \delta_2 + ... + \frac{\partial y_{t+s}}{\partial \eta_{1t}} \delta_n = D_s \delta \qquad (4)$$

where $\delta = (\delta_1, \delta_2, ... \delta_n)$ and δ_i is the change in the innovation η_{it}.

On the other hand, elements of the *ith* column of D_s represent the dynamic multipliers of y_i over time between date t and date ($t+s$) with respect to changes in its own innovations over that period.

Statistical Appendix

Table A4.1: Results of the Perron unit root test with a trend-break for the levels of the variables						
Model/ Variable	Method UR			Method STUD		
	Test Statistic	Break Time (T_b)	No. of Lags (k)	Test Statistic	Break Time (T_b)	No. of Lags (k)
First: Innovational Outlier Model 1 (IO1)						
I	-2.987	99:2	11	-1.513	96:4	2
R	-4.564	89:1	12	-2.783	99:4	12
CR	-4.916	77:4	17	-2.699	99:4	14
DEP	-3.929	93:2	16	-0.477	99:4	0
GS	-4.762	77:2	1	-1.464	99:4	18
NE	-4.399	88:2	20	-2.464	99:4	20
Y	-4.394	88:2	10	-3.024	99:4	19
P	-3.712	78:1	19	-2.110	99:4	12
95% C.V	*-5.10*			*-5.05*		
99% C.V	*-5.70*			*-5.68*		
Second: Innovational Outlier Model 2 (IO2)						
I	-3.084	97:4	11	-0.549	88:1	10
R	-4.774	89:1	12	-2.783	99:4	12
CR	-4.869	77:4	20	-2.699	99:4	14
DEP	-3.872	80:2	0	-0.477	99:4	0
GS	-4.638	77:2	1	-1.464	99:4	18
NE	-4.194	93:3	14	-2.464	99:4	20
Y	-5.374	87:4	9	-3.024	99:4	19
P	-3.773	78:1	19	-2.110	99:4	12
95% C.V	*-5.55*			*-5.19*		
99% C.V	*-6.21*			*-5.86*		
Third: Additive Outlier Model (AO)						
I	-4.030	00:4	2	-2.831	98:1	2
R	-4.262	80:3	12	-2.577	99:4	12
CR	-4.522	81:4	11	-1.147	99:4	14
DEP	-3.618	82:1	2	-0.999	99:4	2
GS	-4.177	85:3	1	-2.796	99:4	1
NE	-2.828	77:2	20	-2.610	99:4	20
Y	-2.946	81:3	19	-2.327	99:4	19
P	-3.532	76:1	19	-1.825	99:4	18
95% C.V	*-4.83*			*-4.67*		
99% C.V	*-5.45*			*-5.38*		

Table A4.2: Accumulated Responses to Cholesky One S.D. Innovation to the Discount Rate (1000 Steps)

Period	Discount Rate	Gross Securities	Credit Volume	Deposits	Real GDP	Price Level
1	0.303365	-0.018703	0.001597	-0.002032	-0.001329	0.002045
2	0.635129	-0.052589	0.002497	-0.007963	-0.001781	0.005508
3	1.039338	-0.094805	0.000370	-0.015919	-0.010744	0.012931
4	1.434226	-0.134294	-0.006549	-0.027606	-0.025033	0.023503
5	1.838591	-0.171108	-0.016479	-0.040073	-0.042452	0.035693
6	2.224705	-0.204233	-0.028594	-0.053903	-0.060564	0.048751
7	2.600764	-0.235285	-0.042058	-0.068321	-0.080158	0.062088
8	2.958832	-0.267543	-0.056808	-0.082776	-0.099577	0.075379
9	3.302838	-0.302647	-0.072764	-0.097006	-0.119044	0.088559
10	3.629018	-0.340591	-0.089971	-0.110810	-0.137665	0.101435
11	3.940065	-0.380968	-0.108461	-0.124384	-0.155736	0.113991
12	4.234662	-0.422451	-0.128113	-0.137764	-0.172964	0.126074
13	4.514819	-0.464096	-0.148787	-0.151157	-0.189602	0.137685
14	4.780597	-0.505065	-0.170276	-0.164661	-0.205555	0.148770
15	5.033373	-0.544993	-0.192357	-0.178355	-0.220957	0.159336
16	5.273298	-0.583700	-0.214829	-0.192280	-0.235816	0.169383
17	5.501033	-0.621232	-0.237532	-0.206454	-0.250228	0.178940
18	5.716603	-0.657673	-0.260342	-0.220864	-0.264195	0.188031
19	5.920293	-0.693102	-0.283158	-0.235474	-0.277750	0.196679
20	6.112127	-0.727535	-0.305896	-0.250230	-0.290884	0.204894
30	7.436906	-1.009874	-0.514123	-0.392388	-0.397279	0.264428
40	7.940549	-1.180210	-0.659523	-0.498662	-0.457796	0.289090
50	7.993901	-1.263015	-0.736829	-0.560181	-0.483021	0.290941
100	7.613611	-1.304926	-0.765975	-0.608049	-0.485873	0.238462
200	7.713716	-1.403651	-0.824314	-0.674588	-0.518346	0.195391
300	7.750705	-1.452157	-0.853190	-0.707790	-0.533913	0.173554
400	7.769077	-1.476313	-0.867573	-0.724326	-0.541664	0.162678
500	7.778226	-1.488343	-0.874736	-0.732561	-0.545523	0.157262
600	7.782782	-1.494333	-0.878303	-0.736662	-0.547445	0.154565
800	7.786180	-1.498802	-0.880963	-0.739721	-0.548879	0.152554
1000	7.787023	-1.499910	-0.881623	-0.740480	-0.549235	0.152055

Table A4.3: Ratios of the variances of real GDP and the price level that is explained by innovations to the channels of monetary policy transmission mechanism
(Using the discount rate as the policy variable)

	Variance Decomposition of GDP			Variance Decomposition of P		
Period	Securities	Credit Volume	Deposits	Securities	Credit Volume	Deposits
1	2.121437	11.41418	2.477206	18.60929	38.59767	0.559631
2	3.581784	12.27956	5.519202	17.34402	28.61679	1.916594
3	7.178418	13.20313	8.789295	18.02500	23.75988	1.984875
4	6.764354	19.20089	9.815386	17.26563	21.91768	1.437167
5	5.722592	19.36834	9.696062	14.95450	21.40559	1.099230
6	4.985579	20.13839	8.742444	12.83632	21.83177	0.886649
7	4.384517	20.52970	7.703680	11.30560	22.22947	0.792104
8	3.941721	21.42490	6.982425	10.11379	23.28011	0.746465
9	3.618940	21.49653	6.492056	9.195729	24.53574	0.683895
10	3.394836	21.16257	6.091872	8.494427	25.75079	0.618231
11	3.227144	20.64992	5.724429	7.962430	26.81214	0.566043
12	3.138594	20.10174	5.439204	7.533453	27.79822	0.524616
13	3.120036	19.42850	5.206853	7.161407	28.73037	0.490891
14	3.161028	18.70172	4.993573	6.830733	29.60293	0.463758
15	3.243235	17.97154	4.790774	6.536893	30.41516	0.441476
16	3.360459	17.27699	4.607028	6.275849	31.19007	0.422763
17	3.495405	16.62184	4.441128	6.044454	31.93036	0.407159
18	3.632082	16.02293	4.289922	5.840613	32.63108	0.394532
19	3.757426	15.49570	4.151899	5.662067	33.28444	0.384568
20	3.867638	15.05234	4.027368	5.505715	33.89014	0.376899
50	3.325715	27.89971	4.848539	4.088472	39.88154	0.355378
100	3.072859	34.37033	5.403141	3.366260	46.02346	0.910943
200	2.863740	37.42852	5.325747	2.950094	50.28979	1.388378
300	2.815751	38.14371	5.313645	2.862540	51.17516	1.483978
400	2.804098	38.31743	5.310723	2.841628	51.38660	1.506799
500	2.801223	38.36029	5.310002	2.836489	51.43855	1.512406
600	2.800511	38.37090	5.309824	2.835218	51.45140	1.513794
800	2.800290	38.37418	5.309769	2.834824	51.45538	1.514223
1000	2.800277	38.37438	5.309765	2.834800	51.45562	1.514249

Table A4.4: Accumulated responses to Cholesky one S.D. innovation to the excess reserves (1000 steps)

Period	Excess Reserves	Gross Securities	Credit Volume	Deposits	Real GDP	Price Level
1	0.119184	-0.025396	-0.005203	0.000790	0.001186	0.003025
2	0.195689	-0.023658	-0.007374	0.007680	0.008433	0.002812
3	0.251832	0.001072	-0.007724	0.013702	0.016229	-3.72E-06
4	0.306972	0.027126	-0.009081	0.025263	0.024676	-0.002998
5	0.353046	0.071218	-0.005234	0.041734	0.037366	-0.010736
6	0.400670	0.123278	0.001576	0.060065	0.052231	-0.020564
7	0.436712	0.173548	0.010446	0.075998	0.068625	-0.031075
8	0.461468	0.220784	0.021600	0.091274	0.085883	-0.042763
9	0.478348	0.262555	0.033425	0.105046	0.102147	-0.054702
10	0.490701	0.302497	0.045386	0.117200	0.117562	-0.066916
11	0.499158	0.341504	0.056952	0.127719	0.132497	-0.079161
12	0.503485	0.380659	0.068026	0.136383	0.146666	-0.091465
13	0.504679	0.420397	0.078570	0.143545	0.159661	-0.103832
14	0.503168	0.460231	0.088378	0.149097	0.171262	-0.116057
15	0.499973	0.499588	0.097331	0.153145	0.181613	-0.128019
16	0.495791	0.537641	0.105336	0.155824	0.190809	-0.139625
17	0.491242	0.573992	0.112337	0.157236	0.198819	-0.150845
18	0.486863	0.608287	0.118216	0.157476	0.205613	-0.161608
19	0.482984	0.640333	0.122870	0.156618	0.211255	-0.171862
20	0.479975	0.670130	0.126253	0.154803	0.215847	-0.181609
30	0.513700	0.862039	0.096590	0.100830	0.220475	-0.256026
40	0.610998	0.907970	-0.002444	0.011267	0.190522	-0.303256
50	0.698093	0.887666	-0.103635	-0.077660	0.160759	-0.339316
100	0.738997	0.751849	-0.282017	-0.283586	0.103726	-0.491817
200	0.680430	0.432519	-0.437792	-0.466363	0.009448	-0.605444
300	0.650963	0.322569	-0.478143	-0.515640	-0.019807	-0.635499
400	0.642462	0.291766	-0.488960	-0.528887	-0.027891	-0.643468
500	0.640158	0.283477	-0.491844	-0.532421	-0.030059	-0.645590
600	0.639542	0.281264	-0.492612	-0.533364	-0.030638	-0.646155
700	0.639378	0.280674	-0.492817	-0.533615	-0.030792	-0.646306
800	0.639334	0.280517	-0.492872	-0.533681	-0.030834	-0.646346
900	0.639322	0.280475	-0.492886	-0.533699	-0.030844	-0.646356
1000	0.639319	0.280464	-0.492890	-0.533704	-0.030847	-0.646359

Table A4.5: Ratios of the variances of real GDP and the price level that is explained by innovations to the channels of monetary policy transmission mechanism
(Using excess reserves as policy indicator variable)

	Variance Decomposition of GDP			Variance Decomposition of P		
Period	Securities	Credit Volume	Deposits	Securities	Credit Volume	Deposits
1	0.621014	14.84723	1.942592	13.45634	40.59959	0.202057
2	2.182049	18.61989	2.624551	12.98483	33.21122	0.437117
3	6.295487	21.55592	4.069028	15.05248	31.30477	0.313996
4	6.317779	31.77417	4.467902	15.21383	32.36497	1.159008
5	5.489664	34.79845	3.873315	12.96356	34.90610	1.976281
6	4.748786	36.66800	3.217347	10.78764	37.58466	2.911097
7	4.116694	37.60083	2.886077	9.122574	40.13681	3.564832
8	3.539778	38.90899	2.557494	7.778686	42.81396	4.136284
9	3.105626	39.24246	2.289847	6.805620	45.27389	4.517264
10	2.773082	39.08903	2.152926	6.056625	47.50698	4.742139
11	2.517212	38.57180	2.158634	5.495741	49.19063	5.007261
12	2.324233	37.96386	2.200379	5.056251	50.50538	5.303521
13	2.186167	37.21313	2.230044	4.692467	51.51942	5.611933
14	2.095594	36.38544	2.268132	4.383002	52.30146	5.901864
15	2.040741	35.52923	2.325331	4.118192	52.88935	6.185789
16	2.018591	34.70781	2.391457	3.891125	53.32465	6.478293
17	2.024306	33.93127	2.449565	3.695798	53.65150	6.765622
18	2.051993	33.22284	2.498288	3.528622	53.89552	7.039265
19	2.095033	32.60227	2.539642	3.386298	54.06930	7.297813
20	2.149419	32.08563	2.573338	3.264982	54.18258	7.545444
50	2.240573	44.50051	2.071708	2.360723	49.05209	11.68715
100	2.195428	45.61811	2.253249	2.181574	46.66737	13.07975
200	2.134396	45.79596	2.632927	2.116421	46.14851	13.42279
300	2.130062	45.77548	2.678607	2.111991	46.12020	13.44337
400	2.129746	45.77368	2.682177	2.111679	46.11823	13.44480
500	2.129723	45.77355	2.682436	2.111657	46.11809	13.44490
600	2.129721	45.77354	2.682454	2.111655	46.11808	13.44491
800	2.129721	45.77354	2.682456	2.111655	46.11808	13.44491
1000	2.129721	45.77354	2.682456	2.111655	46.11808	13.44491

Table A4.6: Responses to Cholesky One S.D. Innovations in the Discount Rate (I) and the Excess Reserves (R)

	Response of Securities		Response of Credit Volume		Response of Deposits		Response of GDP		Response of Price Level	
Period	I	R	I	R	I	R	I	R	I	R
1	-0.0187	-0.0254	0.0016	-0.0052	-0.0020	0.0008	-0.0013	0.0012	0.0020	0.0030
2	-0.0339	0.0017	0.0009	-0.0022	-0.0059	0.0069	-0.0005	0.0072	0.0035	-0.0002
3	-0.0422	0.0247	-0.0021	-0.0004	-0.0080	0.0060	-0.0090	0.0078	0.0074	-0.0028
4	-0.0395	0.0261	-0.0069	-0.0014	-0.0117	0.0116	-0.0143	0.0084	0.0106	-0.0030
5	-0.0368	0.0441	-0.0099	0.0038	-0.0125	0.0165	-0.0174	0.0127	0.0122	-0.0077
6	-0.0331	0.0521	-0.0121	0.0068	-0.0138	0.0183	-0.0181	0.0149	0.0131	-0.0098
7	-0.0311	0.0503	-0.0135	0.0089	-0.0144	0.0159	-0.0196	0.0164	0.0133	-0.0105
8	-0.0323	0.0472	-0.0148	0.0112	-0.0145	0.0153	-0.0194	0.0173	0.0133	-0.0117
9	-0.0351	0.0418	-0.0160	0.0118	-0.0142	0.0138	-0.0195	0.0163	0.0132	-0.0119
10	-0.0379	0.0399	-0.0172	0.0120	-0.0138	0.0122	-0.0186	0.0154	0.0129	-0.0122
11	-0.0404	0.0390	-0.0185	0.0116	-0.0136	0.0105	-0.0181	0.0149	0.0126	-0.0122
12	-0.0415	0.0392	-0.0197	0.0111	-0.0134	0.0087	-0.0172	0.0142	0.0121	-0.0123
13	-0.0416	0.0397	-0.0207	0.0105	-0.0134	0.0072	-0.0166	0.0130	0.0116	-0.0124
14	-0.0410	0.0398	-0.0215	0.0098	-0.0135	0.0056	-0.0160	0.0116	0.0111	-0.0122
15	-0.0399	0.0394	-0.0221	0.0090	-0.0137	0.0040	-0.0154	0.0104	0.0106	-0.0120
16	-0.0387	0.0381	-0.0225	0.0080	-0.0139	0.0027	-0.0149	0.0092	0.0100	-0.0116
17	-0.0375	0.0364	-0.0227	0.0070	-0.0142	0.0014	-0.0144	0.0080	0.0096	-0.0112
18	-0.0364	0.0343	-0.0228	0.0059	-0.0144	0.0002	-0.0140	0.0068	0.0091	-0.0108
19	-0.0354	0.0320	-0.0228	0.0047	-0.0146	-0.0009	-0.0136	0.0056	0.0086	-0.0103
20	-0.0344	0.0298	-0.0227	0.0034	-0.0148	-0.0018	-0.0131	0.0046	0.0082	-0.0097
21	-0.0334	0.0276	-0.0226	0.0021	-0.0148	-0.0027	-0.0127	0.0036	0.0078	-0.0093
22	-0.0323	0.0256	-0.0224	0.0008	-0.0149	-0.0034	-0.0123	0.0027	0.0074	-0.0088
23	-0.0312	0.0237	-0.0221	-0.0004	-0.0148	-0.0041	-0.0118	0.0019	0.0070	-0.0084
24	-0.0301	0.0218	-0.0217	-0.0016	-0.0147	-0.0047	-0.0114	0.0012	0.0065	-0.0079
25	-0.0289	0.0199	-0.0213	-0.0027	-0.0145	-0.0053	-0.0109	0.0005	0.0061	-0.0075
26	-0.0277	0.0181	-0.0208	-0.0037	-0.0143	-0.0058	-0.0104	-0.0001	0.0057	-0.0072
27	-0.0265	0.0163	-0.0203	-0.0047	-0.0140	-0.0063	-0.0099	-0.0006	0.0053	-0.0068
28	-0.0253	0.0146	-0.0197	-0.0057	-0.0137	-0.0068	-0.0095	-0.0011	0.0049	-0.0065
29	-0.0241	0.0129	-0.0191	-0.0065	-0.0134	-0.0072	-0.0090	-0.0015	0.0046	-0.0062
30	-0.0229	0.0113	-0.0184	-0.0073	-0.0130	-0.0076	-0.0085	-0.0019	0.0042	-0.0059
40	-0.0126	0.0004	-0.0113	-0.0109	-0.0085	-0.0095	-0.0042	-0.0034	0.0012	-0.0040
50	-0.0053	-0.0031	-0.0051	-0.0089	-0.0044	-0.0080	-0.0014	-0.0024	-0.0005	-0.0034
60	-0.0014	-0.0027	-0.0014	-0.0051	-0.0017	-0.0054	0.0000	-0.0011	-0.0012	-0.0035
70	0.0000	-0.0019	0.0002	-0.0027	-0.0005	-0.0036	0.0003	-0.0006	-0.0013	-0.0034
80	0.0000	-0.0022	0.0004	-0.0022	-0.0002	-0.0031	0.0002	-0.0009	-0.0011	-0.0031
90	-0.0005	-0.0032	0.0000	-0.0026	-0.0004	-0.0032	-0.0001	-0.0013	-0.0009	-0.0026
100	-0.0010	-0.0041	-0.0004	-0.0029	-0.0006	-0.0033	-0.0003	-0.0015	-0.0007	-0.0021
150	-0.0010	-0.0031	-0.0006	-0.0013	-0.0007	-0.0016	-0.0003	-0.0009	-0.0004	-0.0011
200	-0.0007	-0.0019	-0.0004	-0.0007	-0.0005	-0.0009	-0.0002	-0.0005	-0.0003	-0.0005
300	-0.0003	-0.0002	-0.0002	-0.0001	-0.0002	-0.0001	-0.0001	0.0000	-0.0002	0.0000
400	-0.0002	0.0000	-0.0001	0.0000	-0.0001	0.0000	-0.0001	0.0000	-0.0001	0.0000
500	-0.0001	0.0000	0.0000	0.0000	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
600	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1000	0.0000	-0.0254	0.0000	-0.0052	0.0000	0.0008	0.0000	0.0012	0.0000	0.0030

Table A4.7: Ratios of the variance decomposition that is explained by innovations in the policy indicator variables
(discount rate (I) and the excess reserves (R))

	Gross securities		Banks' credit		Deposits		Real GDP		Price level	
Period	I	R	I	R	I	R	I	R	I	R
1	2.57	5.27	0.29	3.09	0.14	0.02	0.17	0.13	0.70	1.61
2	5.66	2.83	0.20	1.82	0.72	0.93	0.12	3.06	1.38	0.86
3	8.52	3.88	0.28	1.01	1.34	1.16	3.70	4.51	4.04	1.12
4	9.82	4.82	1.35	0.68	2.69	2.48	9.76	5.68	7.36	1.29
5	10.85	8.33	2.80	0.70	4.02	4.80	16.48	8.53	10.17	3.32
6	11.57	12.30	4.35	1.04	5.45	6.88	22.17	11.38	12.37	5.62
7	12.08	15.19	5.78	1.50	6.79	7.84	27.62	13.90	14.12	7.46
8	12.76	17.20	7.04	2.09	7.84	8.40	31.73	16.03	15.37	9.18
9	13.71	18.42	8.13	2.56	8.62	8.61	35.11	17.29	16.30	10.50
10	14.89	19.38	9.10	2.89	9.15	8.57	37.57	18.06	17.03	11.59
11	16.23	20.17	10.00	3.09	9.52	8.40	39.50	18.62	17.62	12.50
12	17.61	20.91	10.85	3.20	9.80	8.14	40.93	19.00	18.09	13.28
13	18.95	21.62	11.66	3.26	10.03	7.86	42.05	19.20	18.44	13.99
14	20.21	22.31	12.43	3.28	10.24	7.56	42.90	19.26	18.72	14.60
15	21.37	22.93	13.16	3.27	10.45	7.28	43.58	19.24	18.93	15.12
16	22.42	23.45	13.83	3.24	10.67	7.02	44.12	19.17	19.08	15.55
17	23.39	23.86	14.46	3.19	10.90	6.78	44.57	19.07	19.19	15.90
18	24.28	24.17	15.04	3.12	11.15	6.58	44.94	18.94	19.27	16.19
19	25.10	24.40	15.60	3.05	11.42	6.41	45.26	18.79	19.32	16.42
20	25.85	24.56	16.12	2.98	11.69	6.27	45.53	18.64	19.36	16.60
50	27.46	20.54	20.54	5.46	14.24	8.22	38.31	14.77	16.91	17.12
100	23.56	18.63	17.67	6.18	11.73	9.01	33.08	14.19	13.96	17.06
200	21.80	18.29	16.64	6.44	10.66	9.32	30.86	14.18	12.32	17.05
300	21.41	18.28	16.40	6.46	10.42	9.34	30.36	14.18	11.98	17.04
400	21.31	18.28	16.34	6.46	10.36	9.34	30.23	14.18	11.89	17.04
500	21.29	18.28	16.32	6.46	10.35	9.34	30.20	14.18	11.87	17.04
600	21.28	18.28	16.32	6.46	10.35	9.34	30.20	14.18	11.87	17.04
700	21.28	18.28	16.32	6.46	10.34	9.34	30.19	14.18	11.87	17.04
800	21.28	18.28	16.32	6.46	10.34	9.34	30.19	14.18	11.87	17.04
900	21.28	18.28	16.32	6.46	10.34	9.34	30.19	14.18	11.87	17.04
1000	21.28	18.28	16.32	6.46	10.34	9.34	30.19	14.18	11.87	17.04

Chapter 5

Demand for Imports and Exports in Jordan

5.1 Introduction

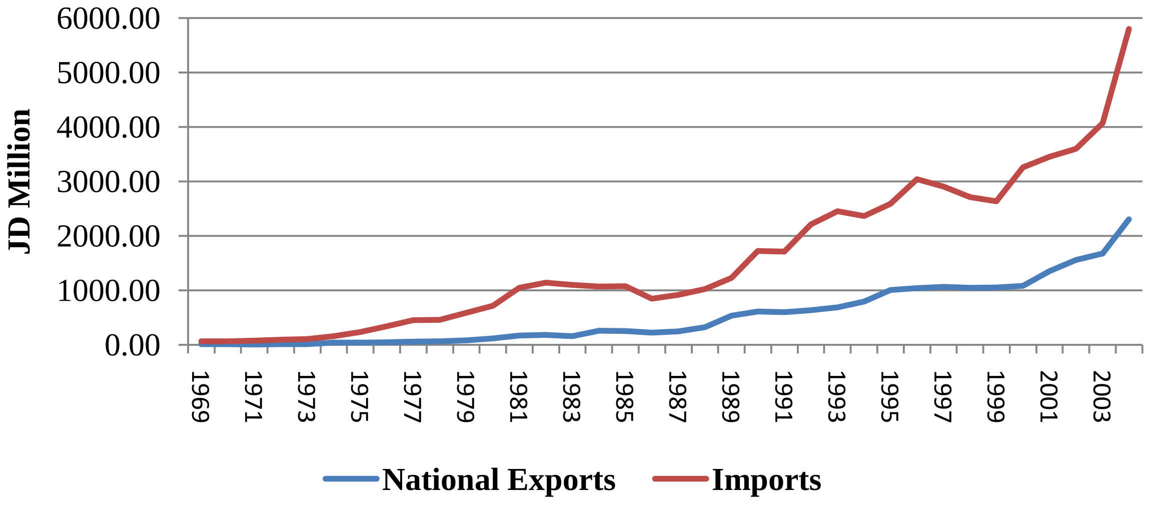
A relatively huge trade deficit (merchandise total exports – merchandise imports) has been one of the main characteristics of the Jordanian economy. In addressing this issue, Jordan has relied heavily on tariffs and, in certain cases, on non-tariff barriers. A flexible exchange rate policy has never been explicitly considered for this purpose. On the contrary, the stability of the exchange rate has always been the announced policy, and for the most of time the Jordan dinar has been pegged to either a single currency or a basket of currencies. Although Jordan experienced a wide-scale process of economic reform during the 1990s, within the framework of which the trade sector has been relatively liberalized, the exchange rate has not been allowed to fluctuate freely. On the contrary, Jordan reverted to the fixed exchange rate policy in late 1995 by pegging the Dinar to the US dollar at a mid rate of US $ 1.41041 per on Jordan Dinar (CBJ 1995).

Maintaining the fixed exchange rate system at the time of liberalizing all other aspects of the economy, including the trade sector and capital movement, raised some query about the appropriateness of such a policy and motivated the desire to investigate the role of exchange rate in the Jordanian economy. The main question that arises within this framework is to what extent do changes in the exchange rate affect the trade balance in a small developing economy like the Jordanian? To answer such a question we intend to estimate demand functions for both imports and exports in Jordan. Assuming that changes in the exchange rates directly affects relative prices, the estimated price elasticity of imports and exports could indicate the impact of exchange rate policy in Jordan on the demand for imports and exports and, consequently, on the persistent trade deficit.

5.2 Trade developments in Jordan

Over the period 1970 through 2004, the average ratio of trade deficit to gross domestic product (GDP) amounted to 35.2% in nominal terms and 34.5% in real terms. The nominal trade deficit to GDP ratio rose sharply during the 1970s to reach 54.7% in 1981(See Figure 2.9). This rise could be explained by consecutive oil shocks and the ambitious development plans during the 1970s, which resulted in high growth rates in merchandise imports and, consequently a widened the trade deficit. Since the deficit to GDP ratio has been downward trending to reach 37.1 per cent of GDP in 2004. The bulk of this deficit has been settled by the surplus of the services balance and current transfers, which averaged to 33.2 percent of GDP over the period 1970-2004.

Figure 5.1: Nominal values of national exports and imports of Jordan 1969-2004



Despite the fact that the growth rate of real exports has been relatively higher than that of real imports on average, the trade deficit, whether in absolute terms or as a percent of GDP, continued to be dominated by the relatively much higher volume of imports. During the1970s, both real exports and real imports grew on average at an equally high rate (13%). While real exports continued to grow on average at a high rate during the 1980s, the growth rate of real imports decelerated sharply during that period to an average of 1.9%. Since 1990 the high growth rate of real exports declined but remained higher than that of real imports, which increased to 5.8 on average during the period 1990-2004. Table 5.1 shows the average growth rates of real exports and imports and their prices.

As mentioned earlier, the high growth of both exports and imports during the 1970s could be attributed to the sharp increase in oil prices. On the one hand, the resulting boom in the Arab oil-producing countries at the time led to a considerable increase in their demand for Jordanian exports and for Jordanian workers, as well. On the other hand, the rise in oil prices and the resulted high inflation rates in industrial countries led to an 8.7% increase in Jordanian import prices. However, the resulted high income of the Arab oil producing countries enabled them to allocate more grants to Jordan. These grants along with the increase in foreign exchange revenue as resulting from the increase in exports and workers' remittances enabled Jordan to implement two ambitious development plans during the period 1973 through 1980, which led to high growth rates in imports.

Table 5.1: Average growth rates of real exports, real imports, export prices, and import prices (in percent)

	70-04	70-79	80-89	90-04
Export Prices	5.4	6.5	7.4	2.3
Import Prices	6.0	8.7	5.4	2.9
Real Imports	6.7	13.0	1.9	5.8
Real Exports	9.7	12.9	11.3	7.2

Interestingly, Table 5.1 reveals also that on average, the high growth rates of both exports and imports were accompanied by acceleration in export and import prices, while the lower growth rates were accompanied by a moderate rises in export and import prices. This might suggest that price elasticity of both exports and imports is on the low side.

Table 5.2 shows that the structure of both exports and imports has considerably changed over the period 1970-2004. In both cases, the relative importance of crude materials and intermediate goods rose sharply at the expense of that of consumer goods. The former rose from an average of 46.9% during the 1970s to an average of 53.6% during the period 1990-2004 in the case of exports, and from an average of 23.4% to 53.5% in the case of imports. The average ratio of consumer goods declined between the two periods from 50.7% to 42.7% in the case of exports and from 48.1% to 26.9% in the case of imports. Such a development reflects the relative success of the policy adopted since the late 1970s to diversify national exports on the one hand, and to encourage import substitution industries on the other.

Table 5.2: Distribution of national exports and imports by economic function
(Average percentage ratios)

	70-04	70-79	80-89	90-04
National Exports	100.0	100.0	100.0	100.0
Consumer Goods	44.5	50.7	39.5	42.7
Crude Materials and Intermediate Goods	52.7	46.9	58.6	53.6
Crude Materials	31.4	35.3	38.0	24.3
Intermediate Goods	21.3	11.5	20.6	29.3
Capital Goods	2.8	2.4	1.9	3.7
Total Imports	100.0	100.0	100.0	100.0
Consumer Goods	36.7	48.1	38.0	26.9
Crude Materials and Intermediate Goods	39.7	23.4	37.2	53.5
Fuels Including Crude Oil	12.7	7.7	16.9	13.8
Intermediate Goods and Other Crude Materials	27.0	15.6	20.3	39.8
Capital Goods	23.6	28.5	24.8	19.6

5.3 Trade Policy

Stability of the exchange rate of Jordan Dinar has been always a key factor in planning and conducting monetary policy in Jordan. In practice, the Jordan Dinar was always pegged either to a single currency or to a basket of currencies to ensure that variability in its exchange rate is minimal. This, in fact, made exchange rate policy in Jordan serving towards combating inflationary pressures rather than adjusting the balance of payments distortions. Adopting such a policy for such a long period of time suggests that the policy makers in Jordan doubted the ability of flexible exchange rate to adjust the balance of payments disequilibrium on the one hand, and feared of the potential negative impact on the inflation rate and even the trade flows associated with exchange rate volatility (See Calvo and Reinhart 2002). Instead, Jordan relied heavily on tariffs and, in certain cases, on non-tariff barriers, to cut down imports.

All imports to Jordan are subject to an import license fee of 4%. The licensing system, however, proved to be just a routine and it serves as a fiscal measure rather than a trade barrier. Unless the importation of certain goods is prohibited, all import licenses are issued automatically. Prior to February 1995, when Jordan declared the dinar fully convertible for all current transactions and such licenses became a pure fiscal measure, import licenses were a pre-requisite for import payments. Commercial banks, however, were authorized to make all outward payments for licensed imports without the prior approval of the Central Bank.

Amid the 1970s, the Government stepped into the trading business and became the sole importer and domestic wholesaler of the main food items such as wheat, sugar, rice, meat, and powdered milk. This step was motivated by social objectives to provide the public with such items at reasonable prices. In effect, the government used to subsidize all these items as well as petroleum products during that period.

With the exception of little number of goods, such as tobacco (which used to be banned until early 1990s), certain drugs, and some agricultural products, no quotas or any other quantitative restrictions were imposed on imports. The only exception of this took place in 1989 when the government decided not to issue new licenses to imports of all luxury goods. This step aimed at cutting down the demand for foreign currencies in the aftermath of the financial crisis that took place in the late 1988.

A preferential system of import duties had been implemented in Jordan. The aim of this policy was to encourage the domestic industry either by protecting them against severe external competition, or by lowering the cost of production especially for export oriented industries. A second aim of this policy was to cut down the import bill in general. Raw materials and intermediate goods were either exempted of import duties or subject to a relatively low rate of duties (up to 15%). On the other hand, import duties on consumer goods were relatively high and ranged between 30% and 100% depending on the degree of luxury of these goods. In certain cases, such as imports of cars, extremely high rates of consumption tax (60-200% depending on the engine size) were introduced for fiscal reasons rather than trade policy reasons.

Jordan has been a member of several bilateral and multilateral trade agreements aiming at facilitating the flow of trade with its trade partners. Three of these agreements (with Yemen, Syria and Iraq) included bilateral payments arrangements. In practice two of these three payments arrangements (with Syria and Yemen) lasted only for few years in early 1980s, while the arrangement with Iraq lasted until 2003, when it was effectively suspended because of the occupation of Iraq.

In the late 1980s a consumption tax (sales tax), over and above import duties, has been introduced on imported consumer goods. Although this tax was designed towards the elimination of foreign competition to domestically produced goods, the fact that its rate was much higher than excise taxes levied on domestically produced goods indicates that it was also designed to serve as a fiscal measure.

With the introduction of sales taxes in the early 1990s, consumption tax on imports has been abolished. Within the framework of the adjustment program, the same rate of sales tax is applied to both domestically produced and imported goods of the same nature (13% on most of consumer goods). Within the same framework, and in line with the guidelines of the World Trade Organization (WTO), of which Jordan became a member in 2000, import duties on all consumer goods were gradually reduced. The present maximum tariff is 30%, while the non-weighted average tariff is about 15%.

5.4 Exchange Rate and Trade; Theoretical Background

The use of exchange rate as a policy tool, gained its momentum in the late 1920's and the early 1930's, when most of industrial countries abandoned the gold standard and shifted towards devaluation as a policy measure to correct the current account deficit in the balance of payments (Riechel 1978). The move came as a result of the downward rigidity of wages, and consequently of relative prices, which hindered the automatic balance of payments adjustment feature. Riechel (1978) argued that this rigidity shifted the burden of adjustment to negative shocks in aggregate demand from a change in relative prices to a decline in output and a rise in unemployment.

The essence of the devaluation policy stems from the fact that changing the exchange rate will affect relative prices between the domestically-produced goods and imports. Therefore any country facing a trade deficit can, by devaluing its currency, raise the domestic price of imports and lower its exports foreign currency prices. In theory, this should enhance the external demand for exports and discourage the local demand for imports, resulting in an improvement in the trade balance (Salmon (1994) and Dornbusch (1980)). In practice, however, the expected positive effect of devaluation on home country and the counter negative effect on its trade partners led to successive devaluations and counter-devaluations among different trade partners without being able to achieve the desired balance of trade equilibrium (Riechel 1978).

As summarized in Miles (1979), the impact of changes in the exchange rate on the trade balance and the balance of payments could be explained by three approaches, namely the elasticities approach, the absorption approach, and the monetarist approach. The elasticities approach relates the magnitude of variation in the trade balance in response to changes in the exchange rate to the magnitude of price elasticities of both the demand and supply for imports and exports. The proponents of this approach argued that large demand elasticity and small supply elasticity are necessary for improvement in the trade balance in response to devaluation (See Branson (1972) and Miles (1979)).

In practice, insufficient price elasticity of exports and imports has been blamed for the failure of devaluation policies to correct for the balance of payments imbalances, especially in developing countries. The deterioration in the terms of trade will not result in an improvement in the trade balance of a certain country unless its export and import price elasticities are large enough to the extent that the Marshall-Lerner condition is satisfied; i.e. the sum of both elasticities exceeds unity (Dornbusch 1980). Nevertheless, even when Marshall-Lerner condition is met, the magnitude of improvement in the trade balance depends on the import component of domestic exports and on the initial trade position of the country. Dornbusch (1980) argued that the larger the import component is, the lesser the improvement will be. Furthermore, the larger the initial trade deficit (surplus) is, the lesser is the improvement (deterioration) would be as a result of a change in the nominal exchange rate (See IMF 2006).

The absorption approach stems from the impact of exchange rate changes on the structure of expenditure. According to this approach, changes in the exchange rate affect the terms of trade, the production, and switch expenditures between foreign and domestic goods. Exchange rate appreciation shifts domestic expenditure in favour of imported goods, while depreciation makes the shift in favour of locally produced goods and may increase the demand for domestic exports (Dornbusch 1980). This, in principle, should directly affect the trade balance. Day (1954) argued that changes in relative prices does not affect the structure of expenditures only, but could affect the volume of expenditure also, especially if money income remained unchanged. Although the direction of the change in the volume of expenditure in response to a certain change in relative prices and the structure of that change are ambiguous, such a change affects the trade balance.

The third approach is the monetarist approach, which attributes the trade effects of changes in exchange rates to their impact on the real value of cash balances and on relative prices of traded and non-traded goods. The wealth effect of the resulted changes in the real value of cash balances and the relative prices shifts the demand for imports and, consequently, affects both the trade balance and the balance of payments.

Empirical studies, however, do not provide conclusive evidence on the impact of exchange rate variations on trade balance. On the one hand, some empirical studies found that positive shocks to terms of trade (a rise of export prices relative to import prices) has negative impact on trade balance (See for example: Spatafora and Warner 1995 and Muellbauer and Murphy 1990). Such findings suggest that devaluations (depreciations in the case of flexible exchange rate systems) could help in improving the trade balance and the balance of payments. On the other hand, however, several other empirical studies showed that changes in exchange rates had either an insignificant or even a perverse effect on the trade balance (See for example Miles (1979), Steinherr (1980), Bin Yusoff and Baharumshah (1993), and Wilson and Tat (2001)).

In practice, the final impact of exchange rate movements on the trade balance depends on several factors. The most popular factor that has been used to explain the magnitude of this impact is the price elasticities of exports and imports. As explained earlier, if these elasticities do not meet the Marshal-Learner condition, changes in exchange rates will fail to have the expected effect on the trade balance (Dornbusch 1980). However, the fact that both imports and exports are usually priced at sometime earlier than the time at which the real transactions take place slows down the process of transmitting the impact of exchange rate movements into the quantities of both imports and exports. This lagged effect (known in the literature as the J-curve phenomenon) could impede the desired effects on the trade balance and the balance of payments even when the elasticities are large enough to meet the Marshal-Lerner condition (Krugman and Baldwin 1987).

The second important factor that affects the impact of exchange rate variation on the trade balance is the degree of the exchange rate pass-through to both the domestic price level and import prices. The degree of the pass-through in either case depends on the role that a certain country plays in determining the price of traded goods. The more a country is likely to be a price taker, the more the magnitude of the pass-through is (See Swift 1998). However, the pass-through effect of exchange rate changes might be only a matter of timing. Branson (1972) argued that the pass-through effect of a change in the exchange rate might not be complete in the short-run only, but in the long-run all the change will be absorbed in the price of traded goods. The magnitude of the pass-through does not vary between countries only but between different measures of the price level also. Papell (1994) found that changes in exchange rates in the G7 countries have only a small effect on domestic price level measured by GNP deflator. As reported in Papell (1994), this impact becomes higher in magnitude and gains more statistical significance if domestic price level is measured by producer price index (PPI) or consumer price index (CPI). Table 5.3 shows the elasticities reported in Papell (1994) of different inflation measures with respect to exchange rate depreciation in the G7 countries along with the asymptotic t statistic:

Table 5.3: Exchange rate elasticities of different price level measures in the G7 countries (Reported in Papell 1994)

Country	GNP Deflator		CPI		PPI	
	Elasticity	t-statistic	Elasticity	t-statistic	Elasticity	t-statistic
Canada	0.01	2.16	0.04	3.09	0.03	1.70
France	-0.02	-1.42	-0.01	-1.50	n.a	n.a
Germany	-0.02	-1.80	-0.02	-2.19	-0.01	-1.54
Italy	-0.04	-1.96	-0.01	-2.42	-0.08	-2.45
Japan	-0.00	-0.16	-0.00	-0.17	-0.06	-2.39
United Kingdom	0.02	1.53	0.07	2.98	0.12	3.16
United States	0.01	2.02	0.03	4.36	0.4	3.44

A third factor that affects the magnitude of the impact of exchange rates movements on the trade balance is the structural characteristics of the economy and the domestic economic policies (See Tamirisa 1998). Anderson et al (1995) showed that distortions in both the commodity and factor markets resulting from domestic tax and subsidy policies increase the Trade Restrictiveness Index and, consequently, depress the volume of trade across the boards. In this regard, however, one should keep in mind that exchange rate policy has, by itself, a certain amount of subsidy and tax for exports or imports. Large devaluations (or depreciations in the flexible exchange rate systems) might be considered as part of dumping policies (See Feinberg 1989).

Another factor that has an important role in determining the impact of exchange rate movements on the trade balance is the cost of entry (exit) to (from) the market that exporters usually incurred. Several empirical studies found that this factor, in addition to volatility, plays a major role in forming what is known in the literature by Hysteresis, where a certain change in exchange rate leads to a persistent impact on the relative prices of both exports and imports (See for example Baldwin and Krugman (1989) and Dixit (1989)). This means that after absorbing the impact of a certain exchange rate change, the following changes in the exchange rate would not have a significant impact on the actual relative prices and, consequently, on the volume of trade unless they are large enough to induce an impact on profits large enough to encourage some firms to enter or exit the relevant market (See Baldwin (1988) and Campa (1993).

Regardless of the magnitude of the price elasticities of exports and imports and the magnitude of the exchange rate pass-through, two issues have attracted much of the interest in the literature on the impact that changes in exchange rates might have on the volume of external trade, namely the impact of transitory changes versus that of permanent changes and the impact of a one off change versus volatility in exchange rates. On the one hand, while the impact of a permanent shock to the exchange rate and, consequently to the relative prices is unambiguous and would be completely absorbed in the long-run, the impact of a transitory change in the exchange rate and, consequently, in the relative prices is ambiguous (Serven 1995). On the other hand, a shift in the level of exchange rate is similar to a permanent change and causes no uncertainties. Therefore its impact would be totally absorbed over the long-run. Volatility, however, raises the degree of uncertainty as well as the level of exchange rate risk and, therefore, have a negative impact on the trade flows (See Chowdhury (1993), Arize and Shwiff (1998) and Sauer and Bohara (2001)).

5.5 Demand for Imports and Exports

The standard demand function for imports (exports) has been traditionally considered a function of domestic (foreign) economic activity and relative prices defined by the ratio of the import (export) price level to a measure of domestic price level in the importing country (See Salehi-Isfahani (1989), Duta and Ahmed (1999), and Hamori and Matsubayashi (2001)). Volume of imports is expected to change proportionately with the variation in domestic economic activity and negatively with the variation in relative prices measured by the ratio of import prices in domestic currency to domestic price level (See Carone (1996) and Cheelo (2003) for example). On the other hand, demand for exports has been estimated as a function of foreign income (a proxy for income of trade partners) and relative prices of exports measured by the ratio of domestic price of exports to the price of foreign competing goods (See Sawyer and Sprinkle 1996).

This specification, however, is based on the assumption that both demand functions are homogeneous in domestic and foreign prices, which means the coefficients of the domestic price level and the foreign price level are equal in magnitude but with different signs. Domestic and foreign price elasticities of different trade aggregates reported in Sawyer and Sprinkle (1996) show that this assumption could be untrue. The problem of homogeneity could be avoided by replacing the relative price in either relationship with its two components, the domestic price level and the foreign price level. Doing so, however, would induce multicollinearity into the estimated relationship because of the relatively high correlation between the domestic and the foreign prices. To investigate the role of exchange rate movements, import and export prices could also be decomposed into changes in the pure import and export prices and changes in the exchange rate (See Sawyer and Sprinkle 1996).

In addition to the standard demand functions, several other models have been developed linking the volume of imports and exports to variables other than or in addition to economic activity and relative prices. Some of these models linked the trade variables to foreign direct investment and real effective exchange rates (Goldberg and Klein 1997). Others used the long-run equilibrium between imports and exports (Arize 2002) and the gravity model, which emphasizes the impact of the distance, the existence of common language, and the common borders between trade partners (Dell'ariccia 1999). Furthermore, some models linked the trade variables to different domestic economic policies and to exchange and capital controls (Snell and Landesman (1989) and Anderson et al (1995)).

Similar to any other field of macroeconomics, there are some issues that one has to consider when estimating a relationship for the demand of imports and exports. The first issue in this regard is the choice of the variables to be included in the model. While the majority of empirical studies have used real gross domestic product (GDP) as a measure of domestic activity variable, some used the permanent income instead (Doroodian 1987). The lack of a unified price index for the domestically competing goods is another issue one might face. In practice, this has been an empirical issue and different price indexes have been used in different studies (See Sawyer and Sprinkle (1996), Marquez (1999) and Pattichis (1999) for example). The third important issue, which have a significant impact on the quality of the estimated relationship, is the issue of aggregation. In certain cases, the issue of aggregation lies behind the failure to estimated a reasonable relationship, and investigating a relationship at the disaggregated level, such as Pattichis (1999), is the only solution.

5.6 Demand for imports and exports in Jordan

As far as I am aware, there are not much empirical studies on the demand for imports and exports in Jordan. The only piece of research I came across with specific interest on Jordan, in this regard, is the work of Kandah (2000), who applied the Engle and Granger (1987) approach of cointegration technique to estimate demand and price functions for both aggregate imports and aggregate exports. Kandah (2000) estimated two quantitative relationships for each of exports and imports. In each case, the first relationship involved the volume of exports (imports), a measure of domestic price level, a measure of foreign price level, and a measure of a scale variable. In the second relationship the two measures of the domestic and foreign price levels were replaced by the relative price of exports (imports). As for the price equations, Kandah (2000) regressed the price of exports on the level of the exchange rate of the Jordan Dinar in terms of the US dollar, wages in US dollars measured by the employees compensations in the national accounts multiplied by the exchange rate of the Dinar as a proxy, and the price level of imported raw materials. Import prices were regressed on the level of exchange rate and Tariffs.

The work of Kandah (2000) suffers from a number of caveats, which make any inferences based on the estimation results subject to a great deal of disagreement. First, one could argue about using the Engle and Granger (1987) procedure to test for cointegration because the models contained more than two variables. In such a case, the rejection of the null hypothesis of no cointegration does not mean that the cointegrating vector is unique and more than one cointegrating vector could exist (Harris 1995). Second, the sample period is relatively short, where only twenty three annual observations are used in the estimation, which leaves the estimated parameters subject to problems associated with finite sample properties. Third, at the specification level, the import price relationship ignored the main component of import prices, namely the foreign price and the export price relationship suffers from multicollinearity because of the existence of the exchange rate in two explanatory variables, namely the exchange rate itself and the price of imported raw materials. These caveats, in addition to the wrong signs of the coefficients of some explanatory variables, make any inferences based on the estimated relationships unreliable.

Within the framework of a multi-country study involving fifty countries, Arize (2002) investigated the long-run convergence between imports and exports in Jordan. Arize (2002) used quarterly data on exports and imports over the period 1973:2 to 1998:1 and applied two tests for cointegration; namely the Johansen (1995) and the Stock and Watson (1988) techniques. According to the Johansen test, Arize (2000) found that Jordan was among the 15 countries in which the volume of imports and exports are not cointegrated. However, the

Stock and Watson test showed that exports and imports in Jordan converge to a long-run equilibrium relationship.

5.6.1 The Model

The intention here is to investigate the existence of a stable long-run relationship featuring the demand for each of exports and imports in Jordan. The aim is to assess the significance of the price elasticities of imports and exports. Assuming that changes in the exchange rate are completely reflected in the relative prices of exports and imports, the existence of a long-run relationship of either imports or exports, enables us to evaluate the impact that such changes might have on the volume of exports and imports and, consequently on the trade balance.

Following the majority of empirical studies in this regard, and using the cointegration and equilibrium-correction models[1], the standard demand functions for imports and exports will be explored. In either relationship, the volume of exports (imports) depends on a scale variable and relative price. The scale variable would be domestic income (real GDP) in the case of imports and foreign income (real GDP for main trade partners) in the case of exports. The relative price for imports will be represented by the ratio of import prices in terms of Jordan Dinar measured by the unit price index of imports to the domestic price level measured by the consumer price index, while that for exports will be represented by the ratio of domestic export prices in Jordan Dinar measured by the unit price index of exports to the foreign price level, which is a composite weighted index constructed for the main trade partners. To construct the foreign price index, we used the producer price index in the relevant country when available; otherwise we used the consumer price index. The index is weighted by the country's share of Jordan's total external trade (exports + imports).

[1] For technical discussion of cointegration and equilibrium-correction models, see Chapter 3 above.

Similar to the procedure followed in Chapter 3, we use the Johansen technique of cointegration analysis and equilibrium-correction model to explore the existence of a long-run demand for each of exports and imports in Jordan. Our long-run demand for either the volume of exports or imports could be written in the form:

(5.1) $x_t = \beta_{0x} + \beta_{1x} fy_t + \beta_{2x} rpx_t + \varepsilon_t$ for the volume of exports and

(5.1a) $m_t = \beta_{0m} + \beta_{1m} y_t + \beta_{2m} rpm_t + \varepsilon_t$ for the volume of imports

In equation 5.1, all the variables are in the log form and *x* represents the volume index of total exports, *fy* represents the income variable for Jordan's trade partners measured by the sum of their real GDP in US dollars at the 1995 prices and the 1995 exchange rate of national currencies in terms of the US dollars, and *rpx* represents the relative price of exports measured by the ratio of domestic export unit price index to the foreign price index calculated to the main trade partners of Jordan. Since real GDP of the main trade partners is determined completely by factors beyond the scope of the Jordanian economy, it will be entered in the system as exogenous.

In equation 5.1a, *m* represents the volume index of total imports, *y* represents real GDP, and *rpm* represents the relative price of imports measured by the ratio of import unit price index in Jordan dinar to the domestic price index represented by the consumer price index. The *βs* are the parameters to be estimated and the error term ε_t is normally distributed with a zero average and a finite variance. From theories of demand for exports and imports, both $ß_{1x}$ and β_{1m} are expected to be positive; while both β_{2x} and β_{2m} are expected to be negative (See Carone (1996), Sawyer and Sprinkle (1996), and Marquez (1999) for example).

Once the null hypothesis of no cointegration is rejected and a cointegrating vector is identified as a long-run relationship for the demand for exports and imports, we will proceed to estimating dynamic equations featuring the equilibrium-correction models for both exports and imports. By re-parameterizing equations 5.1 and 5.1a, the formal representations of the equilibrium-correction models would be:

(5.2) $\Delta x_t = \Pi x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \sum_{i=1}^{k} \Gamma_i fy_{t-i} + \sum_{i=1}^{k} \Gamma_i rpx_{t-i} + \varepsilon_t$ for the dynamics of exports and

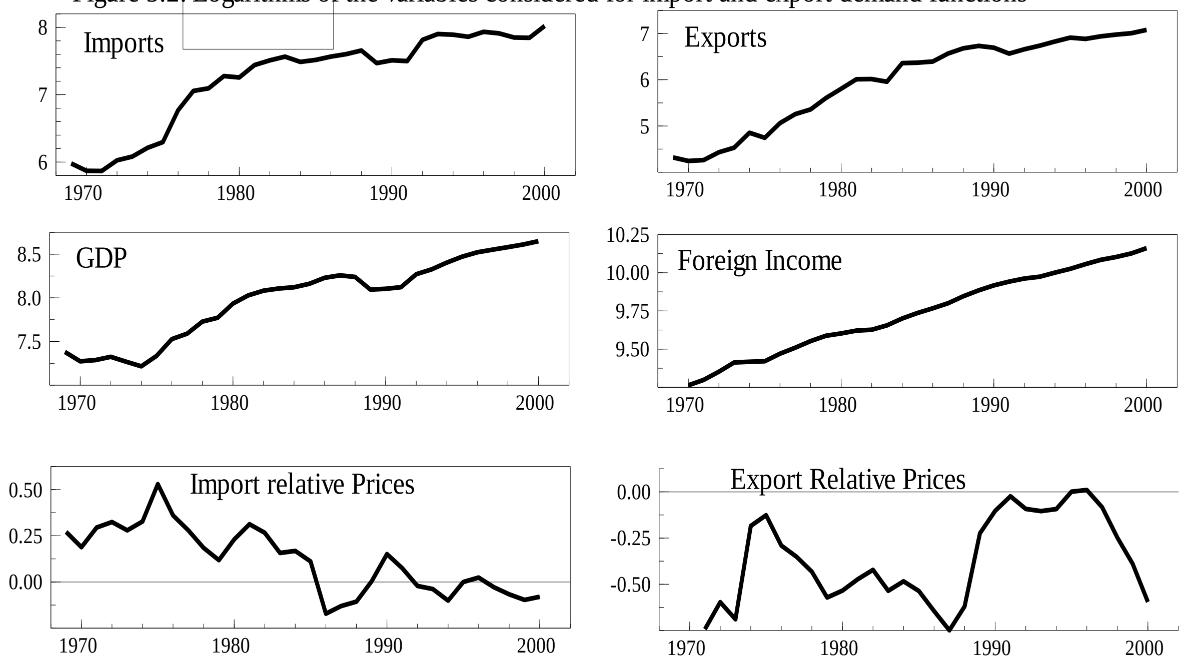
(5.2a) $\Delta m_t = \Pi m_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta m_{t-i} + \sum_{i=1}^{k} \Gamma_i y_{t-i} + \sum_{i=1}^{k} \Gamma_i rpm_{t-i} + \varepsilon_t$ for the dynamics of imports

5.6.2 Data choice and description

For the purpose of this chapter, a set of annual data covering the period 1969 through 2004 is used. The choice of this period and the use of annual data have been bounded by the lack of data on volume and price indexes for the trade aggregates before 1969 and by the non-existence of quarterly data on both the trade aggregates and real GDP for most of the sample period. In the case exports, the sample period starts at 1971 rather than 1969 because the constructed foreign price index starts only at that year. As shown in the specification of equations 5.1 and 5.2, the variables used in the estimation of the demand for imports and exports are the volume index of exports and imports, the relative prices of imports and exports, real GDP, and the real GDP of the main trade partners of Jordan. All the variables are transformed into logarithms.

For real GDP, we used the same series used for the purpose of Chapter three earlier, which is the nominal GDP deflated by the consumer price index. The volume indexes and the unit price indexes of exports and imports were drawn from the (CBJ 2004); *Yearly Statistical Series (1964-2003), a Special Issue on the Occasion of the Fortieth Anniversary of the Establishment of the CBJ,* and updated from the (CBJ 2005); *Monthly Statistical Bulletin* August 2005. Because of successive changes in the base years, the four indexes were spliced to be consistent to one base year (1995). As for the foreign income and price variables, we constructed the real GDP and a composite weighted index for the price level of the main trade partners of Jordan; the group of 18 countries used to construct the nominal and real effective exchange rate indexes. The former variable consists of the sum of real GDP of the individual countries at the 1995 prices and exchange rates of national currencies in terms of the US dollars. The real GDP of each individual country was calculated based on its volume index of GDP, drawn from the IMF database, and its nominal GDP in 1995. To construct the latter variable, we used the producer price index for individual countries if available; otherwise we used the consumer price index. The composite index is weighted by the relative share of each country of totals Jordan's trade with this group of countries. Figure 5.2 shows the time paths of the six variables used for the estimation of export and import demand functions[1].

Figure 5.2: Logarithms of the variables considered for import and export demand functions



5.7 Empirical results

5.7.1 Unit root tests

Three tests were performed to determine the order of integration of the individual variables, namely the ADF test, the Phillips-Perron test, and the Perron test with a trend break.

[1] For further details on the countries included in this index and the weights used, see Chapter 3 above.

Table 5.4 shows the results of both the ADF and the Phillips-Perron test for unit roots for the variables in levels. Both tests reveal that the null hypothesis of a unit root could not be rejected at either the 5% or the 1% level of significance regardless of the deterministic terms included in the model. Accordingly, and binding on the test results for the first differences, it is safe to conclude that none of the individual variables is stationary.

Table 5.4: Unit Root Test for External Trade Variables (in Levels)

	ADF Test		Phillips-Perron Test	
	C	C and T	C	C and T
M	-1.435	-1.411	-1.387	-1.430
Rpm	-1.651	-2.922	-1.657	-3.315
Y	-1.629	-2.424	-0.550	-1.716
X	-0.762	-1.576	-0.849	-1.582
Rpx	-1.760	-1.650	-2.012	-2.191
Fy	-1.287	-3.058	-1.956	-2.149

Note: "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% significance level respectively.

When performing the two tests at the first difference level, both tests revealed identical results also (Table 5.5). In both tests, the null hypothesis of a unit root in the first difference is rejected at the 1% level of significance for all the variables if the constant is included in the model. If the constant excluded from the model, both tests revealed that the null hypothesis of a unit root is rejected also at the 1% level of significance for all the variables except the foreign income variable, where the null hypothesis could not be rejected at either level of significance.

Table 5.5: Unit Root Test for External Trade Variables (in First Differences)

Variables	ADF Test		Phillips-Perron Test	
	None	C	None	C
ΔM	-3.717**	-4.639**	-3.717**	-4.791**
ΔRpimp	-5130**	-5.055**	-5.130**	-5.063**
ΔY	-3.299**	-4.825**	-3.444**	-4.831**
ΔX	-4.254**	-6.744**	-4.254**	-6.718**
ΔrPEXP	-4.209**	-4.164**	-4.209**	-4.208**
ΔFy	-1.618	-4.104**	-1.300	-3.879**

"*" and "**" means the rejection of the null hypothesis at the 5% and the 1% significance level respectively.

However, Figure 5.3 shows that the average change in real foreign GDP is well above zero, which indicates that the relevant result is that of the model involving the constant, and it is safe to conclude that all the variable are integrated of the order one I(1). Nevertheless, and to ensure that the acceptance of the unit root hypothesis in the case of the level of variables was not influenced by the existence of a trend break, the Perron test for unit root with a trend break was also performed.

Figure 5.3: First differences of the variables considered for the demand for imports and exports (Logarithms)

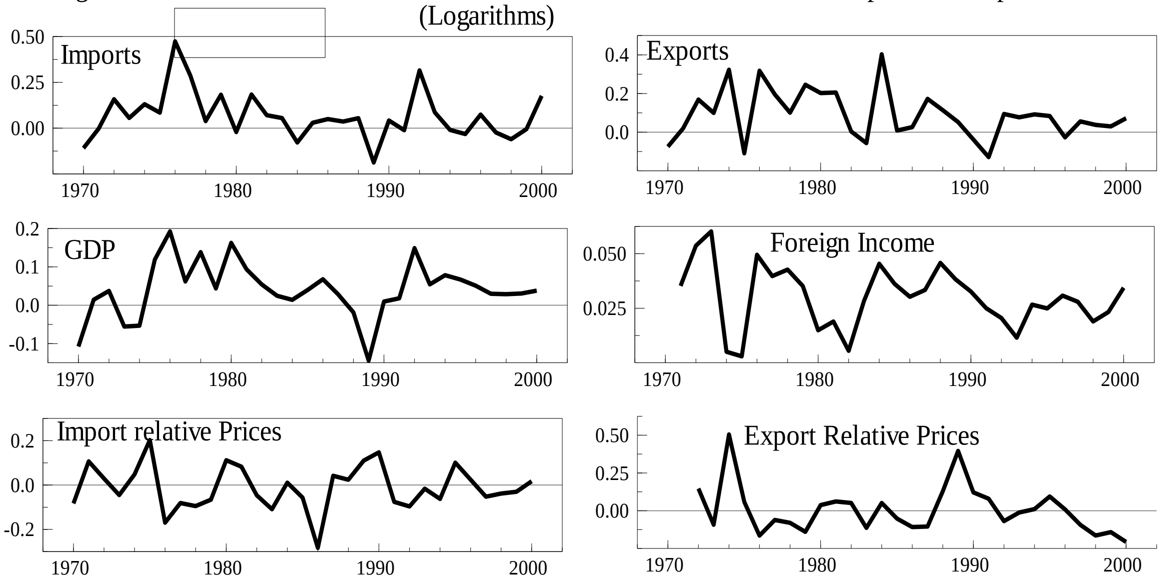


Table 5.6 shows the test results for the three models (IO1), (IO2), and (AO) using the statistical methods UR and STUD[1]. Results of the method STUDABS are not reported because they are identical to those of the method STUD. Except for the relative price of exports, the test results reveal that the null hypothesis of a unit root could not be rejected at the 5% level of significance regardless of the model or the statistical method used in the test. As for the relative price of exports, the null hypothesis of a unit root was rejected at the 1% level of significance when the models (IO1) and (IO2) were used along with the

[1] For further details and technical discussion on the Perron test with a trend break, the three models, and the different statistical methods, see Chapter 3 above.

statistical method UR, and rejected at the 5% level of significance when the model (IO2) was used along with the statistical method STUD. However, when the model AO was used, the null hypothesis of a unit root could not be rejected at either the 5% or the 1% level of significance regardless of the statistical method used.

Table 5.6: Results of the Perron Unit Root Test with a Trend-Break

Variable	Method UR			Method STUD		
	Test Statistic	Break Time	Number of Lags (k)	Test Statistic	Break Time	Number of Lags (k)
Model (IO1)						
M	-5.07	1974	0	-5.07	1974	0
Rpm	-4.19	1984	1	2.31	1995	10
Y	-5.01	1977	5	-5.01	1977	5
X	-4.23	1989	10	-4.23	1989	10
Rpx	-6.56**	1988	10	-4.59	1987	10
Fy	-4.84	1999	7	3.42	1983	10
95% C.V	*-5.23*			*-5.18*		
99% C.V	*-5.92*			*-5.85*		
Model (IO2)						
M	-5.18	1974	0	-3.38	1977	0
Rpm	-5.48	1984	3	-5.14	1989	10
Y	-5.02	1977	6	-2.92	1981	0
X	-4.02	1981	10	2.41	1991	6
Rpx	-6.34**	1988	10	-5.67*	1989	10
Fy	-4.89	1988	1	0.24	1993	10
95% C.V	*-5.59*			*-5.33*		
99% C.V	*-6.32*			*-6.07*		
Model AO						
M	-3.71	1981	4	-3.65	1980	4
Rpm	-3.11	1999	10	-2.27	1988	10
Y	-3.88	1980	5	-3.42	1982	5
X	-3.89	1978	8	-2.70	1985	8
Rpx	-4.45	1993	10	-2.56	1997	10
Fy	-4.34	2000	7	-3.03	1994	5
95% C.V	*-4.83*			*-4.67*		
99% C.V	*-5.45*			*-5.38*		

"*" and "**" mean rejection of the null hypothesis of a unit root at the 5% and 1% level of significance respectively.

As discussed earlier in Chapter three, the Perron test for unit root with a trend break is sensitive to the nature of the break; whether it affects the level of the trend, the slope of the trend, or both. This makes the test results of each single model only relevant if the type of the break in the trend of the variable under consideration conforms to the underlying assumption behind that model.

Looking back at the time path of the individual variables shown in Figure 5.2 above, one can notice that although more than one trend break existed, the major break, which is associated with the financial crisis in the late 1980s, have affected both the level and the slope of the trend. This means that the relevant model for export relative price is the model AO, which assumes the trend break has an impact on both the level and the slope of the trend (See Perron 1989 and 1997). Therefore, we can conclude that the Perron test for unit roots with a trend break could not reject the null hypothesis of a unit root in any of the variables under consideration and, thus, it complements the test results of the ADF and Phillips-Perron tests confirming that all the variables are I(1).

5.7.2 Cointegration Analysis

Since our data set is annual and the number of observations is limited due to the relatively short sample period, cointegration analysis in both systems was performed by setting the lag length at one lag up to three lags. The system involving the demand for exports consists of two endogenous variables, namely the volume of exports and the relative price of exports and one exogenous variable, namely real GDP of trade partners. On the other hand, the system involving the demand for imports consists of three endogenous variables, namely import volume, real GDP, and the relative price of imports, with the sample period covering the. The sample period used for the analysis covers the period 1971 through 2003 in the case of exports, while it covers the period 1969 through 2004 in the case of imports. The relatively shorter sample period in the case of exports is due to the limited available data for the constructed series for the real GDP of trade partners.

As mentioned earlier, the intention here is to investigate the existence of a stable long-run relationship featuring the demand for each of exports and imports in Jordan, using the model specified by equations 5.1 and 5.1a and applying the Johansen maximum likelihood procedure to determine the number of cointegrating vectors. Following the same procedure we have followed in cointegration analysis for the demand for money, the cointegration rank will be determined based on the trace statistic only and the resultant test trace statistic will be compared to the adjusted critical values for the small sample size, calculated from applying the Monte Carlo simulation done by Santoso (2001) rather than to the standard critical values reported in the test results.

Table 5.7 shows the Johansen cointegration test results for the system involving the demand for exports with and without the time trend being restricted to the cointegration space. With all the roots of the companion matrix laying within the unit circle, all the tested unrestricted VAR systems proved to be mathematically stable regardless of the lag length setting, which indicates that it is safe to proceed in exploring the existence of a cointegrating vector and the viability of the long-run relationship featuring the demand for exports if a cointegrating vector exists.

Table 5.7: Johansen cointegration test results for the volume of exports

Number of Lags (Observations)	Rank	No trend		Trend	
		Trace Statistic(1)	95% Critical Value(2)	Trace Statistic(1)	95% Critical Value(2)
1 Lag (32)	0	18.695	19.000050	23.464	27.288701
	1	4.5166	5.2271966	8.6989	8.9638712
2 Lags (31)	0	23.686*	18.950185	28.392*	27.352328
	1	2.3221	5.2473591	7.0274	9.0437724
3 Lags (30)	0	23.290*	18.899720	31.423*	27.268890
	1	2.5514	5.1781991	10.135*	9.0800929

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.

(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

When the time trend is not restricted to the cointegration space, the test results indicate the existence of one cointegrating vector at the 5% level of significance if the lag length is set either at two or three lags. If the time trend is restricted to the system, the test results indicate the existence of one cointegrating vector at the 5% level of significance if the lag length is set at two lags. Since only two endogenous variables are included in the system, the resulting one cointegrating vector is unique and, bending on identification, could represent the long-run relationship featuring the demand for exports (See Harris 1995).

In the case of imports, Table 5.8 bellow shows that when the time trend is restricted to the cointegration space, the null hypothesis of no cointegration could not be rejected regardless of the lag length setting. When the time trend is dropped from the model, the null hypothesis of no cointegration could not be rejected also if the lag length is set at either two or three lags. However, if the lag length is set at one lag, the null hypothesis of no cointegration is rejected at the 5% level of significance, while the null hypotheses of one or two cointegrating vectors could not be rejected. Therefore it safe to proceed in normalizing one of the two cointegrating vector for the volume of imports to check for the existence of a long-run relationship featuring the demand for imports in Jordan.

Table 5.8: Johansen cointegration test results for the volume of imports

Number of Lags (Observations)	Rank	No trend		Trend	
		Trace Statistic(1)	95% Critical Value(2)	Trace Statistic(1)	95% Critical Value(2)
1 Lag (35)	0	35.948*	33.556750	44.508	45.078417
	1	13.686	13.789963	19.481	21.105469
	2	0.64793	4.2768211	3.9619	7.8016280
2 Lags (34)	0	28.283	33.426351	40.421	45.096680
	1	14.775*	13.818571	20.681	20.867018
	2	5.7423*	4.2905795	8.7712*	7.7459513
3 Lags (33)	0	24.600	33.457771	38.465	45.272041
	1	11.738	13.719028	20.118	21.067964
	2	1.8069	4.2527711	8.8762*	7.7105894

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.

(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

5.7.2.1 Long-run relationship for exports

As shown in Table 5.7 above, Johansen test for cointegration rank performed on the system involving the demand for export relationship revealed that one cointegrating vector exists, which indicates the possibility of the existence of a long-run relationship between the volume index of exports (*x*), real foreign GDP (*fy*), and the relative price of exports (*rpx*). Nevertheless, the test results are not conclusive regarding the specification of the model. In other words, the test results do not give clear evidence regarding the number of lags to be included or whether to or not to include the time trend into the cointegrating space. As explained by Harris 1995, the decision on which deterministic factors to be included in the model is not an easy task and could not be decided on a priory. Therefore, we will apply the general to specific approach by including the time trend (T) in the model and leave it to the restrictions imposed on the estimated coefficients to check their statistical significance and, consequently, to determine whether to keep the time trend in the final model or not.

Normalizing for the volume of exports, setting the lag length at two lags, and restricting for the time trend in the cointegrating space, Table 5.9 shows the resulted cointegrating vector for such a long-run relationship along with the test trace statistic and the 95% critical value. All the roots of the companion matrix lie inside the unit circle, which ensures the mathematical stability of the system. This means that following any disturbances to it, the VAR model of this system converges to its equilibrium in the long-run. The positive coefficient of foreign income variable and the negative one of the export relative price conform to the economic theory behind the demand for exports. The sign of the coefficient of the time trend could be, in theory, either way. Therefore, we can conclude that all the coefficients have the right sign and it is feasible to proceed to impose specific restrictions on this relationship to check whether it can be rightly identified as demand for exports relationship.

Table 5.9: Johansen cointegration test results for the volume of exports

	Unrestricted Coefficients		Rank	Trace Statistic(1)	95% Critical Value(2)
Variables	β	α			
x	1.000	-0.10379	0	28.392*	27.352
rpx	1.026	-0.058204	1	7.027	9.044
fy	-0.682				
T	-0.003				

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.
(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

As shown in Table 5.10, the test results of the restrictions are not satisfactory enough to identify this relationship as a long-run demand for exports. With the likelihood ratio amounting to 1.311 with a probability ratio of 0.252, the equation passed the test of normalizing for the volume of exports and the weak exogeneity of the relative prices, which indicates that it enters on the right-hand side of the equation only. Nevertheless, once these two restrictions are imposed, the sign of the coefficient of the foreign income variable changes from positive to negative and the standard errors of the estimated coefficients of all the variables in the right-hand side of the equation became considerably high, which indicates the misspecification of the model and the statistical insignificance of these variables in explaining the behaviour of Jordan exports.

Table 5.10: Restricted cointegrating vector of the long-run demand for exports (Time Trend and two Lags)

Variables	β Coefficients		α Coefficients	
	Value	Standard error	Value	Standard error
x	1.000	0.000	-0.112	0.023
rpx	0.661	0.514	0.000	0.000
fy	2.321	6.009		
T	-0.105	0.181		
LR test for restrictions: χ^2 (2) = 1.3114 [0.2521]				

When the time trend is dropped from the model, the test results of imposing restrictions showed that statistical properties of the estimated cointegrating vector improved slightly but remained unsatisfactory to identify the relationship as a long-run demand for exports relationship[1]. On the one hand, and the regardless of the lag length setting at two or

[1]The test results are not reported but are available from the author on request.

three lags, the estimated coefficients maintained the right signs after normalizing for the volume exports and imposing the weak exogeneity of the relative prices. On the other hand, the estimated coefficient of the relative prices got a relatively high standard error, which indicates it is not statistically significant in determining the volume of exports. Furthermore, when restricting the coefficient of the relative prices to zero, that of foreign income turned to be statistically not significant. Given such inconclusive test results, one could not reliantly identify the above mentioned cointegrating vector as a demand for export relationship.

Given the conformity of the signs of the coefficients in the original cointegration analysis to the economic theory behind the demand for exports, the lack of satisfactory identification of the above relationship could be attributed to misspecification of the deterministic factors included in the model. In specific, this could be attributed to the absence of the constant term, which is usually needed in economic modelling to account for the units of measurement of the variables included in the model (See Harris 1995).

When the constant term is restricted to the cointegrating space, cointegration analysis revealed that one cointegrating vector exists if the lag length is set at one lag and the time trend is excluded from the model. Table 5.11 shows the cointegration analysis results of the system consists of the volume of exports (*x*) and the relative prices of exports (*rpx*) as endogenous variables and the proxy for the GDP of main trade partners (*fy*) as exogenous variable, while the constant term is restricted to the cointegration space and the lag length is set at one lag[1].

Table 5.11: Johansen cointegration test results for the volume of exports

	Unrestricted Coefficients		Rank	Trace	95% Critical
Variables	β	α		Statistic(1)	Value(2)
x	1.000	-0.18298	0	36.146**	21.400
rpx	0.996	-0.00879	1	5.4858	6.536
fy	-2.443				
C	19.839				

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.
(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

[1] The non-satisfactory results of other specifications are not reported but available from the author on request.

The null hypothesis of no cointegration is rejected at the 1% level of significance, while that of the existence of one cointegrating vector could not be rejected at either the 1% or the 5% level of significance. The signs of the estimated coefficients conform to the economic theory behind the demand for exports; where the volume of exports is expected to be positively related to the income of trade partners and negatively related to the relative prices of exports. The adjustment factor coefficient related to the vector of the volume of exports has also the right negative sign, which encourages proceeding to the identification process to check whether this vector could be identified as a long-run relationship featuring the demand for exports in Jordan. Table 5.12 shows the test results of the restrictions imposed on the resulted cointegrating vector normalized for the volume of exports.

Table 5.12: Structural restrictions on the cointegrating vector detected for the system *x*,*rpx*,and *fy*

Restrictions imposed on the coefficients(1)	Statistic $\chi^2(n)$(2)	Probability(3)
β_0 =1; and α_1=0 (weak exogeneity of the relative prices variable)	0.036	[0.8502]
β_0 =1; α_1=0; and β_1=0 (significance of the relative prices variable)	6.999	[0.0302]*
β_0 =1; α_1=0; and β_2=0 (significance of the trade partners' income)	4.124	[0.1272]
β_0 =1; α_1=0; β_1=0; and β_2=0 (joint significance of both variables)	9.572	[0.0226]*
β_0 =1; α_1=0; β_1=0; and β_3=0 (joint significance of relative prices and the constant term)	9.169	[0.0271]*
β_0 =1; α_1=0; and β_1= -1 (homogeneity of the demand function in domestic and foreign prices)	0.037	[0.9815]

(1): β_0, β_1, β_2, and β_3 are the coefficients of the volume of exports variable, the relative prices variable, the trade partners' income variable, and the constant term respectively, while α_1 is the adjustment factor related to the cointegrating relationship normalized for the relative prices variable.
(2): "n" refers to the number of restrictions imposed other than the first one, which meant to normalize the vector for the demand for exports relationship.
(3): "*" and "**" refers to the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.

The null hypothesis of weak exogeneity of the relative prices of exports could not be rejected. This means that this variable enters only the right-hand side of the relationship. With the standard errors of all the coefficients, including the constant term, are relatively low compared to the magnitude of the coefficients, all the coefficients are expected to be statistically significant. Restricting the coefficients of the relative prices and foreign income jointly to zero, the null hypothesis is rejected at the 5% level of significance, which suggests that at least one of the two variables is statistically significant in determining the volume of exports in Jordan. When tested individually, the null hypothesis that the coefficient of the relative prices dose not significantly differ from zero is rejected at the 5% level of significance, while that of the coefficient of foreign income could not be rejected at either the 1% or the 5% level of significance. However, the magnitude of the coefficient of foreign income is relatively high to the extent that it is hard to accept that it is close to zero. Furthermore, with the test statistic, which follows a χ^2 distribution, amounted to 4.124 with a probability of 0.127, the failure to reject this hypothesis is relatively marginal and we can conclude it is almost significant. Taking the theoretical support for the importance of foreign income in explaining the behaviour of the volume of exports, into consideration, and relying on the results of a relatively wide range of empirical studies, which found the estimated parameter of foreign income in the demand function for exports statistically significant (See Table 4 in Sawyer and Sprinkle 1996), one could accept including it in the long-run model, especially it is included as an exogenous variable.

Furthermore, the null hypothesis that the coefficient of relative price equals (-1) could not be rejected, where the test statistic amounted only to 0.037 with a probability of 0.982. This suggests that the implied assumption of the homogeneity of the volume of exports in the domestic and foreign prices is not far from being accurate. In other words, the price elasticity of the volume of exports in Jordan with respect to domestic price level and foreign prices has the same magnitude but with different sign.

Therefore, the reduced form of this relationship could be identified as a long-run demand for exports in Jordan, according to which, the volume of exports is positively related to the real GDP of trade partners and negatively related to relative price of exports measured by the ratio of domestic export prices to the price level in prevailing in the main Jordanian export markets. The formal representation of this function is

(5.3) $x_t = -20.033 + 2.463 fy_t - 1.0rpx$
(3.211) (0.328) (0.0)

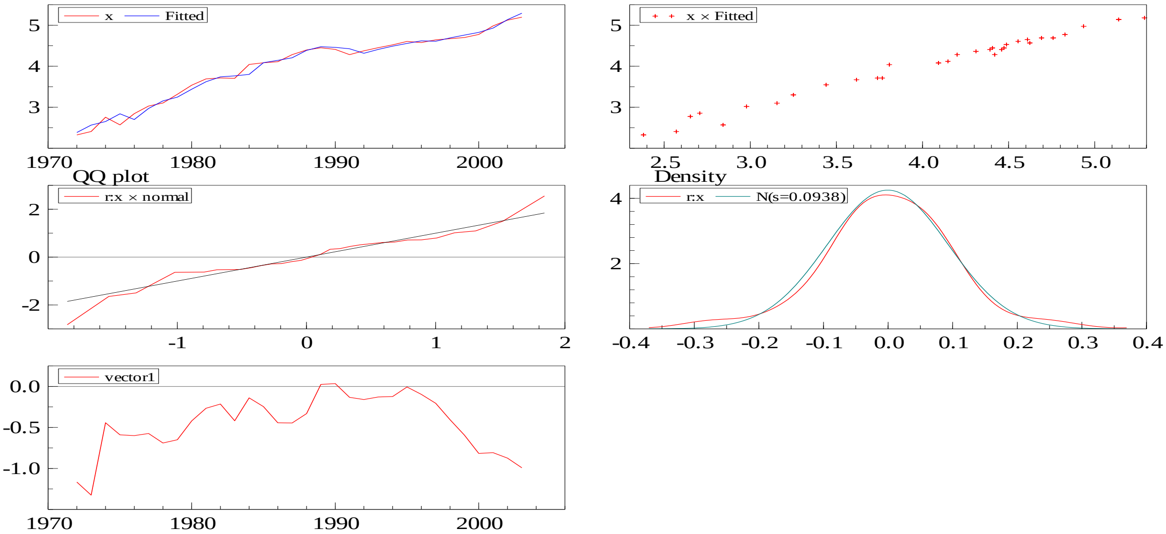
In terms of magnitude, both the foreign income elasticity and the price elasticity of the demand for exports are relatively high and come in line with the findings of several other empirical studies. In their surveys on the demand for exports and imports, Sawyer (1997) and Sawyer and Sprinkle (1996) reported both the foreign income and the relative price elasticities of the demand for exports in Japan and the United States. Although the range between the lowest and the highest elasticity was quite high in both cases, the estimated elasticities of several studies covered in the two surveys were relatively close to our findings. Similarly, Marquez (1990 and 1999) and Senhadji and Montenegro (1999) reported also several elasticities in the same range.

Diagnostic tests show that the residuals of this relationship do not suffer from either autocorrelation or heteroscedasticity. However, the null hypothesis that these residuals are normally distributed is rejected at the 1% level of significance. However, the lack of normality is not expected to cause significant problems because the rejection is mainly due to excess kurtosis rather than the existence of skewness as one can see in the fourth panel of Figure 5.4 below (See Johansen and Juselius 1992). The following are the vector's diagnostic test statistics along with their probability in square brackets.

Vector Portmanteau(4): 18.4363
Vector Normality test: Chi^2(4) = 22.384 [0.0002]**
Vector hetero test: F(18,54) = 0.85120 [0.6350]
Vector hetero-X test: F(27,47) = 0.86097 [0.6559]

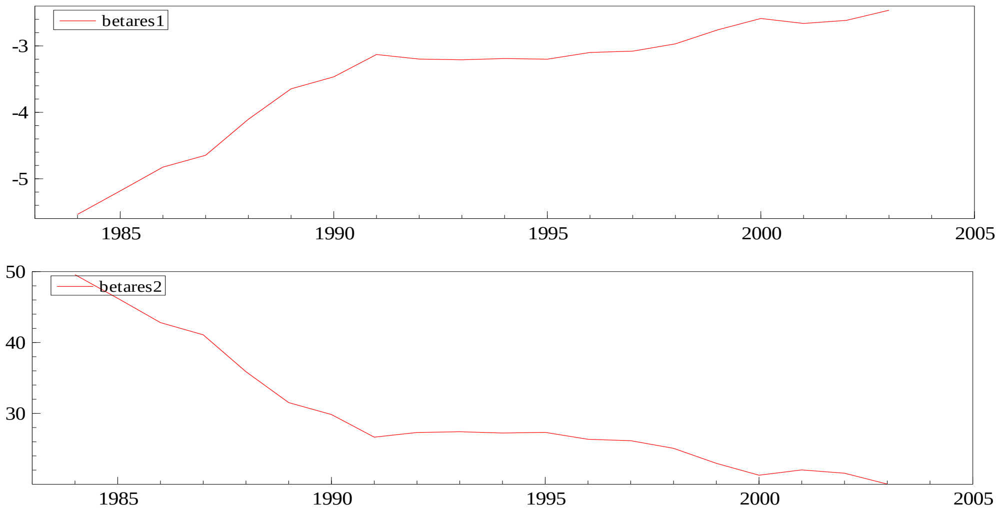
Graphical analysis of this restricted demand for exports relationship shows that the behaviour of this relationship is relatively satisfactory. As shown in Figure 5.4, the time paths of the actual and fitted values of the volume of exports are relatively close to each other, the cross plot of the actual and fitted is satisfactory, the residual QQ plot against the standard normal distribution is also acceptable. The fourth panel of Figure 5.4 shows that the rejection of the null hypothesis that the residuals are normally distributed in the above diagnostic tests is in fact due to the excess kurtosis rather than skewness. The fifth panel of Figure 5.4, however, exhibits some signs of relative instability, featured by the slightly upward trend in residuals and the quite significant shifts in the level of residuals. Taking into consideration that the shifts in the level of residuals has been associated with several external shocks that took place during the period of the study (the oil price shock in early the 1970s, the financial crisis in late the 1980s, the first Gulf war in 1990, and the structural reform process that Jordan implemented), these apparent symptoms of instability could be tolerated and explained by those events rather than by model misspecification or instability of the estimated relationship itself.

Figure 5.4: Graphical analysis for the demand for exports restricted cointegrating rela



The same could be concluded from the recursive test for parameters' constancy depicted by Figure 5.5. The paths of residuals of the two, recursively estimated, parameters show identical pattern although different direction. In both cases, the residuals trended steeply during the second half of the 1980s until 1991; i.e during the period of the above-mentioned external shocks. Since 1991, the residuals of both recursively estimated parameter were almost stable, which suggests that had these shocks not taken place the change in the residuals would not be significant.

Figure 5.5: Recursive graphics for the parameters constancy of the long-run demand for exports



5.7.2.2 The short-run dynamics of the demand for exports in Jordan.

Given the plausible long-run relationship of the demand for exports in equation 5.3 above, it is possible now to estimate the short-run dynamics of such a relationship. At any point of time, the disequilibrium between the actual volume of exports and the expected volume from the long-run relationship is defined by ECM*x*. Formally, it is represented by the equation:

(5.4) $$ECMx = x + 20.033 - 2.463\,fy + 1.0rpx$$

Incorporating the one period lag of this definition into equation 5.2 featuring the vector equilibrium-correction model (VECM) for the demand for the volume of exports, and using the OLS method, the following equation is the parsimonious short-run dynamic equation (i.e after dropping the redundant lagged terms) with numbers in parenthesis are the standard errors.

(5.5) $$\underset{}{\Delta x_t} = \underset{(0.022)}{-0.005} - \underset{(0.044)}{0.217}EMCx_{t-1} - \underset{(0.079)}{0.195}\Delta\Delta rpx_{t-1} + \underset{(0.856)}{1.878}\Delta\Delta fy_{t-1}$$

$R^2 = 0.67$, Sigma = 0.073, F(3,26) = 17.48**, DW = 1.9, and Log-Likelihood = 38.12

The interpretation of this dynamic relationship is that in the short-run, the variation of Jordanian exports in any period of time is positively related to the one period lagged change in economic growth in the main trade partner countries, and negatively related to the one period lagged change in the change of relative prices, as well as to the disequilibrium exports during the previous period. The absence of the simultaneous changes in or acceleration of the changes in the relative prices and foreign income from the right hand side of this relationship could be explained by the time lag between the time of contracting on exports and the time of delivering exports, which is familiar in the case of external trade.

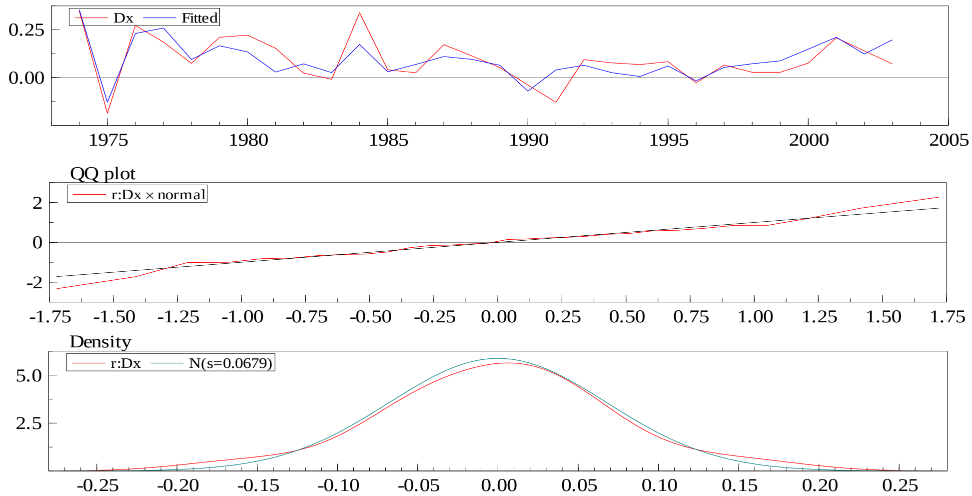
In terms of magnitude, the highest impact on the variation of the volume of exports during any period of time comes from the change in the economic growth rate in trade partner countries, with an elasticity magnitude close to 2. This and the relatively low elasticity with respect to the acceleration of the change in relative prices could be explained by the high ratio of raw materials and agricultural products of total Jordanian exports, where exports of raw material and intermediate goods are expected to be sensitive to the path of economic growth in the partner countries and exports of agricultural products are expected to be relatively price inelastic. The speed of adjustment for any disequilibrium is reasonable with almost 22% of any deviation from the long-run equilibrium is corrected during the next period.

Considering the statistical properties of this short-run relationship, it looks plausible. All the coefficients have the right sign as expected from the theory behind the demand for exports and the rate of determination is quite high for a short run relationship. Except for the coefficient of the constant term, all the estimated parameters are statistically significant; where the coefficient of the error correction term is statistically significant at the 1% level of significance and those of the change in economic growth in the trade partners countries has and the change in the relative price changes are statistically significant at the 5% level of significance. The relationship passed all the diagnostic tests. None of the null hypotheses of no autocorrelation, the normally distributed residuals, no heteroscedasticity, or no misspecification could be rejected at either the 5% or the 1% level of significance. The following are the test statistics and their probability ratios for these tests.

AR 1-2 test: F(2,24) = 0.38510 [0.6845]
ARCH 1-1 test: F(1,24) = 0.61450 [0.4408]
Normality test: Chi^2(2) = 3.2158 [0.2003]
hetero test: F(6,19) = 0.35164 [0.9001]
hetero-X test: F(9,16) = 0.85931 [0.5771]
RESET test: F(1,25) = 0.36948 [0.5488]

Graphical analysis shows that the short-run dynamic relationship for the volume of exports performs relatively well. With the only two clear outliers in 1984 and 1991, the first graph of Figure 5.6 shows that the actual and fitted values of the change in the volume of exports are relatively close. The QQ plot against the normal distribution looks reasonable with residuals so close to the criterion line and the residuals are normally distributed.

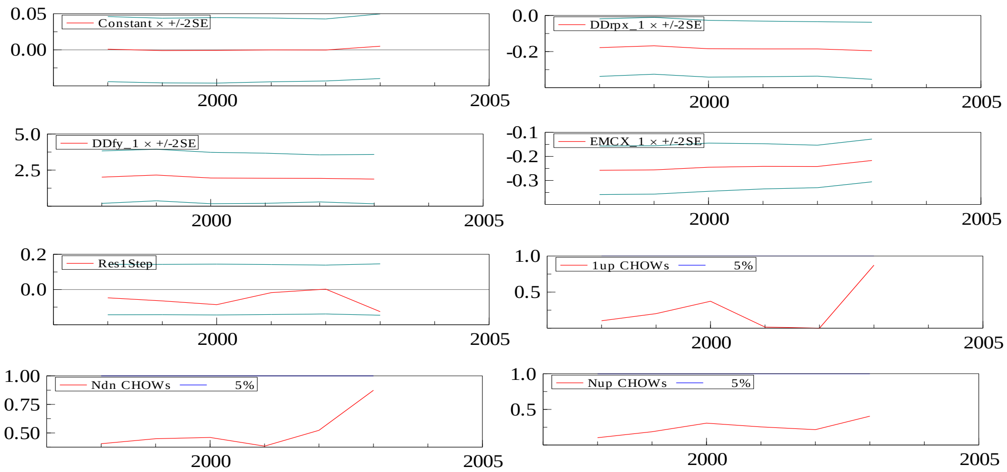
Figure 5.6: Graphical analysis for the short run dynamics of the demand for exports



Furthermore, recursive analysis shows also that this short-run dynamics relationship performs relatively well. The first four graphs of Figure 5.7 shows that all estimated coefficients have been bounded by their mean +/- 2σ interval of confidence. With clearly stable variances, this gives evidence of the parameters' constancy over the sample period. This is supported by the One-step Residual test depicted by the fifth graph, which shows all the residuals laying within the 95% confidence interval. The last three graphs of Figure 5.7 show that none of the test statistics of the

One-step Chow test, the Break-point Chow test, or the Forecast Chow test exceeds its critical line, giving strong evidence on the stability of the estimated relationship.

Figure 5.7: Recursive analysis for the short run dynamics of the demand for exports



5.7.2.3 Long-run relationship for imports

As shown in Table 5.8 above, at least one cointegrating vector exists for the system involving the volume of imports, real GDP, and the relative prices of imports if no time trend included and the lag length is set at one lag. Nevertheless, when normalizing one of the two cointegrating vectors for the volume of imports, the resultant vector could not satisfactorily be identified as a long-run demand for imports. Although the estimated parameters have the right expected signs, the adjustment factor (α) of the volume of imports has the wrong positive sign (Table 5.13). This indicates that such a relationship is an explosive one; i.e. the deviation of the long-run equilibrium during any certain period is larger than the deviation during the previous period and, thus, the long-run equilibrium is never restored.

Table 5.13: Unrestricted cointegrating vector Normalized for the volume of imports (Sample period 1970-2004)

Variables	Estimated Parameters		Standard errors of α
	β	α	
m	1.000	0.15777	0.11196
y	-1.0999	0.21114	0.052288
rpm	0.66748	-0.24757	0.086250

Furthermore, when the cointegrated vector normalized for the volume of imports was tested for the weak exogeneity of either the income variable or the relative prices variable, none of the two variables passed the test; whether tested individually or jointly. Table 5.14 shows the χ^2 statistic and the probability ratio for each of the null hypotheses tested.

Table 5.14: Structural restrictions on the cointegrating vector detected for the system *m*, *y*, and *rpm* and for the sample period 1970-2004

Restrictions imposed on the coefficients(1)	Statistic $\chi^2(n)^{(2)}$	Probability(3)
$\beta_0 = 1$; and $\alpha_1 = 0$ (weak exogeneity of the income variable)	8.8704	[0.0029]**
$\beta_0 = 1$; $\alpha_2 = 0$ (weak exogeneity of the relative prices variable)	5.0776	[0.0242]*
$\beta_0 = 1$; $\alpha_1 = 0$; and $\alpha_2 = 0$ (joint weak exogeneity of both variables)	9.0564	[0.0108]*

(1): β_0, β_1, and β_2 are the coefficients of the volume of imports variable, the income variable, and the relative prices variable respectively, while α_1 and α_2 are the adjustment factors related to the cointegrating relationships normalized for the income variable and the relative prices variable respectively.
(2): "n" refers to the number of restrictions imposed other than the first one, which meant to normalize the vector for the demand for imports relationship.
(3): "*" and "**" refers to the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.

However, when a shorter sample period (1975-2004) is used, a plausible long-run relationship is found for the same system involving the volume index of imports (*m*), real domestic GDP (*y*), and the relative price of imports (*rpm*). Setting the lag length at three lags, Johansen test for cointegration revealed that the null hypothesis of no cointegration is rejected at the 5% level of significance, while the null hypothesis of at least one cointegrating vector could not be rejected at either the 5% or the 1% level of significance. Normalizing for the volume of imports, Table 5.15 shows the unrestricted cointegrating vector for such a long-run relationship along with the test trace statistic.

Table 5.15: Johansen cointegration test results for the volume of imports (Sample period 1975-2004)

	Unrestricted Coefficients		Rank	Trace Statistic(1)	95% Critical Value(2)
Variables	β	α			
m	1.000	-0.58131	0	39.219*	33.9237
y	-1.0105	0.07836	1	13.361	13.9074
rpm	0.3089	-0.45126	2	2.292	4.2638

(1): "*" and "**" means the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.
(2): Adjusted for the small sample size applying the Monte Carlo simulation done by Santoso (2001).

With all roots of the companion matrix lie inside the unit circle, the mathematical stability of the system is ensured, which means that following any disturbances to it, the VAR model of this system converges to its equilibrium in the long-run. The coefficients of both the real GDP and the relative prices of imports have the right signs according to the economic theory behind the demand for imports, where the volume of imports is expected to be positively related to real GDP and negatively related to the relative price of imports. To check whether this relationship could be identified as a long-run demand for imports function, certain structural restrictions based on the theory were imposed. Table 5.16 shows the test results of the various restrictions imposed on the estimated cointegrated relationship.

The test results revealed that the restricted cointegrating vector passed all the restriction tests, while the coefficients continued to have the right signs. First, with a probability ratio of 24%, the null hypothesis of restricting the adjustment factors related to the equations of real GDP and the relative import prices to zero (α_1 and α_2 =0) to check their weak exogeneity, could not be rejected. Therefore, these two variables enter only the right-hand side of this relationship and, binding on the rest of statistical properties of it, the resultant restricted relationship could be identified as a demand function for imports in Jordan.

Table 5.16: Structural restrictions on the cointegrating vector detected for the system (m, y, and rpm)

Restrictions imposed on the coefficients(1)	Statistic $\chi^2(n)$(2)	Probability(3)
β_0 =1; and α_1=0 (weak exogeneity of the income variable)	0.35221	[0.5529]
β_0 =1; α_1=0; and α_2=0 (weak exogeneity of both variables)	2.8816	[0.2367]
β_0 =1; α_1=0; α_2=0 and β_1=0 (statistical significance of real GDP)	20.460	[0.0001]**
β_0 =1; α_1=0; α_2=0 and β_2=0 (statistical significance of relative prices)	2.9749	[0.3955]
β_0 =1; α_1=0; α_2=0 and β_2=0.3089 (imposing the original value of coefficient of the relative prices)	4.1634	[0.2444]

(1): β_0, β_1, and β_2 are the coefficients of the volume of imports variable, the income variable, and the relative prices variable respectively, while α_1 and α_2 are the adjustment factors related to the cointegrating relationships normalized for the income variable and the relative prices variable respectively.

(2): "n" refers to the number of restrictions imposed other than the first one, which meant to normalize the vector for the demand for imports relationship.

(3): "*" and "**" refers to the rejection of the null hypothesis at the 5% and the 1% level of significance respectively.

Restricting the coefficient of real GDP to zero (β_1=0), is rejected at the 1% level of significance, while restricting the coefficient of import relative prices to zero (β_2=0), could not be rejected at either the 5% or the 1% level of significance. This indicates that the real GDP is highly significant while the relative price is not significant in explaining the variation in the volume of imports in Jordan. Given the structure of imports in Jordan, the lack of significance of the relative price variable in the demand for imports relationship is not beyond our expectations. On the one hand, imports of crude materials and intermediate and capital goods constitute a relatively high ratio of total imports (See Table 5.2 above), which reflects the importance of imports for domestic investments. On the other hand, a relatively high ratio of imported consumer goods has no domestically produced substitutes. These two factors make the demand for imports in Jordan mainly determined by income rather than prices. Nevertheless, and based on the theoretical emphasis of the importance of the price variable in any demand function, we intend to keep the relative prices variable in the long-run demand for imports function regardless of its statistical significance. While this might raise some concerns about the parsimony of the estimated relationship, it helps in measuring the magnitude of the price elasticity of imports especially with the null hypothesis of restricting the parameter of relative prices to its originally estimated value in the unrestricted cointegrated vector (0.3089) could not be rejected. The likelihood ratio for the three restrictions imposed on the model (α_1=0, α_2=0, and β_2=0.3089) amounted to 4.16 with a probability ratio of 0.244.

According to this relationship, the volume of imports is positively related to the real GDP and negatively related to relative price of imports measured by the ratio of domestic import prices to the consumer price level in Jordan. The formal representation of this function is

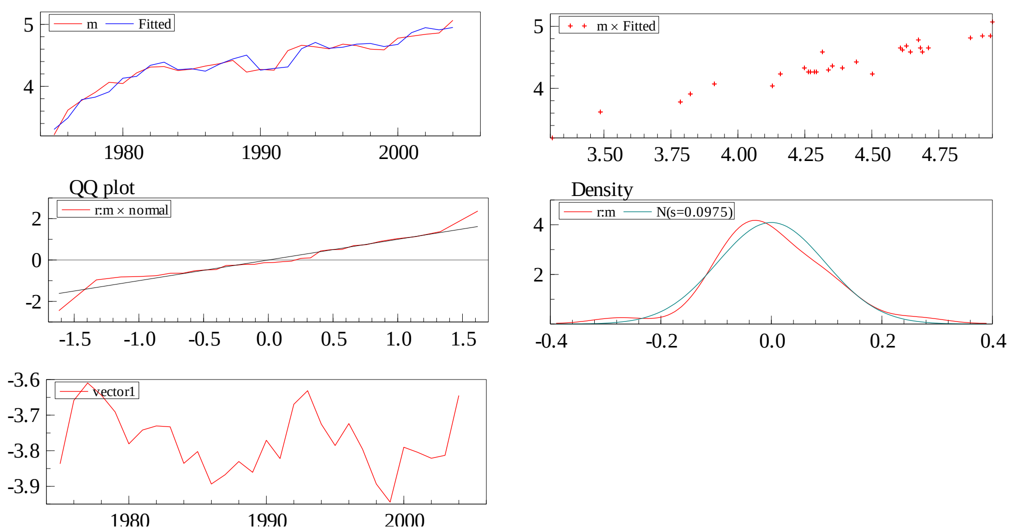
(5.6) $$m_t = 0.994 y_t - 0.309 rpm_t$$

This equation has passed all the diagnostic tests, where none of the null hypotheses of no autocorrelation, normally distributed residuals, and no heteroscedasticity could be rejected at the vector level. The only drawback in this regard is the lack of normality at the individual variable equations level for the volume of imports and real GDP, where the null hypothesis of normally distributed residuals is rejected at the 5% level of significance in each equation. The following are the vector diagnostic test statistics along with their probability ratios.

Vector Portmanteau(4):	30.369
Vector Normality test:	Chi^2(6) = 5.0603 [0.5361]
Vector hetero test:	Chi^2(108)= 106.62 [0.5195]

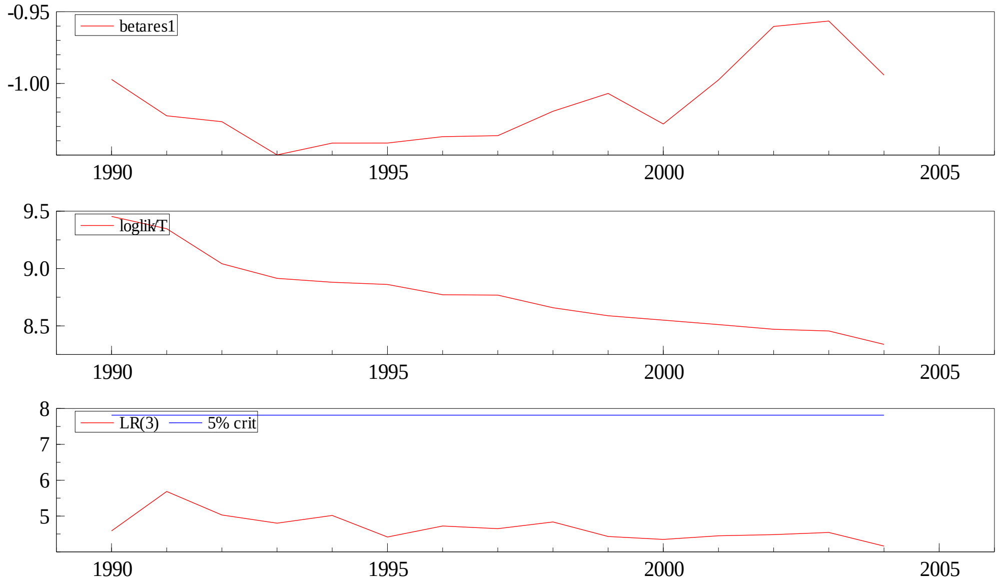
Graphical analysis of this restricted demand for imports relationship shows that the behaviour of this relationship is relatively satisfactory. As shown in Figure 5.8, the time paths of the actual and fitted values of the volume of imports are relatively close to each other, the cross plot of the actual and fitted is satisfactory, the residual QQ plot against the standard normal distribution is also acceptable. Although the fourth panel of Figure 5.8 shows some skewness in the distribution of residuals, the fifth panel exhibits no signs of instability.

Figure 5.8: Graphical analysis of the restricted cointegrated vector representing the demand for imports in Jordan



Recursive analysis reveals also that this long-run relationship for imports performs well. Given the restricted coefficient of the relative prices, the first panel of Figure 5.9 depicting the recursive estimation of the relationship shows that the estimated coefficient of the real GDP is relatively constant over the sample period. Similarly, the third panel gives clear evidence that no signs of instability exist in this relationship.

Figure 5.9: Recursive analysis for the restricted long-run relationship of the demand for imports in Jordan



In terms of magnitude, the almost unity income elasticity and the low price elasticity of imports conform to what is expected in a small developing country. Regardless being a small country with limited resources and narrow productive base, Jordan has experienced receiving relatively large amounts of capital inflow either in the form of transfers or in the form of foreign borrowing to finance the ambitious development plans. The fact that disposable income has exceeded GDP for a long time has raised the average propensity to consume considerably. Consumption to GDP ratio has ranged between 88.2% and 120.5% over the period 1976-2004 with an average of 103.2%. In such a situation, income elasticity of imports is expected to be high and close to unity if not higher. On the other hand, the need for intermediate and capital goods to ensure sustainable economic development is expected to lower the price elasticity of imports. Imports of raw materials, intermediate goods, and capital goods constituted more than 74% of total imports in 2004 with an average of 63.4% over the period 1969-2004. This could explain the low magnitude of the price elasticity of imports.

The range of reported income and price elasticities of imports between empirical studies on demand for imports is quite wide to the extent that makes it difficult to set a magnitude criterion of either elasticity. Nevertheless, and contrary to the income elasticity of imports, the resultant price elasticity of imports in Jordan lies in the low side compared to those in developed countries (See Sawyer and Sprinkle (1996), Sawyer (1997), and Marquez (1999)) or even if compared to developing countries (See Marquez (1990), and Siddique (1997)).

5.7.2.4 The short-run dynamics of the demand for imports in Jordan.

Given the plausible long-run relationship of the demand for imports in equation 5.6, the disequilibrium between the actual volume of imports and the expected volume from the long-run relationship at any point of time is defined by ECM*m*. Formally, it is represented by the equation:

$$(5.7) \quad ECMm = m - 0.994y + 0.309rpm$$

Incorporating the one period lag of this definition into equation 5.2a featuring the vector equilibrium-correction model (VECM), and using the OLS method, the following equation has been estimated for the short-run dynamics of imports after dropping the redundant lagged terms, with numbers in parenthesis are the standard errors.

$$(5.8) \quad \Delta m_t = -2.764 - 0.724ECMm_{t-1} + 0.296\Delta m_{t-1} + 1.469Dy_t - 0.189\Delta\Delta rpm_t$$

(0.484) (0.126) (0.109) (0.211) (0.083)

$R^2 = 0.77$ Sigma = 0.062 $F(4,25) = 21.0$** DW = 2.07 Log-Likelihood = 43.42

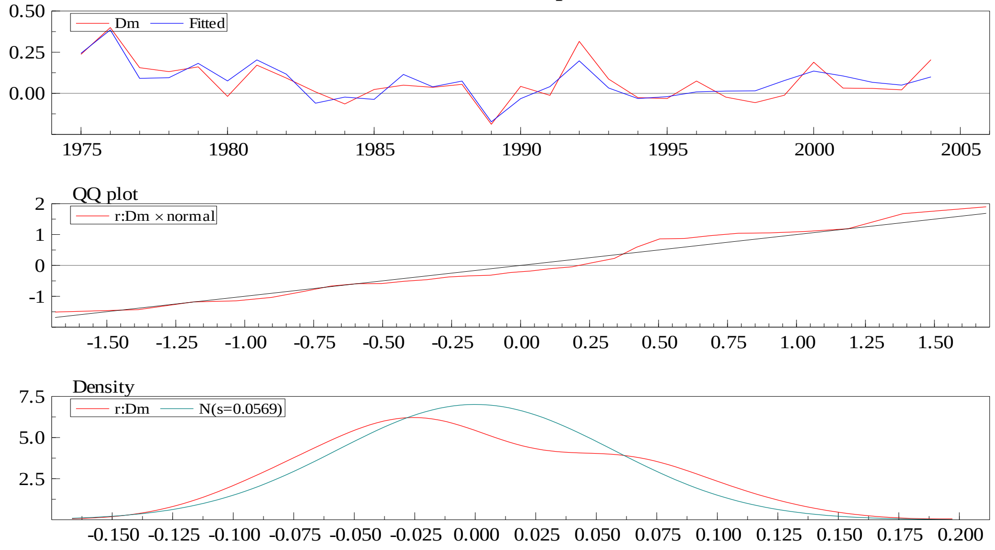
With all the coefficients have the right sign as expected from the theory behind the demand for imports, this relationship looks plausible. All the coefficients are statistically significant at either the 5% or the 1% level of significance, the rate of determination (0.76) is quite high for a short run relationship, and the standard error of the regression is quite low. Further, this equation passed all the diagnostic tests, where none of the null hypotheses of no autocorrelation, no heteroscedasticity, normally distributed residuals, and no misspecification could be rejected at either the 5% or the 1% level of significance.

AR 1-2 test: F(2,23) = 0.29328 [0.7486]
ARCH 1-1 test: F(1,23) = 0.18513 [0.6710]
Normality test: Chi^2(2) = 1.8417 [0.3982]
hetero test: F(8,16) = 0.84253 [0.5801]
RESET test: F(1,24) = 0.38750 [0.5395]

The interpretation of this dynamic relationship is that in the short-run, the change of imports in any period of time is positively related to its own growth in the previous period and to the domestic economic growth during the same period, and negatively related to the previous period deviation from its long-run equilibrium and to the current second change in the relative prices of imports. The speed of adjustment of the disequilibrium term is quite high with more than 72.4% of any deviation from the long-run equilibrium is corrected during the next period.

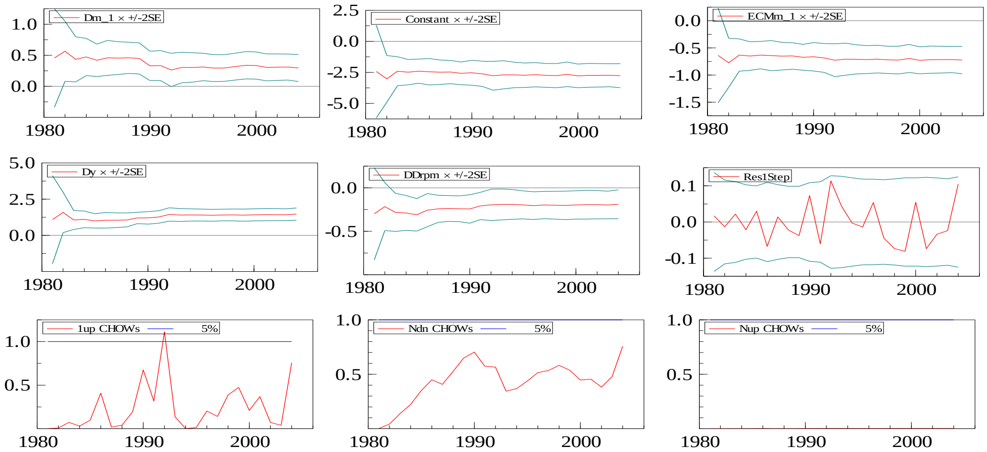
Graphical analysis also shows that the short-run dynamic model performs relatively satisfactorily. The first graph of Figure 5.10 shows that the actual and fitted values are relatively close. Whenever an outlier exists, the adjustment takes place so quickly within the next period, which is consistent with the high coefficient of the equilibrium correction term in the model. The QQ plot against the normal distribution looks reasonable with the residuals so close to the criterion line. Although some signs of kurtosis exist, the residuals are in general normally distributed.

Figure 5.10: Graphical analysis of the short-run dynamic equation of the demand for imports



Recursive analysis for the short-run dynamics of the demand for imports, depicted by Figure 5.11, reveals also that the model performs relatively well. Although the standard deviation is quite large at the begining and gets smaller over time, it became clearly constant after the early 1980s and all the estimated coefficients have been bounded by their mean +/-2σ interval of confidence; giving evidence of the parameters' constancy over the sample period. The sixth graph shows that the one-step residual test supports parameter constancy. All the residuals lie within the 95% confidence interval. The seventh graph, however, shows one sign of instability, with the One-step Chow test statistic exceeding its critical line once in 1992. Nevertheless, it is clear from the graph that this incident is an outlier rather than a permanent change in the path, which remains generally stable. In fact, this incedent was due the surge in the demand for imports as a result of the sudden repatriation of hundreds of thousands of Jordanians who were working in Gulf countries in the aftermath of the Iraqi invasion of Kuwait in the late 1990 and the war that followed early 1991. The eighth graph shows that trend breaks are non-existent and the Chow forecast test (the last graph) shows that forecasts do not lie outside their 95% confidence intervals. In summary, these tests indicate that the model fits the original data series well, has constant parameters and stable residuals, and performs reasonably well for forecasting purposes.

Figure 5.11: Recursive analysis of the short-run dynamic equation of the demand for imports



5.8 Conclusions

This chapter has investigated the existence of a stable demand function for imports and exports in Jordan using annual data for the period 1969 through 2004 and utilizing the Johansen procedure for cointegration analysis and the equilibrium-correction model (ECM)., One cointegrating vector has been detected and identified as the long-run demand relationship for each of the volume of exports and the volume of imports and the short-run dynamics of both equations were estimated using the specification of the equilibrium-correction model. Statistical properties of both long-run and short-run functions were satisfactory and confirm our basic assumptions of the existence of a stable long-run demand function for each of exports and imports and that the volume of either imports or exports is positively related to the related scale variable and negatively related to the relative price variable. Furthermore, the scale variable in both demand functions proved to be statistically significant, while the relative price variable is statistically significant only in the case of the demand function for exports.

In terms of magnitude, income elasticity of both exports and imports is found considerably higher than the price elasticity, which is not uncommon in the literature of external trade (See Carone (1996) and Sawyer and Sprinkle (1996)). On the other hand, and regardless of the insignificance of the relative price in the demand for imports, the unitary price elasticity of exports is more than triple of that of imports. This could be explained by the fact that the largest part of imports is for production purposes, while the largest share of exports has been for consumption purposes.

Another interesting finding regarding the elasticities is the fact that the sum of the two long-run price elasticities exceeds unity, which means that they meet the Marshal-Lerner condition. While this looks appealing to suggest that changing the relative prices, through introducing more flexible exchange rate system, might help in affecting the trade balance, one should look into such a consideration cautiously because of three factors. First, while allowing the exchange rate of the Dinar to depreciate might help in pushing up exports, it has less prospects of cutting down imports due to their low price elasticity. Second, the relatively large trade deficit in Jordan reduces the improvement as a result of exchange rate depreciation (See IMF (2006) and Hakura and Billmeier (2008)). Third, and having in mind the high income elasticity of imports relative to that of price elasticity into consideration, the income effect on imports is expected to surpass the price effect on both imports and exports and, therefore, to offset the effect of elasticity differential. Another factor which might offset the effect of elasticity differential is the speed of adjustment of any short-run disequilibrium, where any deviation from the long-run equilibrium needs only less than two years to be corrected for in the case of imports, while it needs a good five years in the case of exports.

In summary, although the findings of this chapter are appealing, one should not, however, rush to any conclusion regarding the regime change. More research is needed in this regard, especially in the area of the exchange rate pass-through. Another area where more research is also needed before rushing to any policy recommendations based on the results of this work is the estimation of demand functions for exports and imports at the micro level; i.e. at the sector level or at the commodity level, because aggregation is usually associated with less efficient estimation.

Statistical Appendix

Table A5.1: Main Components of the Balance of Payments in Jordan (Percentages of GDP)						
	Trade Balance	Services Balance	Current Transfers (net)	Current Account	Capital Account	Overall Balance
1970	-0.234	0.030	0.178	-0.026	0.001	-0.011
1975	-0.422	0.151	0.321	0.049	0.101	0.107
1976	-0.493	0.294	0.231	0.032	-0.027	-0.020
1977	-0.549	0.300	0.245	-0.004	0.074	0.096
1981	-0.547	0.245	0.293	-0.009	0.047	0.010
1982	-0.515	0.226	0.219	-0.070	0.067	-0.037
1983	-0.487	0.249	0.161	-0.077	0.086	0.028
1984	-0.393	0.200	0.141	-0.053	0.032	-0.035
1985	-0.377	0.172	0.156	-0.049	0.068	0.009
1986	-0.274	0.156	0.110	-0.007	0.024	0.008
1987	-0.270	0.126	0.090	-0.054	0.034	-0.017
1988	-0.282	0.133	0.103	-0.047	0.014	-0.053
1989	-0.247	0.135	0.156	0.044	-0.089	-0.049
1990	-0.378	0.122	0.153	-0.102	-0.017	-0.095
1991	-0.258	0.096	0.087	-0.075	0.103	0.098
1992	-0.418	0.176	0.080	-0.163	0.045	-0.097
1993	-0.411	0.228	0.070	-0.113	-0.032	-0.097
1994	-0.321	0.201	0.054	-0.066	-0.009	-0.073
1995	-0.295	0.209	0.047	-0.039	0.033	-0.043
1996	-0.372	0.280	0.058	-0.033	0.020	-0.053
1997	-0.312	0.262	0.055	0.004	0.041	0.038
1998	-0.256	0.212	0.046	0.003	0.037	-0.015
1999	-0.230	0.211	0.068	0.050	0.023	0.077
2000	-0.317	0.241	0.083	0.007	0.068	0.112
2001	-0.283	0.236	0.047	0.000	-0.007	-0.003
2002	-0.239	0.242	0.055	0.057	-0.005	0.034
2003	-0.258	0.235	0.140	0.117	-0.027	0.114
2004	-0.371	0.246	0.125	0.000	-0.010	0.029

Table A5.2: External Trade Ratios to Gross Domestic Product (in Percentages)						
	In Nominal Terms			In Real Terms		
Year	National Exports	Imports	External Trade	National Exports	Imports	External Trade
1969	0.048	0.271	0.319	0.051	0.271	0.322
1970	0.041	0.288	0.329	0.055	0.283	0.338
1975	0.092	0.537	0.629	0.079	0.374	0.453
1976	0.087	0.599	0.686	0.093	0.524	0.618
1977	0.087	0.658	0.746	0.105	0.634	0.739
1978	0.081	0.577	0.658	0.101	0.575	0.676
1979	0.084	0.596	0.680	0.107	0.567	0.674
1980	0.103	0.615	0.718	0.118	0.502	0.620
1985	0.130	0.545	0.675	0.166	0.524	0.691
1986	0.101	0.379	0.480	0.162	0.522	0.684
1987	0.109	0.400	0.509	0.188	0.529	0.717
1988	0.139	0.435	0.573	0.208	0.550	0.758
1989	0.220	0.507	0.727	0.245	0.511	0.756
1990	0.222	0.625	0.847	0.236	0.535	0.771
1991	0.202	0.578	0.781	0.205	0.520	0.725
1992	0.176	0.613	0.789	0.196	0.623	0.820
1993	0.178	0.632	0.810	0.203	0.651	0.854
1994	0.182	0.542	0.724	0.212	0.614	0.826
1995	0.213	0.549	0.762	0.217	0.560	0.777
1996	0.212	0.620	0.831	0.207	0.591	0.798
1997	0.208	0.566	0.774	0.212	0.558	0.770
1998	0.187	0.484	0.670	0.213	0.510	0.724
1999	0.182	0.456	0.638	0.213	0.492	0.706
2000	0.180	0.543	0.724	0.220	0.571	0.792
2001	0.213	0.543	0.755	0.260	0.564	0.824
2002	0.230	0.531	0.761	0.284	0.550	0.834
2003	0.233	0.565	0.798	0.293	0.542	0.835
2004	0.283	0.710	0.993	0.335	0.619	0.954

Table A5.3: Relative Importance of Food Imports in Jordan					
Year	Imports Value (JD Thousands)			Ratio of Food Imports to	
	Food and Live Animals	Consumer Goods	Total Imports	Consumer goods	Total Imports
1969	17837	37920	67752	47.0%	26.3%
1970	18684	37350	65882	50.0%	28.4%
1971	20125	45400	76628	44.3%	26.3%
1972	27296	57900	95310	47.1%	28.6%
1973	30813	65800	108247	46.8%	28.5%
1974	42740	85700	156607	49.9%	27.3%
1975	49420	93910	234013	52.6%	21.1%
1976	81378	134950	339495	60.3%	24.0%
1977	75921	149240	454518	50.9%	16.7%
1978	87568	180460	458943	48.5%	19.1%
1979	108280	216630	585666	50.0%	18.5%
1980	118789	242180	715977	49.0%	16.6%
1981	167930	327030	1047504	51.4%	16.0%
1982	191924	370820	1142493	51.8%	16.8%
1983	180366	414970	1103310	43.5%	16.3%
1984	184317	447060	1071340	41.2%	17.2%
1985	175784	408420	1074445	43.0%	16.4%
1986	165568	399180	850199	41.5%	19.5%
1987	155719	381720	915555	40.8%	17.0%
1988	172909	408480	1021668	42.3%	16.9%
1989	197650	444270	1230142	44.5%	16.1%
1990	403896	473210	1725828	85.4%	23.4%
1991	417668	486170	1710463	85.9%	24.4%
1992	416023	589650	2214002	70.6%	18.8%
1993	435146	593280	2453625	73.3%	17.7%
1994	409673	563790	2362583	72.7%	17.3%
1995	419232	614313	2590250	68.2%	16.2%
1996	685917	727720	3043556	94.3%	22.5%
1997	539547	706760	2908085	76.3%	18.6%
1998	532183	763650	2714374	69.7%	19.6%
1999	484133	794260	2635207	61.0%	18.4%
2000	529895	1058090	3259404	50.1%	16.3%
2001	524323	962910	3453729	54.5%	15.2%
2002	530179	1031900	3599160	51.4%	14.7%
2003	630338	1132460	4072008	55.7%	15.5%
2004	761300	1504110	5799241	50.6%	13.1%

Table A5.4: Jordan Exports by Economic Function

Year	Consumer Goods	Crude Materials	Intermediate Goods	Capital Goods	National Exports
1969	59.8%	32.3%	6.1%	1.8%	100.0%
1970	65.0%	26.3%	5.4%	3.3%	100.0%
1971	62.1%	26.6%	6.9%	4.3%	100.0%
1972	49.2%	29.5%	17.4%	4.0%	100.0%
1973	49.0%	32.5%	15.1%	3.4%	100.0%
1974	35.2%	50.8%	12.4%	1.6%	100.0%
1975	40.0%	50.1%	8.4%	1.5%	100.0%
1976	51.3%	40.5%	6.5%	1.7%	100.0%
1977	53.4%	31.3%	13.4%	1.9%	100.0%
1978	50.9%	32.3%	15.6%	1.3%	100.0%
1979	50.9%	33.4%	14.4%	1.3%	100.0%
1980	45.2%	41.0%	12.5%	1.4%	100.0%
1981	45.4%	33.5%	17.8%	3.3%	100.0%
1982	47.5%	33.1%	16.6%	2.7%	100.0%
1983	58.9%	32.9%	6.1%	2.1%	100.0%
1984	41.7%	33.4%	23.6%	1.4%	100.0%
1985	38.8%	38.6%	21.5%	1.2%	100.0%
1986	34.6%	43.4%	21.2%	0.9%	100.0%
1987	33.8%	36.8%	27.9%	1.5%	100.0%
1988	24.8%	45.1%	28.4%	1.7%	100.0%
1989	24.8%	42.1%	30.6%	2.5%	100.0%
1990	23.6%	38.4%	36.0%	1.9%	100.0%
1991	28.2%	38.1%	32.3%	1.3%	100.0%
1992	33.9%	34.4%	28.3%	3.4%	100.0%
1993	43.6%	27.9%	23.0%	5.6%	100.0%
1994	38.8%	26.2%	28.6%	6.5%	100.0%
1995	41.0%	25.9%	29.0%	4.1%	100.0%
1996	39.2%	24.3%	34.2%	2.3%	100.0%
1997	47.5%	21.8%	27.8%	2.9%	100.0%
1998	43.7%	24.0%	29.3%	2.9%	100.0%
1999	39.7%	22.9%	33.4%	4.0%	100.0%
2000	41.7%	21.2%	32.3%	4.8%	100.0%
2001	46.3%	16.9%	30.6%	6.3%	100.0%
2002	53.4%	15.0%	27.1%	4.6%	100.0%
2003	58.9%	14.3%	24.1%	2.7%	100.0%
2004	61.0%	12.8%	23.7%	2.5%	100.0%

Table A5.5: Jordan's Imports by Economic Function

	Consumer Goods	Fuels Including Crude Oil	Intermediate Goods and Other Crude Materials	Capital Goods	Total Imports
1969	56.0%	5.6%	15.9%	22.5%	100.0%
1970	56.7%	5.7%	17.3%	20.3%	100.0%
1971	59.2%	5.8%	12.0%	23.0%	100.0%
1972	60.7%	4.8%	14.9%	19.5%	100.0%
1973	60.8%	3.8%	16.7%	18.7%	100.0%
1974	54.7%	3.3%	15.8%	26.1%	100.0%
1975	40.1%	10.6%	13.8%	35.4%	100.0%
1976	39.7%	10.9%	15.6%	33.8%	100.0%
1977	32.8%	9.5%	17.2%	40.5%	100.0%
1978	39.3%	10.2%	15.4%	35.1%	100.0%
1979	36.7%	12.5%	17.9%	32.8%	100.0%
1980	33.8%	17.1%	14.7%	34.5%	100.0%
1981	31.2%	16.8%	12.4%	39.6%	100.0%
1982	32.5%	20.3%	13.0%	34.3%	100.0%
1983	37.6%	18.8%	15.4%	28.1%	100.0%
1984	41.7%	19.1%	23.2%	15.9%	100.0%
1985	38.0%	18.0%	25.2%	18.7%	100.0%
1986	47.0%	13.1%	23.3%	16.6%	100.0%
1987	41.7%	16.3%	24.2%	17.8%	100.0%
1988	40.0%	12.9%	25.6%	21.5%	100.0%
1989	36.1%	16.6%	26.0%	21.3%	100.0%
1990	27.4%	17.7%	39.8%	15.0%	100.0%
1991	28.4%	14.1%	42.8%	14.7%	100.0%
1992	26.6%	13.1%	39.4%	20.8%	100.0%
1993	24.2%	12.5%	40.4%	22.9%	100.0%
1994	23.9%	12.2%	41.5%	22.4%	100.0%
1995	23.7%	12.5%	42.6%	21.1%	100.0%
1996	23.9%	12.0%	42.3%	21.8%	100.0%
1997	24.3%	12.9%	40.5%	22.3%	100.0%
1998	28.1%	9.0%	41.1%	21.7%	100.0%
1999	30.1%	11.8%	37.9%	20.2%	100.0%
2000	32.5%	15.3%	34.6%	17.7%	100.0%
2001	27.9%	14.0%	38.7%	19.4%	100.0%
2002	28.7%	15.0%	37.9%	18.5%	100.0%
2003	27.8%	16.2%	38.6%	17.3%	100.0%
2004	25.9%	18.4%	38.2%	17.5%	100.0%

CHAPTER SIX

CONCLUDING REMARKS

This thesis has investigated some aspects of the role of the exchange rate in the Jordanian economy. Specifically, it investigated the impact of changes in the exchange rate on the demand for money in Jordan, the implications of the exchange rate policy for the efficiency of monetary policy, and the implications of the exchange rate policy for external trade balance. Utilizing the impulse response analysis in VAR analysis, we investigated the potential channels of monetary policy transmission mechanism, with the objective of exploring the channels that serve as a good vehicle to transmit shocks innovated by monetary policy actions to the real side of the economy and, therefore to evaluate the efficiency of monetary policy. Using cointegration and the equilibrium-correction models, we investigated the existence of stable long-run relationships featuring the demand for money and the demand for exports and imports, with the objective to exploring where the exchange rate lies among the determinants of these relationships in the context of Jordan. The following are the main findings of the research pursued within the framework of this thesis.

6.1 Conclusions related to demand for money

1. Regardless of the monetary aggregate, the scale variable, and the definition of the exchange rate used, no satisfactory relationship could be detected when the nominal discount rate, the inflation rate, and the exchange rate variable were included among other endogenous variables, as arguments for the money demand. However, when the model was re-specified by including the real interest rate instead of the nominal one and including the level of the standard definition of the exchange rate as exogenous, a stable long-run relationship for the demand for the narrowly defined money existed. According to this relationship, the demand for the narrowly defined

monetary aggregate (RM1) in Jordan is found to be positively related to the scale variable and the level of the exchange rate of the Dinar in terms of the US dollar, and negatively related to the domestic real interest rate (measured by the difference between the discount rate and the inflation rate) and the foreign interest rate measured by the US federal funds rate. On the other hand, no satisfactory relationship could be detected for any of the broader definitions of money.

2. The existence of a plausible demand relationship for the narrowly defined monetary aggregate but not for the broadly defined one is not far from reality for two reasons. First, the narrowly defined monetary aggregate is purely non-interest bearing balances, while the bulk of the broadly defined aggregate is interest bearing balances. This fact makes the response of the former to changes in the opportunity cost variables, such as interest rates, more observable. Second, the narrowly defined monetary aggregate is more associated with consumption (transactional demand for money). The relatively high ratio of consumption to either GDP or total final expenditure makes detecting the positive correlation with the scale variable in this case easier than the case with the broadly defined monetary aggregate.
3. The relatively high elasticities of money demand with respect to the scale variable and the low elasticities with respect to the interest rate variables are generally in line with the findings of several empirical studies over the last two decades (See Arize (1994), Karfakis and Sidiropouos (2000) and Apergis (1997)). Such a result is not uncommon for the narrowly defined money demand, especially in developing countries because this monetary aggregate is more associated with the transactional demand, which is not expected to vary significantly in response to changes in the interest rate, especially the short term interest rates.

4. The most interesting part of the findings of this research, however, is the magnitude of the exchange rate elasticity of the demand for the narrowly defined money. Both the unity elasticity in the model involving real GDP and the 0.50 elasticity in the model involving real total final expenditure are clearly on the high side compared to the findings of other empirical studies (See Arize (1994), Kogar (1995), Caruth and Sanchez-Fung (2000), Bahmani-Oskooee et al (1998) and Shibly (1999)). In theory, such a high long-run elasticity is expected in the case of the broader definition of the monetary aggregate, where the largest part of it is more associated with role of money as a store of value and, thus, expected capital gains or losses, especially those related to expected changes in the exchange rate, make a difference. However, the failure to identify a long-run relationship for any of the broader definitions of monetary aggregates eliminates the possibility to check the role of the exchange rate factor in the demand for those aggregates or even to compare its importance between different monetary aggregates.
5. Nevertheless, the high long-run exchange rate elasticity of the narrowly defined demand for money in Jordan could be explained by two factors. First, the long lasted pro-fixed exchange rate stand in Jordan could have enhanced the Central Bank's credibility to the extent that the public expected any appreciation of the Dinar to last longer time or even accelerate over time. Given the fact that Jordan has received relatively large amounts of external current transfers, except for a limited short period of time (the second half of 1980s), such expectations were plausible. Second, the positive expected impact of the pro-fixed exchange rate stand on imports, which ratio to GDP has averaged at 75% over the last two decades could partially explain the high positive exchange rate elasticity of the demand for the

narrowly defined money. The need to finance these imports increase along with the appreciation of the Dinar.

6. In the short-run, the factors that explain the variation in the demand for narrow money differ significantly between the model involving the real GDP and that involving the real total final expenditures. First, the magnitude of the feedback of the equilibrium-correction term is significantly higher in the later, where 40% of any disequilibrium is corrected for during the next period compared to only 25% in the model involving real GDP. Second, while the change in the exchange rate is the only variable other than the feedback of the equilibrium-correction term that plays a role in explaining the short-run variation in the demand for money in the model involving real GDP, both the change in the scale variable and the change in foreign interest rate play a role in explaining that variation in the model involving real total final expenditure. Having in mind that changes in the exchange rate have been historically limited, the latter model looks more appealing. Third, although both models passed all the diagnostic tests, the statistical properties of the latter look more appealing with a relatively higher coefficient of determination, lower standard error, higher Durbin-Watson statistic, and less signs of instability.
7. From a policy perspective, the above results suggest that the Central Bank of Jordan, when pursuing its monetary policy, should consider some changes regarding its medium target and the scale variable to be under its surveillance. First, the failure to detect a stable long-run relationship featuring the demand for any of the broader definitions of monetary aggregates suggests that the Central Bank of Jordan should target the narrowly defined money when pursuing its monetary policy. While this suggestion might have some ground when it comes to combating inflation, it would

not be ideal for policy actions that target the aggregate demand. Second, statistical properties of the estimated relationships, indicate that the demand for the narrowly defined money is more correlated to the total final expenditures rather than GDP, which means the former is a better representative of aggregate demand for the purpose of formulating the monetary policy. In the context of Jordan, this conclusion have some ground because disposable income has always exceeded the domestically generated income as a result of the relatively high level of current transfers from abroad. Third, the high magnitude of the exchange rate elasticity of the demand for the narrowly defined money gives some support for the pro-fixed exchange rate policy. However, one should not rush into any recommendation regarding the exchange rate system, because exchange rate flexibility has never been experienced in Jordan and more empirical work is needed in this regard before reaching any conclusive recommendation in this regard.

6.2 Conclusions related to monetary policy transmission mechanism

1. Regardless of the policy indicator variable used, and regardless whether the VAR system is estimated using the variables in the first difference format or in the level format, the impact of monetary policy shocks on both the variables representing the channels of monetary transmission and the variables representing the economic activity are extremely low in magnitude, to the extent that one could say that monetary policy is irrelevant when it comes to the actual monetary and economic developments in Jordan.
2. The low magnitude of the monetary policy impact could be mainly explained by two factors. First, the lack of monetary policy independence resulted from the long lasted fixed exchange rate practice (See Bernanke 2005). The relatively high margin between

domestic and foreign interest rate during the 1990s is a clear example of the monetary policy actions designed just to support the fixed exchange rate system regardless of the domestic economic activity requirements. Second, banks traditionally maintain a relatively high level of liquidity, especially in the form of excess reserves, which helps them to offset most of monetary policy shocks to the system. On the one hand, banks have rarely resorted to borrowing from the Central Bank, which made changing the discount rate irrelevant in practice. On the other hand, the relatively high ratio of banks' liquid assets enables banks to easily bypass any policy action aiming at reducing the free banks' excess reserves.

3. Another issue might come to mind when trying to explain the lack of effectiveness of monetary policy is the absence of quantitative targeting. This, in addition to the lack of empirical quantitative relationships and, consequently, the absence of estimated elasticities of the relevant variables made it impossible to determine the size of the policy action needed to achieve the desired economic growth or inflation rate. The practice of not setting any monetary or inflation target made the evaluation of the impact of monetary policy actions immeasurable on the one hand and subject to value judgement on the other. In practice, and for two thirds of the sample period, government intervention in economic activity or in price determination has hindered the market forces and suppressed the inflation rate. This could have eased the pressure on the Central Bank and made the decision maker wrongly believe that the policy is effective enough.

4. The finding that banks' credit explains a relatively high share of the variances of real GDP and the price level suggests that the lack of efficiency of monetary policy is not attributed to the non-appropriateness of the channels of transmission but to the

inability of the policy actions to kick off these channels especially the credit channel. If that is the case, the effectiveness of monetary policy could be easily enhanced if the CBJ directs the emphasis of its policy actions towards domestic requirements on the one hand, and targets the credit expansion as an intermediate target on the other.

5. Given the high degree of economic liberalization and the free capital mobility that Jordan experiencing since the late 1990s, the above mentioned issues remain a real threat to the CBJ's ability to achieve its monetary policy objectives, especially if it is faced by a wave of inflationary pressures. To avoid such a possibility, we recommend the CBJ should look into the possibility of reconsidering its long practiced pro-fixed exchange rate attitude in order to enhance the independence of monetary policy (See Bernanke 2005). For this purpose, the Central Bank needs to launch a wide range of empirical research to quantitatively evaluate the final impact of the fixed exchange rate regime on all aspects of the economy. If the outcome, however, is in favour of continuing the fixed exchange rate system, it is recommended that the CBJ should shift the emphasis, while performing its monetary policy, towards using the tools that affects the money multiplier (See Abrams and Settle (2007).
6. We also recommend the Central Bank should seriously consider setting money or inflation targets to be able to quantifiably evaluate the effectiveness of its monetary policy (See Rasche and Williams 2007). For this purpose, the Central Bank needs to identify structural relationships between its monetary policy tools and the intermediate money targets on the one hand, and between the intermediate targets and the end real activity targets on the other. Having done this, the Central Bank would be in a position to determine which policy rule is more appropriate (See Nelson (2008) and Friedman (1968)) and, then the right size of shock needed.

6.3 Conclusions related to the trade sector

1. Using the standard specification of the demand function for exports and imports and utilizing the cointegration and equilibrium-correction models, a stable demand function for each of imports and exports in Jordan existed. Either function conforms to the economic theory behind demand for exports and imports, being positively related to the relevant scale variable and negatively related to the relevant relative price.
2. Income elasticity of both exports and imports was found considerably higher than the price elasticity, which is in line with most of empirical studies in the literature of external trade.
3. In the short-run, changes in the effective exchange rate plays a significant role in the variation of imports in the short-run, while it has no such impact on the variation of exports. This could be explained by the fact that a relatively large part of the Jordanian exports are priced in foreign currencies rather than in the Jordan dinar, such as exports of phosphate and potash. Economic growth in both sides of trade has also a significant role in explaining the short-run variation in both exports and imports.
4. One of the interesting points about the magnitude of elasticities estimated is that the price elasticity of exports exceeded that of imports by three folds. This could be explained by the fact that the largest part of imports is either for production purposes or has no domestically produced substitute, while the largest share of exports is manufactured or agriculture goods, which face severe competition from neighbouring countries.
5. Interestingly, however, the sum of the two long-run price elasticities exceeds unity, which means they meet the Marshal-Learner condition. While this looks appealing to suggest that changes in relative prices of exports and imports, through changing the

exchange rate for example, could help improving the trade balance, the long lasted experience of widening trade balance raises some doubts about this. As explained by Hakura and Billimeier (2008), meeting the Marshal-Learner condition is not the only factor that determines the size of improvement of the trade balance in response to exchange rate depreciation, but the initial position of trade balance is in fact a crucial factor in this regard. The larger the deficit in trade balance before the depreciation, the lesser is the improvement after the depreciation. Another factor which might offset the effect of elasticity differential is the speed of adjustment of the short-run disequilibrium, where any deviation from the long-run equilibrium needs only less than two years to be corrected for in the case of imports, while it needs a good five years in the case of exports.

6.4 Issues for future research

The findings of this thesis raise some concern regarding the effectiveness of monetary policy and the existence of a long-run demand for money in Jordan, especially at the broader definitions level of monetary aggregates. Even when some long-run relationships were detected, the statistical properties of the estimated relationships are not conclusive enough to reach definite conclusions about policy implications, especially regarding a regime change. The fact that the period of study witnessed several structural shocks as a result of regional instabilities and the wide scale and comprehensive economic reforms Jordan has performed explains the low quality of the estimated relationships. Nevertheless, the findings of the thesis provoke the need further research in all the issues addressed within the framework of this thesis in order to reach more conclusive results and draw solid conclusions. As far as I am aware, empirical studies on all aspects of the behaviour of different economic agents in Jordan are rare and a lot of work is needed in this regard.

Within the framework of this thesis, several areas need to be addressed in future research. In the area of demand for money, more research is needed at different monetary aggregate levels. In specific, it is recommended to explore the existence of a stable long-run demand function at the component level of each monetary aggregate since each component serves a different purpose when it comes to financial services that money provide and lie behind the demand for money theories. In light of this variation in financial services and the huge financial innovation, that has taken place across the world, it might be helpful exploring the possibility of constructing a single "One Divisia" monetary aggregate to be monitored by the Central Bank rather than monitoring the simple aggregated monetary definitions (See Drake, Mullineux and Agung 1997).

To understand the right connection between the monetary policy and the real side of the economy, more empirical research is needed such as modelling inflation, determinants of investment and economic growth. In light of such models' findings, one might revisit the analysis of monetary policy transmission by using new set of variables. Further investigation of the channels of monetary policy transmission, especially the asset prices channel might add new light to mechanism in which this transmission takes place.

In the area of external trade, more research is also needed in the estimation of demand functions for exports and imports at the micro level, whether it is the sector level, the country level, or at the commodity level. This is because aggregation is usually associated with less efficient estimation. Another issue that needs investigation is the exchange rate pass-through to the domestic price level.

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