UNIVERSITY OF BIRMINGHAM

INVESTIGATING THE TRANSMISSION MECHANISM OF MONETARY POLICY IN EGYPT

By

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ABSTRACT

This thesis investigates the transmission mechanism of monetary policy in Egypt in the last four decades. To achieve this, five empirical studies are included in this thesis. The consumer's expenditure is estimated in Chapter 3, while the investment expenditure under uncertainty is estimated in Chapters 4. Furthermore, the results of these two chapters paved the way to the next chapters, the interest rate channel, chapter 5, and the bank lending channel, Chapter 6. Moreover, Chapter 7 devoted to estimate the exchange rate channel under the regime shift. However, Chapter 2 provides all the required discussion about the economic policies and developments in the Egyptian economy for the purpose of this thesis.

The time series econometrics is used in all of these chapters. The unit root tests, the Engle-Ganger two-step cointegration approach, the bounds tests, and GARCH models are used in Chapters 3 and 4. However, unit root tests, the VAR models, Granger-causality, the impulse response function, variance decomposition, the Johansen's cointegration, and the VECM are used in Chapters 5, 6, and 7. The results of these chapters assert the existence of the channels of monetary transmission mechanism in Egypt between 1975 and 2010.

DEDICATION

To the memory of my father and my teacher Dr. Sayed El-Bawab, my mother, my brother, my grandmothers and my grandfathers.

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ABBREVIATIONS AND ACRONYMS

Abbreviations:

APC	Average propensity to consume
API	Average propensity to invest
BdC	Banque du Cairo
BM	Bank Misr
BoA	Bank of Alexandria
CASE	Cairo and Alexandria Stock Exchange
BP	Balance of Payments
CBE	Central Bank of Egypt
CCP	Consumer currency pricing policy
CMA	Capital Market Authority
DOTS	Direction of Trade Statistics
ECES	Egyptian Center for Economic Studies
EGP	Employment Guarantee Programme
ERF	Economic Research Forum
ERSAP	Economic Reform and Structural Adjustment Programme
GDF	Global Development Finance
GFS	Government Finance Statistics
ICIC	Islamic Capital Investment Companies
IDA	International Development Association
IFS	International Financial Statistics
IMF	International Monetary Fund
IS	Investment-Savings
IS-LM	Investment-Savings/ Liquidity Reference-Money Supply model
IS-LM-BP	Mundell-Fleming model or Investment-Savings/ Liquidity Reference-Money Supply/Balance of Payments model
L.E.	Egyptian pound
LCP	Local currency pricing policy
LCPIH	Life cycle-permanent income hypothesis
LM	Liquidity Reference-Money Supply
MENA	Middle East and North Africa
MOP	Ministry of Planning
MPCC	Monetary Policy Coordination Council
MPU	Monetary Policy Unit
MTM	Monetary transmission mechanism or the transmission mechanism of monetary policy
NBE	National Bank of Egypt
NTB	Non-tariff barriers
PCP	Producer currency pricing policy
PIH	Permanent income hypothesis
REPIH	Rational expectations-permanent income hypothesis
REPOS	Repurchase Operations
SFD	Social Fund for Development

UIP	Uncovered interest rate parity
WB	World Bank
WDI	World Development Indicators

Statistical Abbreviations:

ACF	Autocorrelation function
AIC	Akaike Information Criterion
AO	Additive outlier
ARCH	Autoregressive Conditionally Heteroscedastic
ARDL or ADL	Autoregressive Distributed Lag
ARMA	Autoregressive moving average
CLRM	Classical linear regression model
ECM	Error-Correction model or Equilibrium-Correction model
GARCH	Generalised Autoregressive Conditionally Heteroscedastic
HQIC	Hannan-Quinn Information Criterion
IO	Innovational outlier
IRF	Impulse Response Function
PACF	Partial autocorrelation function
SBIC	Schwarz Bayesian Information Criterion
SVAR	Structural vector autoregressive
VAR	Vector Autoregressive
VECM	Vector error-correction model

Symbols:

F	*F*-statistic.
F_{ar}	*F-test* of serial correlation
$F_{ar(1-n)}$	*F-test* of Roots (1 to n)
F_{arch}	*F-test* of autoregressive conditional heteroskedasticity
F_{het}	*F-test* of heteroskedasticity
F_{reset}	*Ramsey-test*
LHS	Left-hand side
RHS	Right hand side
R^2	Determination coefficient
R^2_{adj}	Adjusted determination coefficient
RSS	Residual sum square
σ or *SD*	Standard deviation
T	Number of observations
χ^2_{het}	*Chi-square-test* of heteroskedasticity
χ^2_{nor}	*Chi-square-test* for normality
χ^2	*Chi-square* distribution
LR-test	Likelihood Ratio test

CHAPTER 1 : INTRODUCTION

1.1. Overview

Until 1970's most economists emphasized fiscal policy as a more effective tool for modifying and controlling the level of economic activities than monetary policy. Monetary policy became more popular in the late 1960s due to the problems caused by the large budget deficits. Furthermore, the rise of stagflation, the failure of the Phillips' curve in the 1970s and the hyperinflation encouraged economists to rethink about monetary policy and its role. When monetarist economists provided a suitable explanation for these phenomena, they used monetary policy to stabilise output and inflation.

Many developing countries around the world, moved to adopt a policy of inflation targeting, as they suffered, in earlier stages, from financial and banking crises due to following exchange rate regimes pegged to other currencies or to a basket of currencies (EBI, 2003). Inflation targeting policies were also adopted by developed countries like Canada, the United Kingdom, New Zealand, Sweden, Australia, Finland, Spain and Israel (Bernanke and Mishkin, 1997).

Inflation targeting policy is defined as "*any monetary regime in which the central bank has no intermediate target, but it targets inflation itself*" (EBI, 2003). Under inflation targeting, the monetary authority determines the inflation target range, then it tries to forecast the future inflation rate. If the forecasted inflation rate exceeds the targeted range, then the central bank adopts a tightening monetary policy, and the converse holds (EBI, 2003).

Inflation targeting has many distinguishing advantages such as a simple general framework, a high degree of credibility and transparency, and a greater focus on price stability (EBI, 2003). However, the successful inflation targeting policy needs many prerequisites such as a stable financial system, a strong financial market, good forecasts, avoiding fiscal dominance and an effective monetary policy transmission mechanism (EBI, 2003). Accordingly, studying the monetary transmission mechanism (MTM) is essential when adopting inflation targeting in order to achieve the objectives of this policy successfully.

The Monetary Transmission Mechanism (MTM) ''*is a process through which monetary policy decisions are transmitted into real GDP and inflation*'' (Taylor, 1995, p.11). Monetary-induced changes have many transmission channels that can affect the equilibrium prices and quantities in the financial market. These MTM channels include the interest rate, the credit, the exchange rate, and the asset price channels. Taylor (1995) distinguishes between two views of the MTM: financial market prices and financial market quantities[1]. In addition, he argues that interest rate changes lead the movements in consumption and investment and the real exchange rates changes reflected in the real demand of exports and imports (Taylor, 1995). On the contrary, Bernanke and Gertler (1995) puts more stress on the financial market quantities and its effects.

The monetary transmission mechanism has more than one view about how monetary shocks affect the macroeconomic variables. There are two distinct views of MTM: the money view and the credit view. Whilst the money view concentrates on bank liabilities on the balance sheet, the credit view looks at links with assets (Gertler and Gilchrist, 1993). In his research, Ramey (1993) concluded that measuring the deviation of money and credit from

[1] Financial market prices include variables like short-term interest rates, bond yields, and exchange rates, but financial market quantities include variables such as the money supply, bank credit, the supply of government bonds, foreign denominated assets.

their long-term relationship with output is the best method to determine exactly the importance of the both views in the MTM.

The money view originally comes from the simple assumption about the ability of the monetary authority to control the amount of money in circulation. A change in the money supply (i.e. outside money) will be reflected in real rates of returns. A contractionary policy will reduce the inflation consequently the real interest rate, especially in the short term, will rise. Through the relationship between investment and the interest rate we can expect that the average desired return on investment will jump to a higher level. Not all the investment projects will find a source of finance under the new situation. If, and only if, the average return from the potential investment project is higher than or at least equal to the new average desired return then this project will be financed.

The second view, i.e. credit or lending view, of the MTM is divided into two parts according to if we are using bank loans or not. The broad lending view stresses the impact of the applied policy on the balance sheet of borrowers. In this view there are imperfections in the credit market so we can expect more difficulty in calculating the marginal efficiency of investment. As the ability of a firm to obtain internal finance depends on the state of its balance sheet, this source of finance will be so hard to obtain if information is asymmetric and moral hazard exists (Cecchetti, 1995).

Policy-induced increases in the nominal and real interest rate can affect the firm's net worth through reducing the expected value of future sales and increasing the value of the nominal debt. According to the previous mentioned reasons the firm is less creditworthy and cannot obtain the desired funds. Furthermore, internal finance will be cheaper than external finance as a result of information asymmetry and the increasing risk premium (Cecchetti, 1995). The second part of this view divided other assets in investors' portfolios into outside

money, loans and other funds. For simplicity, suppose that small firms cannot have access to external sources of finance except loans and the policy action can affect the interest rate or loans amount (Cecchetti, 1995; Romer et al., 1990).

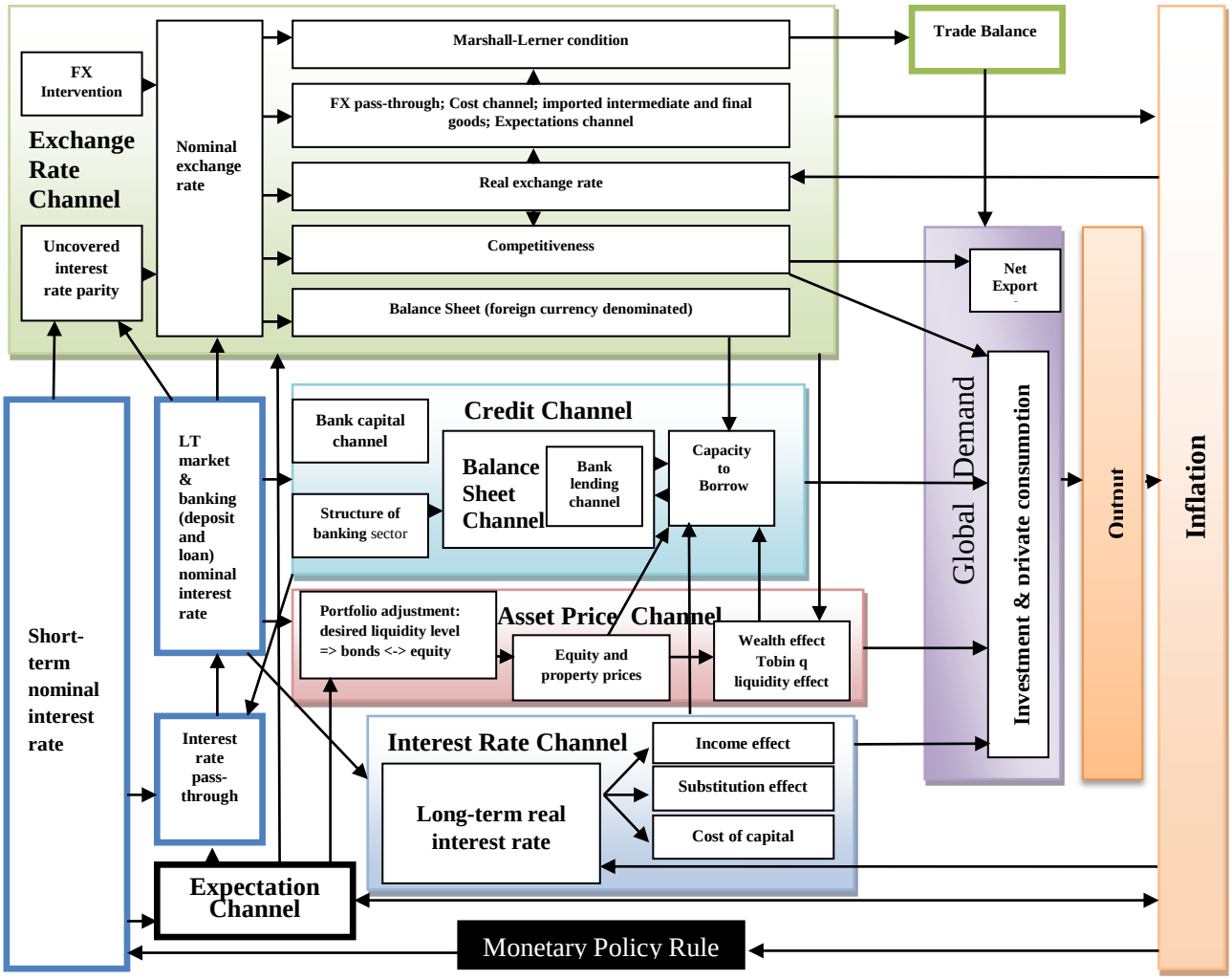
'How important is the lending channel in MTM?. This is a question that many economists tried to answer, Bernanke and Blinder (1988) presented a model which stresses three necessary conditions which are needed for the lending (i.e. credit view) channel to exist. Firstly, loans and bonds must not be perfect substitutes for some firms. Secondly, the monetary authority must be able to affect the supply of loans through changing the available size of banks' reserves. Thirdly, imperfect price adjustment should exist to be sure that monetary policy shocks are not neutral (Kashyap and Stein, 1994).

There are a number of different frameworks to analyse the MTM, one of the best is Égert and MacDonald (2006), being overlapping with each channel having connections with other channels and sub-channels, see figure 1.1.

Egypt, like other developing countries, intended to apply an inflation targeting policy as declared by the Central Bank of Egypt (CBE). For this reason, the monetary policy transmission mechanism in Egypt needs to be examined to know how channels of this mechanism work and the importance of each channel. Furthermore, information on the specification of the suitable channel (and the instruments of this channel) to transmit the effects of monetary policy shocks to output in Egypt, according to the macroeconomic environment, is necessary to support the inflation targeting policy.

For the previous reasons, I decided to undertake this research to help in filling this gap about the transmission mechanism of monetary policy in Egypt. However, studying of inflation targeting is outside of this thesis objective. Accordingly, this thesis will concentrate only on the channels of MTM in Egypt.

Figure 1.1: The Framework of Monetary Transmission Mechanism



Source: Égert and MacDonald (2006, p.8).

The monetary transmission mechanism in some developing and emerging economies is relatively less effective comparing to the case of developed economies. Bhattacharya *et al.* (2011) explain this limited effect of the monetary policy transmission channels by three factors. These factors are underdeveloped financial markets, low competition in the banking systems, and the large informal sector. They argue that an underdeveloped bond market can weaken the transmission through which changes in the short term policy interest rate will affect the yield curve. Furthermore, low competitive banking system and high public sector ownerships in banking system will prevent deposit and lending interest rates from responding

rapidly to changes in the policy interest rate. Moreover, Bhattacharya *et al.* (2011) argue that the large informal sector in these economies will diminish the effect of the monetary policy because this policy is linked to formal sector, which in this case is relatively small.

Mishra *et al.* (2010) surveyed a large number of low income countries to check what is affecting the monetary transmission in these countries. They found many potential reasons for the limited and less effective transmission mechanism in these economies. The size of formal financial sector in low income countries affects the monetary transmission negatively since the small size of this sector diminishes the transmission of the central bank's actions on economy (Mishra *et al.*, 2010). The central bank independency level in low income countries is small which, in turn, affects the scope of monetary policy in these countries, and limits the transmission mechanism in these economies.

Mishra *et al.* (2010) pointed out that low quality of the institutional and regulatory environment play a role in limiting the impact of the monetary transmission mechanism in these countries, and this could occur through its negative impact on money and interbank market developments because the credibility and transparency of the monetary authority will be at a low level in this type of economic environment. Also, they refer to poorly developed secondary market for government securities which makes central banks are not able to conduct their policies through open market operations. Furthermore, they found that low competition in the banking sector, because the small number of banks or high share of government ownership in banks, mirrored in a high degree of concentration and large interest rate margin. Therefore, it is expected that changes in the policy interest rate may have weak impact on market rates.

Other factors had discussed by Mishra *et al.* (2010), like financial repression, maturity of government obligations, stock market size and liquidity, efficiency of real estate markets,

international financial integration, and exchange rate flexibility. Furthermore, Mishra and Montiel (2012) extended the study of Mishra *et al.* (2010) to survey the empirical evidence in low income countries, in order to answer the question how effective is monetary transmission in these countries.

1.2. Research Significance

There is a distinct shortage in empirical studies about the MTM in Egypt. However, the studies of the complete MTM in Egypt are extremely rare, but the majority of these studies focus on exchange rate pass-through. In addition, the results of these studies did not draw the full picture of the MTM process in Egypt. The need of a recent quantitative study about the MTM process and channels, bringing together the channels of MTM, is extremely essential for Egyptian policymakers, especially at the macroeconomic level and in the monetary policy area. As the CBE adopted inflation targeting policy, the need of this complete study is increasing. Accordingly, this research attempts to increase the knowledge base by examining various channels of the MTM for Egypt.

1.3. Research objectives

The key purpose of this research is to investigate the MTM's channels in Egypt over the last four decades, in order to specify the relative important channels of MTM. The purpose of this research is not only specifying the important channels but also considering the reasons for the less effectiveness or significance for these channels (i.e. consumers' expenditure, investment expenditure, the interest rate, bank lending and the exchange rate).

To achieve these objectives, this thesis will start, in chapter 2, by an intensive study of the Egyptian economy during the last four decades. This analysis will focus on developments,

trends, and main events which shaped the economy in the past and the present, and, in turn, in the future. In addition, using advanced econometric techniques suitable for the data and the research objectives will be the keystone for answering the thesis's research questions, in chapters 3, 4, 5, 6 and 7.

1.4. Research Questions

This research has many questions to answer, but I can mention here some of these questions that, from my point of view, are more important such as:

1. Does a stable consumption function exist in Egypt? If it does, what is the impact of financial wealth, the interest rate and bank lending?
2. Does uncertainty affect the private investment expenditure in Egypt? and What is the other variables that determine the investment in Egypt?.
3. Does the interest rate channel exist in Egypt in the long-run?
4. Does the bank lending channel play a significant role in the Egyptian economy?
5. Does the exchange rate channel exist in Egypt under the regime shift?

1.5. Research Methodology

To answer the research questions, the research will apply quantitative (econometric) analysis to examine the relationship between macroeconomic and monetary variables in the Egyptian economy. The time series analysis will be used to investigate the transmission mechanism of monetary policy in Egypt.

Annual data will be used in this thesis. Selection of variables depended on theory, previous empirical studies suggestions, and the availability of data. Annual data are selected

because higher frequency data, i.e. quarterly and monthly, are not available for many variables in the case of Egypt except for recent years resulting in the limited sample size. Also, the selection of the study period mainly 1975-2010, was determined by consisting data and avoiding the extreme changes in the economy, like the war period 1967-1973 and its following years. As with all researches, the availability of data played a role in selecting the time period and variables.

Macroeconomic and monetary data are the main source of variables. Gross domestic product, gross national income, consumers' expenditure, private investment, inflation rate, monetary stance, the interest rate, bank lending, and the exchange rate are the main variables which were used in this thesis.

A number of data sources have been used. They comprise IMF databases (International Financial Statistics (IFS) and Direction of Trade Statistics (DOTS)), World Bank databases (World Development Indicators), the Central Bank of Egypt database, the Egyptian Ministry of Development[2] database, and Cairo and Alexandria Stock Exchange (CASE) database, see the data appendix at the end of the thesis.

The cointegration analysis, under the Engle-Granger Error Correction Model (ECM), is used in chapter 3 to answer the first research question. The ARDL model is used as a bounds test to check the existence of the long-run relationship between consumers' expenditure and income, financial wealth, the interest rate and the bank lending. Similarly, chapter 4 follows the same econometric methodology as chapter 3 to answer the second research question. However a GARCH model is used in order to estimate the uncertainty measure, which, in turn, was included in the estimated model of investment expenditure. Also, these two chapters were beneficiated from recursive estimation and Chow's stability

[2] This was called the Ministry of Planning, so both names will be used alternatively.

tests to confirm the stability of the estimated model. Moreover, the in-sample forecasting technique is used in these two chapters to test the forecasting ability of the estimated models.

The Johansen's cointegration analysis, the VAR and the VECM are used to answer the third research question in chapter 5. Additionally, the Granger-Causality analysis, the impulse response function and the variance decomposition are used in analysing the interest rate channel. Additionally, recursive analysis and Chow's stability tests were used to confirm the stability of the estimated model. The identification of the cointegrated vectors is used to determine the long-run relationship, and then the in-sample forecasting analysis was done to check the goodness of the estimated model in predicting the future.

The fourth research question was answered in chapter 6 by using the same econometric techniques as that were used in chapter 5, although the long-run weak exogeneity test is used. However, the fifth research question was answered in chapter 7 by using the same econometric methods as those are used in chapters 5 and 6, but with concerning the regime shift effect. The regime shift, which is affecting the stability of the estimated exchange rate channel model, required some specific treatments. These treatments can be summarised in the discussion of the effect of outliers, the econometric treatment of these outliers, the unit root test with structure break, and the cointegration test under the structure break.

1.6. Research Outline

The thesis divided into seven chapters excluding the introduction. These chapters are as follow:

Chapter 2, the development of economic policies in the Egyptian economy, discussed the Egyptian economy development during the last four decades. Economic growth and the structure of economy were illustrated in beginning of this chapter, which draw the main

features of the economy. Then the Economic Reform and Structural Adjustment Programme (ERSAP) had discussed in some details. The ERSAP divided into two main parts. The first part is the economic reform (stabilisation) programme, which contains fiscal policy, monetary policy and the exchange rate system. And the second part is the structural adjustment programme, which contains public enterprise reform, pricing policy, foreign trade policy and private sector reform. Therefore, the conducting of monetary policy by the central bank of Egypt was discussed, and then the banking sector structure was illustrated. The interest rates and the bank lending development explained. In addition, the development in the exchange stock market and the exchange rate regime were described. Finally, the development of the unemployment ratio, and the distribution of unemployment between men and women illustrated at the end of this chapter.

Chapter 3, modelling the consumers' expenditure in Egypt, surveyed the literature and theories of consumption function, like Keynesian, permanent income hypothesis, random walk hypothesis, the rational expectations-permanent income hypothesis (REPIH), the pure life cycle-permanent income hypothesis (LCPIH), and the rule-of-thumb model. Then, it surveyed the determinants of the consumers' expenditure. The econometric methodology, data, econometric model and empirical results were followed each other and the chapter ended up with the conclusion.

Chapter 4, estimating the investment expenditure under uncertainty in Egypt, discussed the determinants of investment expenditure and surveyed the investment theories, like the Keynesian-Kalecki, the accelerator, the neoclassical, the Tobin's *q*, uncertainty and irreversibility of investment. Then, econometric methodology and data sections provide details about the econometric techniques and the variables which have been used in estimating

the investment expenditure model. Both econometric and empirical results sections provided in details discussion of the estimated model.

Chapter 5, investigating the interest rate channel in Egypt, explained the theoretical background of the interest rate channel and the empirical studies' results of this channel in Egypt and other countries. The econometric methodology was discussed in some details, and then the data section illustrated the developments of the variables. The econometric model section explained the estimated model and the relationship, i.e. the short- and long-run, between variables. However, the summary of results section explained the results of the estimated model and its predictability of future, and then the chapter ended up by the conclusion.

Chapter 6, investigating the bank lending channel in Egypt, started by surveying the literature of the credit channel, i.e. the bank lending channel, the balance sheet channel and the bank capital channel, and the relation between the credit channel and trade credit. The evidence from Egypt and other economies is summarised in a separate section. The methodology, data and econometric model contained the main discussion of variables and the relationship between these variables, i.e. the estimated model. Although, the summary of results section was explained the results and checked the predictability of the estimated model.

Chapter 7, estimating the exchange rate channel with regime shift in Egypt, discussed the exchange rate channel and other related topics, like the exchange rate pass-through, uncovered interest rate parity, exchange rate and trade, exchange rate and investment, and the relationship between the exchange rate channel and the credit channel. Therefore, the evidences of the exchange rate channel from Egypt and other countries were collected in a separate section. The development of variables was explained in the section of data. The

methodology and econometric model were separated into two sections to maintain the estimated model, which, in turn, describes the relationship between the exchange rate channels. Finally, the summary of results section explained the findings of the estimated model and tested the forecasting power of it, and then conclusion finalised the chapter.

Chapter 8, conclusion and findings, concluded the results of all previous chapters.

CHAPTER 2 : THE DEVELOPMENT OF ECONOMIC POLICIES IN THE EGYPTIAN ECONOMY

2.1. Introduction

Egyptian economic history is very rich with a considerable number of important events, especially after the revolution of the *Free Officers*[3] in 23 July 1952. This revolution transferred the country from a Kingdom to a Republic. The period 1967-1974 saw main consequences of the war and the beginning of transferring to a free market economy. This chapter concentrates mainly on the period from 1975 to 2010.

Between 1952 and 1956, the economy's structure did not change from that before the 1952 revolution, the private sector continued to dominate economic activity. However, between 1957 and 1960 the government started to intervene in the economic activates gradually. In period 1961-1973 the economy saw an increasingly intervention of the government started with applying the Nationalism programme, and then the economy moved toward the socialism, which called *Arab Socialism*, and central planning.[4]

From 1974 a new economic policy has announced by President *Al-Sadat*. This new policy was *Al-Infitah*, i.e. open-door policy, which put Egypt on the way of the free market economy. However, this shift in the economic structure was slow, because until the beginning of the 1990s

[3] See Gordon (1992) for details about Free Officers and the July revolution.
[4] There are some references about this period, i.e. 1952-1973, like Ikram (2006), Aliboni *et al.* (1984), Hansen (1975), Hansen and Nashashibi (1975), O'Brien (1966) and Hansen and Mead (1965).

the private sector share in economic activities was limited. Between 1976 and 1990, extraordinary political events[5] were mirrored by the economic changes in Egypt. In 1991 Egypt applied the Economic Reform and Structural Adjustment Program (ERSAP) proposed by IMF and World Bank, which was lasted until 1996. This reform programme aimed at establish the stabilisation and structure reform for the Egyptian economy after years of economic imbalances, that put Egypt on the threshold of external debt crisis at the end of 1980s.

After the completion of the ERSAP in 1996, the 1997 Asian crisis affected the Egyptian banking sector borrowers, who were not able to return their loans. As a consequence, the non-performing loans (NPLs) in banks' balance sheets increased and the Central Bank of Egypt (CBE) and government intervened to find a solution to this crisis. The liquidity crisis in 1997-1998 increased the pressures on the economy in the time that the privatisation programme was underway. The merger and acquisition of banks are raised as a possible solution for the difficulties that had been experienced in the banking sector. At the beginning of the new century, the privatisation programme was accelerated, the interest rate became freely adjusted by commercial banks and the Egyptian pound has floated in 2003. In 2004 some indicators for a potential banking crisis were announced by some economic commentators who are interested in financial and money markets. However, these signs were removed by the end of 2004.

The CBE changed its monetary policy and adopted the inflation targeting. This new policy was launched in June 2005 when the CBE introduced the overnight interest rate corridor system. The rise of international food prices in 2007 and the financial crisis in 2008 negatively affected the Egyptian economy and the stock exchange market started to decline. Finally, the

[5] The most important political events were the Bread Riots (1977), the Camp David Accords (1978), The Peace Treaty (1979), President *Al-Sadat* Assassination (1981), Egyptian Conscription Riot (1986), The Invasion of Kuwait or Iraq-Kuwait War (1990).

Egyptian revolution of *25th of January 2011*, which comes in the same time of what so called the *Arab Awakening* or *Arab Revelations Spring*[6], put more stress on the Egyptian economy.

The main objective of this chapter is to provide the background about the Egyptian economy, which is essential to understand the Egyptian case when the empirical results and analysis are presented in further chapters. This chapter will give all the required economic background and will provide a concrete investigation into the economic development and policy making in Egypt during the period of study. This discussion will prevent us from duplicating the analysis in each empirical chapter.

This chapter discusses the economic developments in the Egyptian economy during a long time span. The hierarchy of this chapter will start by the economic growth and economy's system structure, then the ERSAP. Afterwards, the conducting of monetary policy by the CBE, the banking system structure, the interest rates and bank lending were discussed. The exchange stock market performance and the exchange rate regime were explained in a separate two section. Finally, the discussion of unemployment and the conclusion come in the last two sections.

2.2. Economic Growth and Economy's Structure

The economic growth and the changing of the economic structure in Egypt have many faces. However, the analysis of economic growth and the economic structure is a difficult process, because the major changes in the structure of the economy during 1975-2010. In this section both economic growth and economy's structure will be discussed.

[6] This expression is used by the commentators to describe the people's revelations against their political systems in Arab countries, like Tunisia, Egypt, Libya, Yemen, Syria and other countries.

2.2.1. Economic Growth

Economic growth, measured by the annual growth of GDP or GNI, in Egypt fluctuated from a very high level to a low level over the period 1976 to 2010. Generally, the initial policy period 1976-1980 experienced the highest level of economic growth; the average growth in GDP peaked at 9.9%, figure 2.1. The open-door policy and its consequences on investment played a chief role in this very high growth (WorldBank, 1980). Also, the returning of oil fields after the end of the war and the high oil prices, the increase of Suez Canal dues, and the rise of workers' remittance shared in this high growth (Ikram, 2006). The period 1981-1985 saw high growth, with an average equal to 6.8%, which reflected the decline in oil prices that was clear from 1982. The decline in GDP growth continued in 1986-1990, being 4.2% in average per annum. This decline was in a line with the sharp decline in oil prices over this period, which reached a trough in 1986[7] when the average crude oil price was 14.17 US $ per barrel, figure 2.2. Table 2.1 summarises the average growth rates of GDP and GNI during the whole period of study.

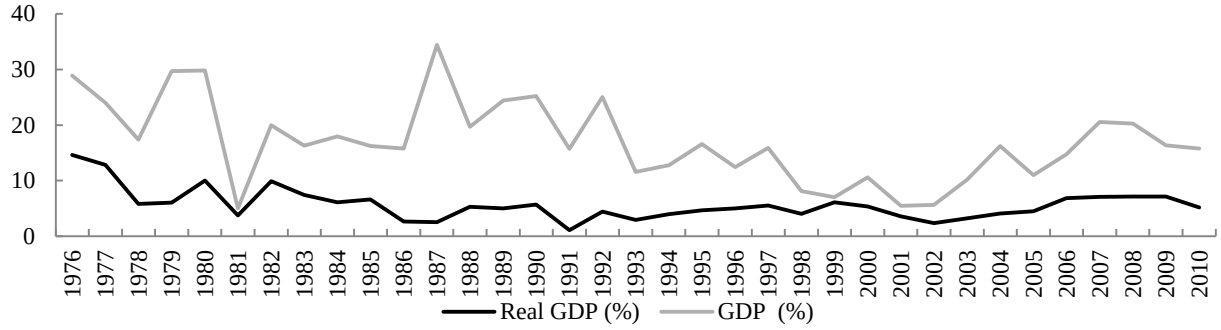
Table 2.1: Economic Growth Indicators

Period	*Real GDP (%)*	*Real GNI (%)*
Average of Period (1976-1980)	9.9	10.9
Average of Period (1981-1985)	6.8	7.4
Average of Period (1986-1990)	4.2	2.7
Average of Period (1991-1995)	3.4	2.9
Average of Period (1996-2000)	5.2	5.1
Average of Period (2001-2005)	3.5	3.8
Average of Period (2006-2010)	6.7	7.0

Source: WorldBank (2012b).

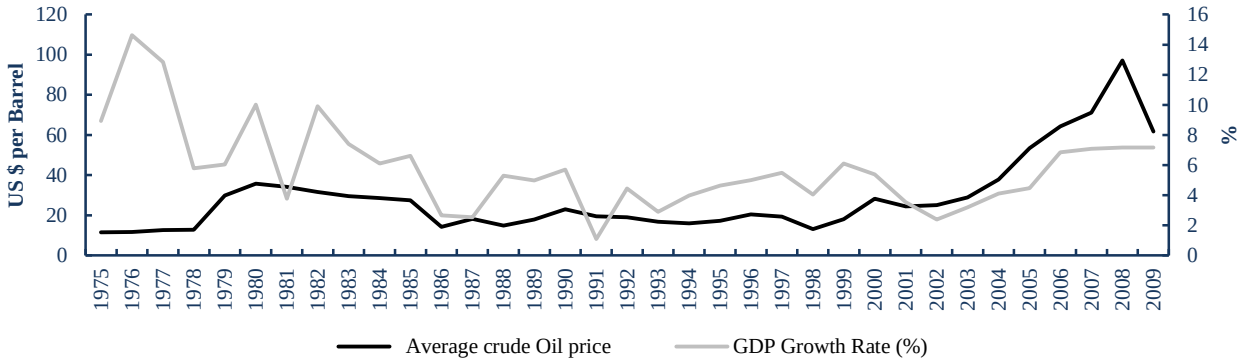
[7] Some commentators return this to the intent of the USA to affect Soviet Union's economy inversely, through declining the international oil prices. The USA convinced Saudi Arabia, which was afraid from the incursion of the Soviet Union influence in the Arab countries, to decline the oil price from 1982 (Gately, 1986). Therefore, the impact was clear in 1986 when Saudi Arabia doubled its petroleum output which declined its prices by approximately 50% in the same year (Crémer and Salehi-isfahani, 1989).

Figure 2.1: Growth Rates of GDP and Real GDP



Source: WorldBank (2012b) and MOP (2000).

Figure 2.2: Accompany between GDP Growth and Oil Price Fluctuations



Source: WorldBank (2012b) and IMF (2012b).

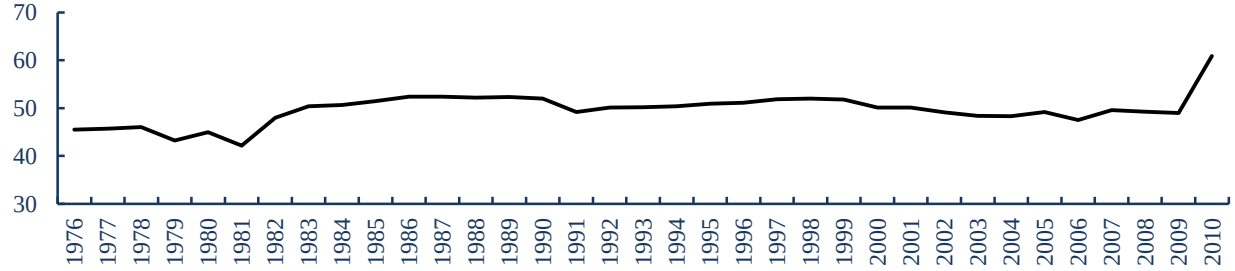
Average growth of real GDP was 3.4% in period 1991-1995. This was the lowest rate since 1976. The main reason was the contractionary effect of the ERSAP that was designed after the negotiation between Egypt and the IMF and the World Bank, which launched in 1991. In addition, the continuous decrease in oil prices affected negatively on the economic growth in this period. In the next period, 1996-2000, the economic growth improved being 5.2% per annum, which was in a line with an upward trend of global petroleum prices that jumped to 28.23 US $ per barrel in 2000. However, the negative impact of the Asian crisis in 1997 and Luxor attack in the same year, figure 2.1. The economy was sluggish in 2002 where the growth rate was at a very slow level, 2.4%. Furthermore, the Iraq War in 2003 accompanied with the slow growth, 2.3%, in

Egypt in the same year. The period 2001-2005 watched a very slow growth that reflected the regional and international events, like 11 September 2001 Attack, which left the growth rate of Egyptian economy at a low level, 3.5% per annum, figure 2.1. Recently, the Egyptian economy grew at high level 6.7% in average between 2006 and 2010, table 2.1. Furthermore, the effects of events like the food price crisis in 2007-2008, the USA subprime mortgage in 2008 and the upward trend of petroleum prices until 2008 appeared in the growth of economy, see figure 2.2.

2.2.2. Economy's Structure

The structure of the Egyptian economy changed over the years. However, the services sector maintained its share in GDP at about 50% between 1976 and 2010. The average share of services sector in GDP was 48.6% between 1976 and 1990, and it was slightly higher, 50.5%, in the next period, 1991-2010, although, the ratio peaked at 61% in 2010, figure 2.3.

Figure 2.3: Share of Services Sector in GDP (%)



Source: WorldBank (2012b)

Five sectors will be analysed in accordance to their importance in in the economy. Three of them related to production and the others are services. These sectors are agriculture, industry and mining, petroleum and its products, Suez Canal and tourism. The reason for choosing these sectors is their importance to the Egyptian economy during the period of study. The total

contribution of these five sectors was 53.3% in the first period after the war, when the open-door policy was applied. Whereas, the contribution declined gradually in the following periods before the ERSAP, being 48.7% and 44.2% in period 1980-1985 and 1986-1990, respectively, see table 2.2. After the ERSAP, the total contribution of these sectors began to increase again.

Table 2.2: Main Sectors Importance in GDP (%)

Year	Main Sectors				
	Agriculture	*Industry & Mining*	*Petroleum & Its Products*	*Suez Canal*	*Tourism*
Average (1976-1979)	*25.5*	*14.9*	*8.3*	*2.8*	*1.8*
Average (1980-1985)	*19.7*	*13.5*	*11.7*	*2.7*	*1.1*
Average (1986-1990)	*19.4*	*17.1*	*4.7*	*1.6*	*1.4*
Average (1991-1995)	*16.9*	*16.9*	*9.1*	*4.1*	*1.5*
Average (1996-2000)	*17.1*	*18.5*	*6.4*	*2.5*	*1.4*
Average (2001-2005)	*15.9*	*18.1*	*11.0*	*3.0*	*2.3*
Average (2006-2010)	*13.8*	*15.9*	*15.6*	*3.1*	*3.5*

Source: MOP (2000).

The contribution of the agriculture sector to GDP decreased steadily between 1976 and 1990; as its share declined from 28.3% in 1976 to 19.4% in 1990. The average contribution in periods 1976-1979, 1980-1985 and 1986-1990 were 25.5%, 19.7% and 19.4%, respectively. This decline can be explained by the slow-growth of this sector which was 2.6% in average before the ERSAP. However, it increased to 3.2% during 1991-2010, it still modest. The slow-growth of this sector can return in part to migration internally and externally. Internal migration from rural to urban areas, like Cairo and Alexandria, decreased the number of peasants. However, international migration, particularly to Arab Oil countries, after the war period was responsible for slow growth in the period before 1991. Furthermore, average agricultural land as a share of total Egyptian lands during 1976-1990 was about 2.6% never reached 3%.

Wahba (2007) found that the internal migration from rural to urban regions increased in 1998-2006 relative to its level in 1990-1998. However, this type of migration was relatively low. Furthermore, Wahba (2007) stressed the role of international migration on the Egyptian economy. Additionally, the average percentage of land taken up by agriculture was 3.3% during 1991-2008, which increased in cultivated lands according to the reclamation efforts. However, this ratio was still at a very modest level in a country like Egypt where the Nile River goes through its lands and it has the high Dam.

Industry and mining share in GDP remained at similar level during the majority of the period, about 33% of GDP (Ikram, 2006). However, if petroleum and its products are placed in a separate sector the picture changes.[8] The share of the Industry and mining sector decreased gradually between 1976 and 1988, since the contribution was 14.9% and 13.5% in 1976-1979 and 1980-1985, respectively. In 1986-1990, the contribution of this sector increased to 17.1% due to huge infrastructure projects, increasing the foreign investment especially Arab investors, and the increase of Islamic Capital Investment Companies (ICIC) between 1985 and 1988. Subsequently, period 1991-1995 remarked by the decline in industry and mining sector's share in GDP, and it may explain by the disappearance of ICIC from the Egyptian economy after 1988 and the impact of the ERSAP. However, this share rose in 1996-2000, when the privatisation programme speeded up, which, in turn, propagated an inflow of funds and investment. Similarly, the importance of this sector maintained approximately, 18.1% of GDP. While, this importance declined at the end of the sample period to 15.9%, the lowest during the last quarter century. This downward trend in this sector coincided with the cancellation of some investment stimuli like tax relief.

[8] Egyptian cabinet contains a separate ministry for petroleum.

The contribution of the petroleum sector in the national income varies with world oil prices fluctuations, being 8.3% and 11.7% in 1976-1979 and 1980-1985, respectively. These shares were explained by the return of Sinai Peninsula oil fields after the war of 1973 and the relatively high oil prices in this time. Although, the aggressive drop of oil prices in 1986 affected this sector growth negatively in period 1986-1990 where its contribution in the national income declined to 4.7% per annum. But, this contribution returned to rise again in 1991-1995 to be equal 9.1% of GDP. Later, in period 1996-2000 the contribution of this sector declined by approximately 30%. Dissimilarly, the importance of the petroleum sector increased to 11% of GDP in period 2001-2005, where the Iraq War II in 2003 occurred and the oil prices increased. The rise in oil prices was continuous, jumping from 53.35 US $ per barrel in 2005 to 97.04 US $ per barrel in 2008. Consequently, the share of petroleum sector in period 2006-2010 peaked at 15.6% per annum.

The services sectors in Egypt include two important sectors, the Suez Canal and tourism. Suez Canal contribution in the national income varied, on average, from 2.8% in 1976-1979 to 1.6% in 1986-1990. The decline started from 1985 and continued as the Suez Canal dues were connected to the world economic condition. Furthermore, the changes in the global oil prices affect the dues of Suez Canal; with the sharp drop in oil prices in 1986 influenced the slow-growth in period 1986-1990. Suez Canal contribution in GDP rose in period 1991-1995, reaching 4.1% per annum. However, this share declined again, becoming 3.1% in period 2006-2010.

The tourism sector contributed to 1.8% in GDP on average in years after the war, 1976-1979, and it declined to 1.1% in 1980-1985. However, it increased slightly over 1986-1990, where its share became 1.4% per annum. Also, the contribution of this sector in 1991-1995 was similar to the period before. This sector's contribution reached to the trough in period 1996-

2000, when the terrorist attack on tourists, which known by the Luxor Massacre, in 17th November 1997. The impact of this attack was distinct in next two years, which watched the lowest shares of tourism sector in the national income, 1.2% in 1998 and 1.3% in 1999, during the period 1992-2010. Later, the contribution increased gradually until it became 3.5% per annum in period 2006-2010.

Tohamy and Swinscoe (2000) assert that the share of tourism in GDP, according to the national accounts which is usually about 1%, is underestimated. Tohamy and Swinscoe (2000) found that the direct effect of this sector to exceed 4% of GDP, it was 4.4% in 1999, and the indirect effect is about 7.2% of GDP in 1999. Moreover, the tourism sector provides 1.2 million job opportunities directly and 1.5 million job indirectly. Additionally, this sector contributes by 5.1% of direct and indirect tax revenues (Tohamy and Swinscoe, 2000).

2.3. The Economic Reform and Structural Adjustment Program (ERSAP)[9]

Severe condition of Egyptian economy, massively disequilibria and unsustainable growth were the chief reasons behind the desire of Egyptian policymakers to implement the economic reform and structural adjustment program (ERSAP) in early 1990's. This programme was supported by IMF and the World Bank, since it divided into two parts the stabilisation programme, which supported by IMF Standby Agreement (SBA), and the structural adjustment programme, which designed with the World Bank and financed mainly by the Structural Adjustment Loan (SAL).

The ERSAP began in March 1990 and its ultimate goal was achieving the sustainable growth and improving living standards. This ultimate goal divided into three areas of intention

[9] This section was depended mainly on the World Bank report (WorldBank, 1991).

(WorldBank, 1991, p.10): a) macroeconomic balance and curbing inflation by stabilisation b) stimulate medium- and long-run growth by structural adjustment and c) minimise the inverse effect on poor people. The last area was supported by establishing the Social Fund for Development (SFD) which was financed by the international Development association (IDA) and other donors, which designed to minimise the reverse effect of ERSAP on poor and supporting returning Egyptian workers from Iraq (WorldBank, 1991, p.10-11).

2.3.1. Economic Reform (Stabilisation) Programme

Stabilisation programme consists of three major items: fiscal policy, monetary policy and the exchange rate system

2.3.1.1. Fiscal Policy

It was the cornerstone of the stabilisation and aims at achieve the noninflationary creditable and sustainable fiscal adjustment. This was designed to achieve sustainable government finance position, diminish the role of government in economy and avoid unnecessary contraction in growth and employment. The WorldBank (1991) summarised these reforms as follow:

- *Public sector borrowing reduction:* reducing public sector borrowing as per cent of GDP from 22% in 1991 to 1.5% in 1996. This quick reduction was planned to be achieved through reducing subsidies and public sector investment.
- *Tax revenues:* the plan was to increase these revenues through introducing the comprehensive sales tax and increase the governmental fees and services taxes.

- *Non-tax revenues:* for example the domestic prices of petroleum would increase from 56% of international equivalent in 1991 to 100% by June 1995. Also, electricity prices would increase from 59% of equivalent international prices in May 1991 to full international prices by June 1995.
- *Expenditure reduction:* the continuous shrinking of subsidies and declining the public investment from 15% of GDP in 1990 to 8.5% of GDP in 1996, which will decline the overall fiscal deficit and encourage the crowding in of private sector.
- *Deficit financing:* the finance from social security system would be limited and credit from the central bank would be totally eliminated by 1993. This would reflect in drying up the inflationary waves in economy to be less than 10% comparing with about 30% before the ERSAP. Furthermore, Treasury bills introduced as a real (non-inflationary) financing tool for the government.

2.3.1.2. Monetary Policy

Interest rate ceilings and credit rationing distorted the monetary market in Egypt before the ERSAP. In addition, banking system suffered from week supervision and regulation mechanism before 1991. All these deficiencies were eliminated under the ERSAP. Also, the direct credit from the CBE to government was prohibited and the Treasury bills instrument developed by the CBE. Additionally, the banking system encouraged private savings under the tight-money policy and low inflation after eliminating money-finance of the budget. Moreover, ceilings were imposed on major monetary aggregates which achieved 25% reduction of net credit to nonfinancial public sector in 1991-1992 and a rise of private sector credit by 10%. Furthermore, six-month deposit interest rate increased by 22-25% per annum.

2.3.1.3. Exchange Rate System

New foreign exchange regime implemented beginning from February 1991. According to this new regime the primary market operated through the CBE which includes all payments of public and private exports activities. Additionally, the secondary market includes all other transaction, especially tourism, and the prices were freely determined. The difference between these two markets does not exceed 5%. By February 1992, the unification and liberalisation of foreign exchange market occurred.

2.3.2. Structural Adjustment Programme

The aims of structural adjustment were a) reducing the role of government in economic activities and strengthen the free market mechanism, b) increasing the competition through dealing with private and public companies equally, and c) liberalise prices and trade policies to eliminate the distortions in prices and incentive systems (WorldBank, 1991).

2.3.2.1. Pricing Policy

The administrated pricing and subsidies declined in order to minimise the burden on the budget and curbing the deficit. Many sectors were under this new free pricing system, like industrial goods, energy and power, agriculture and transport (WorldBank, 1991).

2.3.2.2. Public Enterprise Reform

It is the core of stabilisation programme and it aims at improve the productivity and efficiency through the privatisation programme and the policy environment reform (WorldBank, 1991), which, in turn, requires the institutional reform and eliminating the soft budget constraint,

which was presented in easy access to public banks credit and automatic financial support from the government (WorldBank, 1991, p.19).

2.3.2.3. Foreign Trade Policy

Major non-tariff barriers (NTB) were eliminated within first two years of the programme and the tariff diminished to the reasonable level (WorldBank, 1991). Remaining NTB had abolished and the decline in the average tariff rate contained.

2.3.2.4. Private Sector Reform

Decontrolling prices, free trade, encouraging private sector, eliminating investment restrictions, like investment licensing and production licensing, were the steps that the government achieved to reform the private sector environment (WorldBank, 1991).

2.4. The CBE and Monetary Policy

Ikram (2006) pointed out that the CBE followed an ineffective monetary policy before the ERSAP, since the monetary policy instruments were very limited. In the 1980s the monetary policy instruments were loan-deposit ratio and commercial banks' partial credit ceiling (Ikram, 2006). In 1975 the CBE was free to set deposit and lending interest rates (Abou-El-Eyoun, 2003). In 1974 the CBE started in using the credit ceilings as a monetary policy instrument. In June 1988 the CBE regulations prevented commercial banks to lend public and private business sectors over 60% of these sectors' deposits in commercial banks, and, according to these regulations, the annual growth rate of credit to private sector should not exceed 8% (Abou-El-

Eyoun, 2003). The reserve requirement ratio was used from 1957 by the CBE. This ratio was around 20% during the period 1957-1975, but rose to 25% in March 1975 (Abou-El-Eyoun, 2003). Furthermore, open market operations had been used by the CBE in a few occasions before the ERSAP (Abou-El-Eyoun, 2003).

Before the 1990s the Ministry of Finance directed the CBE in order to minimise the cost of budget deficit financing through enforcing the CBE to maintain interest rates at a low level. Also, the conflict between the role of the CBE as the monetary authority and the manager of public debt complicated its role in conducting monetary policy (Ikram, 2006).

In the second half of the 1980s, Egyptian economy faced a potential financial disequilibrium with high budget deficits, 15% of GDP, and high inflation rates, exceeding 20% (Subramanian, 1997). Additionally, these high deficits resulted in an expansionary monetary policy. As a consequence, the dollarization, i.e. the foreign currency denominated deposits to domestic liquidity (M2), reached 50% and at the same time the current account deficit as a ratio of GDP was 8% which, in turn, led to the inability to service the external debt (Subramanian, 1997).

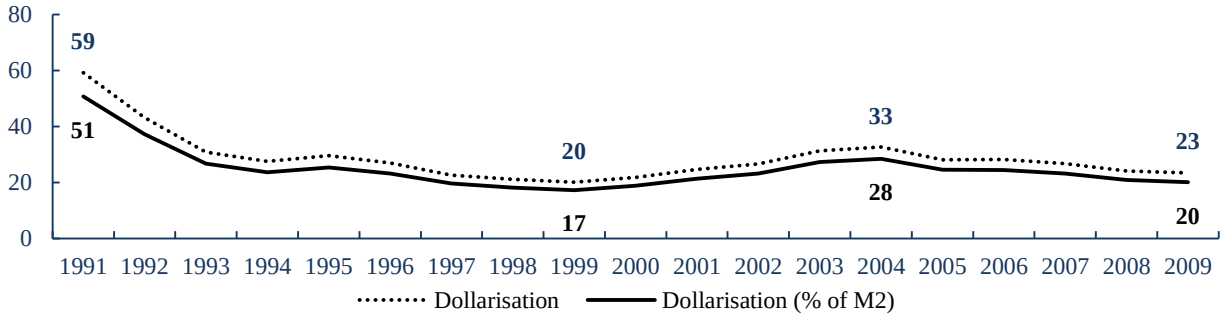
It was clear to Egyptian politicians and policymakers that the economy needs a massive restructuring of the policy framework. For this reason, an agreement with IMF and the World Bank was signed and the result was the ERSAP in the early 1990s. Additionally, the main components of this programme were curbing the budget deficit (through a massive fiscal adjustment process), unification and then liberalization of the exchange rate, and the tightening monetary policy which selected exchange rate as anchor of this policy (Al-Mashat and Billmeier, 2007). Furthermore, the ERSAP was a successful programme in returning macroeconomic stability to the Egyptian economy (Al-Mashat and Billmeier, 2007).

Monetary policy became active in the early 1990s, with the start of the ERSAP. Treasury bills auctions and its rate became one of important interest rates and an effective instrument in conducting monetary policy (Ikram, 2006). Direct credit ceiling was cancelled and the CBE used indirect instruments, like redemption and sell of Treasury bills to conduct monetary policy (Ikram, 2006). Abou-El-Eyoun (2003) mentioned that the CBE reduced the reserve requirement ratio in December 1990 to be 15%, and then the CBE changed the accounting base for this ratio in 2001 and 2002. Ikram (2006) asserted that, although many instruments were introduced by the CBE, like liquidity asset ratios, exposure regulations and capital adequacy, the most important one was repurchase operations using the Treasury bills (repos). The repos system was introduced in 1993 by the CBE, but started to play a distinct role from 1996, then it was used intensively from 1997 (Abou-El-Eyoun, 2003). The discount rate was linked to the Treasury bills rate until 1995, when the link was cancelled, which resulted in the rigidity of the discount rate (Abou-El-Eyoun, 2003).

Monetary policy applied under the ERSAP resulted in some desired changes, like curbing the dollarization phenomenon as dangerous levels had been reached. Figure 2.4 illustrates the development in dollarization, i.e. foreign currency denominated deposits to total deposits ratio, reached 59% in 1991 and declined sharply during 1992-1993. This decline was unbroken until 1999 when it bottomed out at 20%. However, the ratio increased gradually between 1999 and 2004 until the exchange rate has devaluated during this time, but after that it declined again gradually to reach 23% in 2009. Furthermore, the situation did not changed when another measure of dollarization, the foreign currency denominated deposits to domestic liquidity (M2), is used, see figure 2.4.

The second advantage of the ERSAP was the enormous accumulation of international reserves, which started from 1991. Figure 2.5 shows a dramatic change in the international reserves measured by how many months of imports it could cover. Before 1991, international reserves were covering about 1-3 months of imports, when the optimal coverage is 6 months of imports. But, from 1991 international reserves covered no less than 6 months of imports and reached about one year in 1996. This was one of advantages of the declining trend of dollarization after applying the ERSAP.

Figure 2.4: Dollarization in Egypt

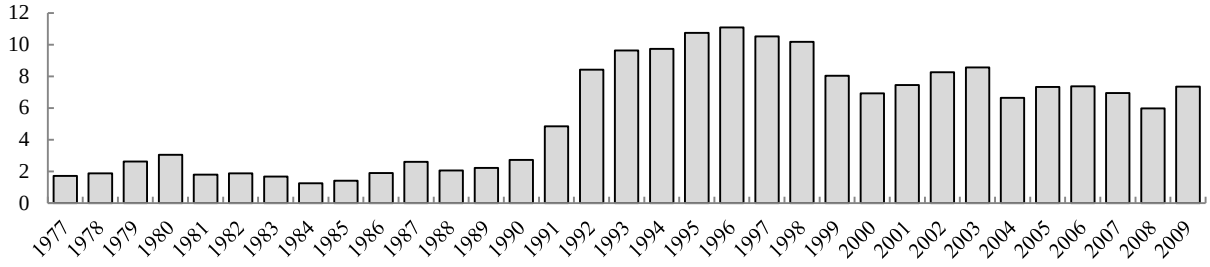


Source: IMF (2012b) and CBE (2012).

Frequent changes occurred in conducting monetary policy from 1991 as the CBE stimulates the short-term development of the real economy (Moursi *et al.*, 2006). Although the final targets of monetary policy were relatively stable, being prices and exchange rate stability, both intermediate and operational are changed over time (Moursi *et al.*, 2006).[10] To achieve these objectives the CBE used domestic liquidity, M2, growth as intermediate target and both the short-term nominal interest rate and excess reserves as operational targets (Moursi *et al.*, 2006). Figure 2.6 shows the behaviour of inflation rate with M1 and M2 growth. It is clear from mid-1980s the M2 growth was more able to predict the inflation waves better than M1 growth.

[10] Appendix (2.1) provides more details about the monetary policy objectives, targets and instruments in Egypt.

Figure 2.5: International Reserves as Months of Imports



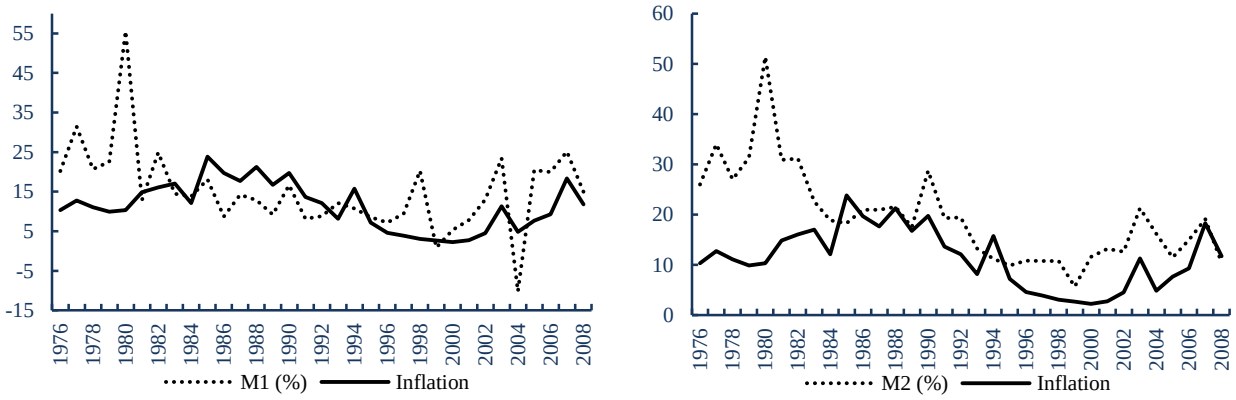
Source: WorldBank (2012a).

The CBE used many instruments to achieve its objectives, such as the required reserve ratio, reserve money, open market operations and interest rates management. The indirect instruments were used more heavily after the beginning of the economic reform in 1991 (Moursi *et al.*, 2007). In addition, the credit ceiling on private and public sectors was cancelled in 1992 and 1993 respectively (Moursi *et al.*, 2007). Throughout the period 1990-2005 intermediate targets remained, almost, unchanged with the main focus on controlling the annual growth rate of domestic liquidity, i.e. *M2*. Also, the two operational targets were nominal short-term interest rates and excess bank reserves in local currency at the CBE. In June 2005 the CBE adopted a new main operational target, i.e. the overnight interest rate on interbank transactions, instead of the excess bank reserves and other nominal short-term interest rates (Moursi *et al.*, 2006). The CBE applied the corridor system with a ceiling, i.e. the overnight interest rate on lending from the CBE, and the floor, i.e. the overnight interest rate on deposit at the CBE, in order to manage interest rates behaviour in the economy (Moursi *et al.*, 2006).

Recently, the CBE's concern of the soundness and the modernisation of the banking sector increased. Many actions were applied in different directions. In July 2003 the Central Bank, Banking Sector and Money Law has been approved to confirm the independency of the CBE (CBE, 2003, p.3), and, after that, the Electronic Signature Law was sent to Parliament in

2003 (CBE, 2003, p.3). Additionally, the prudential regulations were modified by the CBE. Further actions by the CBE were taken, like: increasing the minimum capital adequacy ratio to 10% by March 2003, additional capital injection from the government to all state-owned banks were undertaken in March 2003, and the provision levels of banks were monitored seriously by the CBE (CBE, 2003, p.4). The Audit Committees in banks became compulsory at the same time that the CBE was preparing the banking sector to adopt the Basel II requirements (CBE, 2003, p.5).

Figure 2.6: Inflation and Money Aggregates



Source: IMF (2012b).

The Central Bank, Banking Sector and Money Law, i.e. Law no.88 of 2003, established the Monetary Policy Coordination Council (MPCC) which was responsible for determining the monetary policy objectives (CBE, 2003, p.6). According to the restructuring of the CBE, a new unit was established, i.e. the Monetary Policy Unit (MPU) which was responsible for reporting to the CBE's Governor directly about the developments in the monetary policy (CBE, 2003, p.6). The CBE began to accept short-term deposits from banks for 7, 14, and 28 nights of maturity and

the reserve requirements were changed by excluding Treasury bills of less than 15 days of maturity (CBE, 2003, p.6).

Noureldin (2005) points out that understanding the monetary transmission mechanism process and channels by the CBE leads to better design and implementation of monetary policy. Also, accurate selection of intermediate variables that should be monitored by the CBE to control prices and output is important. It also allowed the estimation of the lag between change in policy instrument and effects on prices level and output, and achieving the desired level of expansionary or contractionary of monetary policy. Furthermore, Abou-El-Eyoun (2003) asserts that an effective monetary transmission mechanism is an important factor lies behind monetary policy success. Moreover, in the case of Egypt, this factor is more important when the CBE intends to adopt the inflation targeting policy (Abou-El-Eyoun, 2003).

The CBE (2003) asserts that the Central Bank of Egypt intended to adopt the inflation targeting policy and according to this policy some requirements are needed. The most important requirements are summarised in (CBE, 2003, p.8) as follow:

> Monetary policy targeting inflation will be executed through affecting short-term money market interest rates as the operational target and the reserve money as the nominal anchor...Transmission mechanism and channels of the monetary policy actions have to be defined taking into consideration the characteristics of the Egyptian economy.

2.5. Banking System, Interest Rates and Bank Credit

This section will discuss three important issues: the banking sector structure, the interest rates and the bank lending in Egypt in the last four decades.

2.5.1. Banking System's Structure

The first financial institutions had introduced to Egyptian economy were commercial banks. Many reasons delayed the appearance of commercial banks in Egypt, like Islamic view about usury, financial instability, low income per capita and savings, and limited experience about bank's operations (Mohieldin, 2001). In 1830 the Egyptian government tried to establish the first government-owned bank, but it failed according to inability to raise the required capital (Mohieldin, 2001). The Bank of Egypt was the first bank, which had established in 1856 with a head office in London to encourage trade between Egypt and Britain (Mohieldin, 2001). Later, in 1911 the Bank of Egypt was forced into liquidation as a result of financial crashes in late 1900s after the excessive speculation in land, shares and cotton (Mohieldin, 2001). In 1898 another commercial bank, the National Bank of Egypt (NBE), was established with head office in Cairo, and it was responsible for issuing banknotes (Mohieldin, 2001). Mohieldin (2001) pointed out the NBE worked as a government advisor and its main objective was providing the short-term finance for big cotton cultivators, where cotton was the main export of Egypt until 1970s. In 1920 the Bank of Misr, BM, was established to be the first bank owned mainly by Egyptians. In 1952 Banque du Cairo, BdC, was established and was followed by Bank of Alexandria, BoA, in 1975.

The nationalisation program in early 1960s resulted in transferring the ownership of the commercial banks to the government. In 1961 the NBE was divided into two banks. The first took the same name, the NBE, and worked as a commercial bank and the second became the Central Bank of Egypt (Mohieldin, 2001). Later, after the open-door policy, foreign capitals were allowed to participate in joint-venture commercial banks, according to the law 43 for 1974 and the law 32 for 1977, however this participation should not exceed 49% of ownership (Mohieldin,

2001, p.14). As a consequence, the number of commercial banks increased from 4 in 1975 to 44 in 1986, see table 2.4.

Mohieldin (2001) pointed out that the ERSAP encouraged the increasing of private sector participation in commercial banks. In 1994 the government requested from the four public banks to reduce their shares in joint-venture commercial banks to less than 51%, and in 1996 they required to decrease their shares to a maximum 20%. According to the CBE's plan, i.e. the divesture of state-owned banks, the public banks sold their shares in some commercial banks (CBE, 2008b), see table 2.5. Moreover, according to the CBE's plan, i.e. the privatisation and consolidation, many banks' merger and acquisition occurred; see table 2.3 and table 2.6.

Table 2.3: Banks' Acquisitions in Egypt

Acquired Bank	Acquirer	Acquisition Date	%	Acquisition Price (LEmn)	Deal Value (LEmn)
Misr America International Bank	Arab African International	May-05	100	239.5	239.5
Egyptian Commercial Bank*	Piraeus	Jun-05	88	20	169
Suez Canal Bank	Arab International Bank	Aug-05	16.8	10	48.2
Misr International Bank	NSGB	Sep-05	90.7	43.2	2,204.00
Misr Romania **	BLOM Bank	Dec-05	99.4	11.8	590
Egyptian American Bank	Credit Agricole	Feb-06	74.6	45	2,176.60
CIB***	A consortium led by Ripplewood Holdings	Feb-06	18.7	53.5	1,302.50
Cairo Far East	Audi Bank	Mar-06	99.7	205.3	540.1
Misr Iran Development Bank	National Investment Bank	Apr-06	29.9	223.4	107.7
Delta International Bank	A consortium led by Ahli United Bank	Aug-06	89.3	37	1,652.00
Alexandria Commercial Maritime	Union National Bank	Aug-06	94.8	23	244.5
Bank of Alexandria	San Paolo	Dec-06	80	72	9,215.00
National Development Bank	Abu Dabi Islamic Bank	Jul-07	51.3	11	159.1
Al Watany Bank of Egypt	A consortium led by National Bank of Kuwait	Dec-07	98.1	77	5,660.20
Total				**1071.7**	**24308.4**

*In June 2005, Piraeus acquired around 69% of the Egyptian Commercial Bank, bringing its total stake to 88.0%.
**In December 2005, Blom Bank acquired around 84% of Misr Romania Bank, in which it originally owned 12.5%, bringing its total stake to 96.7%.Later on, it raised its stake to 99.4%.
***Currently, the Consortium's stake in CIB is 5.6%
Source: CBE (2012), MOF (2012) and GIH (2008).

Table 2.4: Egyptian Banking Sector Structure (1970-2003)

Year	Commercial Banks				Non-Commercial Banks										Total	
	Public Sector Banks		*Private & Joint Venture Banks*		*Business and Investment Banks*				*Specialized Banks*							
					Private & Joint Venture Banks		Off-Shore Banks		The Egyptian Industrial Development Bank		The Arab Egyptian Real Estate Bank		Principal Bank for Development &Agricultural Credit.			
	Banks	Branches	Banks	Branches	*Banks*	*Branches*	*Banks*	*Branches*	*Banks*	*Branches*	*Banks*	*Branches*	*Banks*	*Branches & village Banks*	*Banks*	*Branches*
1970	5	347							1	3	2	3	17	121	25	474
1975	4	388			1		2				2	18	17	121	26	527
1980	4	449	15	34	7	5	22	30	1	3	2	20	1	879	52	1420
1986	4	633	40	199	11	35	22	51	1	3	2	11	1	886	81	1818
1987	4	644	40	209	11	45	22	47	1	3	2	11	1	886	81	1845
1989	4	663	40	221	11	43	22	46	1	3	2	11	1	895	81	1882
1990	4	663	40	221	11	43	22	46	1	3	2	11	1	895	81	1882
1991	4	663	40	221	11	43	22	46	1	3	2	11	1	895	81	1882
1992	4	772	40*	254	11	74	22	45	1	8	2	15	1	953	81	2121
1993	4	811	26*	253	11	74	21**	36	1	8	2	15	1	953	66	2150
1994	4	831	24*	261	11	80	21	39	1	8	2	18	1	954	64	2191
1995	4	851	24	273	11	86	21	38	1	9	2	19	1	965	64	2241
1996	4	866	24	288	11	88	21	41	1	14	2	21	1	967	64	2285
1997	4	883	24	298	11	90	21	42	1	14	2	22	1	976	64	2325
1998	4	908	24	312	11	98	20**	42	1	14	2	23	1	994	63	2391
1999	4	918	24	323	11	105	20	45	1	14	2	25	1	1004	63	2434
2000	4	913	24	340	11	112	20	47	1	14	1***	26	1	1029	62	2481
2001	4	921	24	367	11	126	20	51	1	14	1	26	1	1031	62	2536
2002	4	919	24	375	11	136	20	58	1	14	1	26	1	1033	62	2561
2003	4	917	24	383	11	148	20	59	1	14	1	27	1	1034	62	2582

Note: Egyptian banks abroad are not included, also two banks established under private laws and are not registered with CBE: the Arab International Bank, and Nasser Social Bank.
* 13 banks of the development banks had been merged into the National bank for Development in Cairo in 1992 and 2 banks in 1994, also Bank of Credit and Commerce (Egypt) had been merged in Misr Bank in 1993.
** One branch of the foreign banks operating in Egypt was crossed out in 1993 and other one in 1998.
*** The Egyptian Real Estate Bank had been merged in the Arab Real Estate Bank in December 1999 according to the CBE decision in 21/6/1999.
Source: CBE (2012).

Table 2.5: Sales of Public Banks' Stakes in Joint Ventures

Divested Public Bank	Acquirer	Acquired Shares in Joint Ventures
National Bank of Egypt	Ripplewood Consortium	Commercial International Bank
	Arab Banking Corporation International	Suez Canal Bank
	Societe Generale	National Societe Generale Bank
Banque Misr	National Societe Generale Bank	Misr International Bank
	BLOM Bank	Egypt Romania Bank
Banque du Cairo	Arab African International Bank	Misr America International Bank
	Audi	Cairo Far East
	Union National Bank	Alexandria Commercial and Maritime
Bank of Alexandria	Barclays	Cairo Barclays
	Piraeus	Egypt Commercial Bank
	Credit Agricole	Egypt American Bank
	Shareholders in Delta International Bank	Delta International Bank
	National Investment Bank	Misr Iran Development Bank

Source: CBE (2012), MOF (2012) and GIH (2008).

Table 2.6: Banks' Mergers in Egypt

First Bank	Second Bank	New Entity	Date
American Express Bank (Branches in Egypt)	Egyptian American Bank	Egyptian American Bank	Sep-04
Misr Exterior Bank	Banque Misr	Banque Misr	Sep-04
Credit Lyonnais Branch	Credit Agricole Indosuez	Calyon	Mar-05
Misr America International Bank	Arab African International Bank	Arab African International Bank	Sep-05
Mohandes Bank	National Bank of Egypt	National Bank of Egypt	Oct-05
Bank of Commerce and Development	National Bank of Egypt	National Bank of Egypt	Dec-05
Nile Bank with Islamic International Bank for Investment and Development	United Bank of Egypt	United Bank of Egypt	Jun-06
Egyptian American Bank	Calyon	Credit Agricole Egypt	Sep-06
Misr International Bank	National Societe Generale Bank	National Societe Generale Bank	Nov-06
Banque du Caire	Banque Misr	Banque Misr	Feb-07

Source: CBE (2012), MOF (2012) and GIH (2008).

The bank classifications were abolished upon the issue of the Law No. 88 of the Central Bank, the Banking Sector and Money, in June 2003.The structure of banking system in Egypt consists of 6 public banks, 27 private and joint venture banks, and 7 branches of foreign banks[11] (CBE, 2008a).[12] The number of the foreign banks' branches declined from 20 in 2002 to 7 according to the privatisation and consolidation plan (CBE, 2008b). Also, the

[11] These banks are National Bank of Abu Dhabi, Citi Bank NA-Egypt, Arab Bank PLC, The Bank of Nova Scotia, Mashreq, National Bank of Greece and National Bank of Oman S.A.O.G.
[12] See the notes of table 2.4.

banking density declined from 24.9, measured by thousands of population per banking unit, in 2004 to 22.3 in 2010 as a result of increasing number of banks' branches, see table 2.7.

Table 2.7: Egyptian Banking Sector Structure (2004-2010)

Year	Public Sector		Private & Joint		Off-Shore Banks		Total	
	Banks	Branches	Banks	Branches	Banks	Branches	Banks	Branches
2004	7	2153	35	571	19	59	61	2783
2005	7	2185	34	607	11	49	52*	2841
2006	7	2222	29	674	7	48	43**	2944
2007	6	2074	28	930	7	52	41**	3056
2008	6	2089	27	1145	7	63	40**	3297
2009	5	2088	27	1270	7	85	39**	3443
2010	5	2080	27	1329	7	93	39	3502

* The decrease was mainly because seven branches of foreign banks ended their business.
** The decline is ascribed to cases of bank mergers and acquisitions according to the CBE banking reform plan.
Source: CBE (2012).

2.5.2. Interest Rates

The CBE stared to use interest rates as a monetary policy instrument in 1975, when the Law 125/1975 permitted the CBE to determine the discount rate, deposit rate and lending rate without restricted limits of the interest rates that the Egyptian Civil Law had determined (Abou-El-Eyoun, 2003). The CBE used discriminated interest rates for different economic sectors to encourage productive sectors and depressing consumer credit (Abou-El-Eyoun, 2003). For example, the discount rate had been linked implicitly with the main agriculture product, i.e. cotton, as discount rate was declining in period of harvest and marketing of cotton then it was rising in other period of the year (Abou-El-Eyoun, 2003).

During 1975-1976, the deposit interest rate was between 2% and 5% for individuals and firms, table 2.8. Furthermore, the discount rate was 6% in the same period, while the lending rate was 7-8%. From 1977 to 1989, the spread of the deposit rate increased between short- and long-term maturities, table 2.9. This spread reached to 11% between 2-week and 7-year or more maturity. Furthermore, the interest rate on investment certificates was always the highest and it reached 16.25% in 1989. In addition, the discount rate rose from 7% in 1977 to

14% in 1989, table 2.10. The structure of lending rates, between 1977 and 1981, did not differentiate between the maturity of loans or economic sectors, table 2.10. From 1982 the lending rates did not differentiate between maturities but it differentiated between sectors. From 1987 to 1989, the lending rate differentiated according to maturity and sectors, and it favoured the agriculture and industry sector comparing with services and trade sectors.

Table 2.8: Interest Rates in 1975-1976

	1975		1976	
	Deposit Rates			
	Individuals	Firms	Individuals	Firms
15-less than 1 month	2	2	2	2
1 month-less than 3 months	3	2.5	3	2.5
3 months-less than 6 months	4	3	4	3
6 months-less than a year	4.5	3.5	4.5	3.5
1 year or more	5	4	5	4
Savings Deposits (max L.E. 10000)	4		4	
	Discount Rate			
	6		6	
	Lending Rates			
	Minimum	Maximum	Minimum	Maximum
Agriculture and Industry Sectors	7	8	7	8
Services Sector	7	8	7	8
Trade Sector	7	8	7	8

Source: The CBE (2012) and Abou-El-Eyoun (2003).

Interest rates were increasing during the 1970s, and became relatively high in the 1980s, more than 18% for lending interest rate in 1989, see figure 2.7. Nonetheless, this high level of interest rate was fake because the real rates were negative during 1970s and 1980s due to the high inflation rates, figure 2.8. After the ERSAP, as inflation was curbed and nominal interest rates increased considerably, real interest rates became positive. The high interest rates in the early 1990s had been linked to the Treasury bills auctions, and had encouraged investors to buy them. The reduction in the inflation rate led to a reduction in nominal interest rates. Succeeding, when the inflation rate peaked up in 2007 and later years real interest rates returned back to suffer from negative signs, however they increased from 2009, figure 2.8.

Table 2.9: Deposit Interest Rates (1977-1989)

	1977	1978	1979	1980	1980	1981	1982-88	1989
Deposit Rates								
7-less than 15 days				4.5	4.5	5	5	5
15-less than 1 month	3	4	5	5.5	5.5	6	6	6
1 month-less than 3 months	4	4.5	5.5	6	6.5	7.5	7.5	7.5
3 months-less than 6 months	5	5.5	6	7	7.5	8.5	8.5	8.5
6 months-less than a year	5.5	6	6.5	7.5	8	9	9.5	10
1 year-less than 2 years	6	6.5	7	8	9	9.5	11	12
2 years-less than 3years	6	7	7.5	8.5	9.5	10.5	12	13
3 years-less than 5 years	6	7	8	9	10	11	12.5	14
5 years-less than 7 years	6	7	8.5	9.5	10.5	11.5	13	15
7 years or more	6	7	8.5	9.5	10.5	11.5	13	16
Savings Deposits	5	5	6	7	8	8.5	10	11
Investment Certificates	7	9	9	10	11	12	13.25	16.25

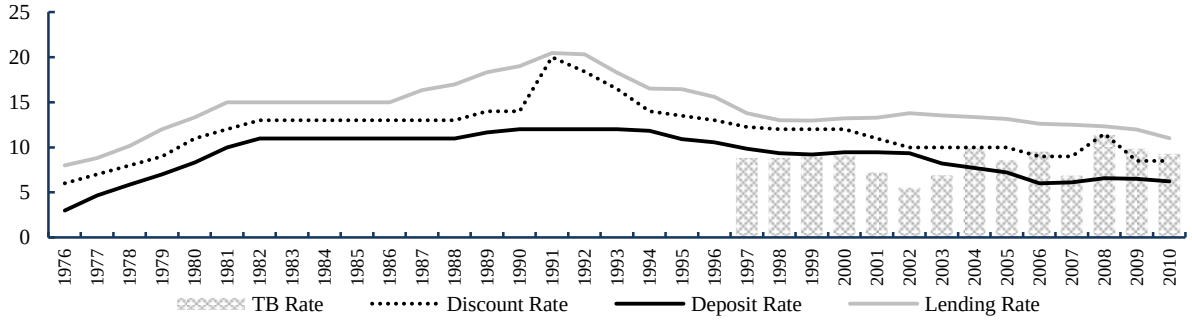
Source: The CBE and Abou-El-Eyoun (2003).

Table 2.10: Discount and Lending Rates (1977-1989)

	1977	1978	1979	1980	1980	1981	1982-86	1987-88	1989
Discount rate	7	8	9	10	11	12	13	13	14
Lending Rates									
Agriculture and Industry Sectors									
I year or less	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	13-none	11-13%	13-15%
1 year-less than 2 years	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	13-none	12-14%	14-16%
2 years or more	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	13-none	13-15%	15-17%
Services Sector									
I year or less	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	13-15%	13-15%	15-17%
1 year-less than 2 years	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	13-15%	14-16%	16-18%
2 years or more	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	13-15%	15-17%	17-19%
Trade Sector									
I year or less	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	16-none	16-none	18-none
1 year-less than 2 years	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	16-none	17-none	18-none
2 years or more	8-9%	9-11%	10-12%	11-13%	12-14%	13-15%	16-none	18-none	18-none

Source: The CBE and Abou-El-Eyoun (2003).

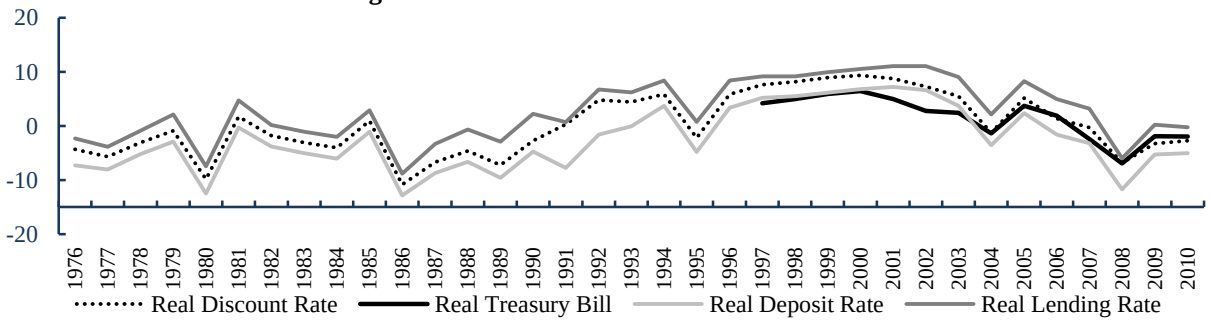
Figure 2.7: Development in the Interest Rates



Source: IMF (2012b).

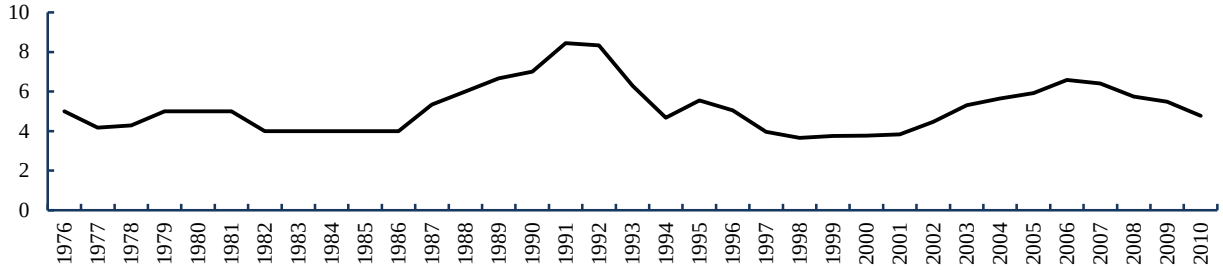
Real interest rates were negative before 1991, except for the few years when inflation rate was relatively low. These negative interest rates discouraged self-finance of economic activities and lead to high debt-to-equity ratios in Egyptian enterprises (Ikram, 2006). Domestic savings in the shape of deposits declined due to the negative interest rates, especially those that came from workers' remittances (Ikram, 2006).

Figure 2.8: Real Interest Rates Fluctuations



Source: IMF (2012b).

Figure 2.9: Interest Rate Spread (Lending Rate -Deposit Rate)



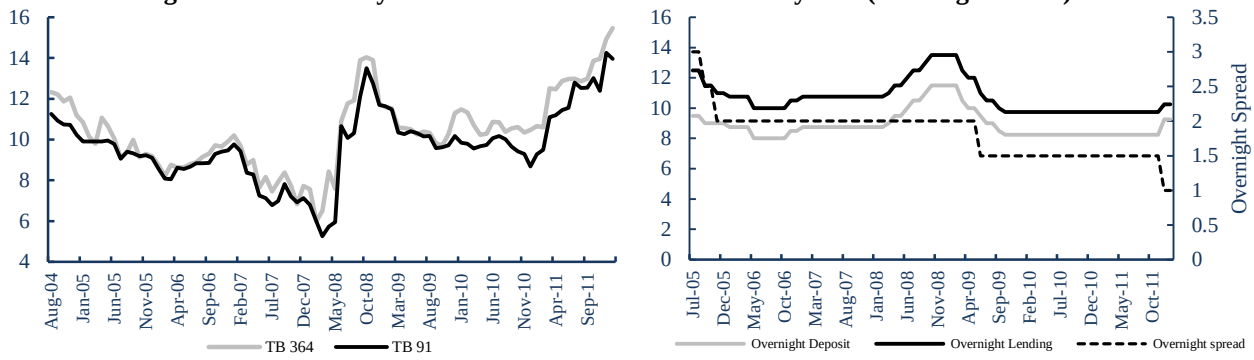
Source: IMF (2012b).

The interest rate spread, the difference between lending and deposit rates, increased in the early 1990s, and it reached its peak in 1991 at 8.5%, figure 2.9. However, this spread declined gradually during the 1990s only to increase again, becoming 6.6%, in 2006.

In the late 1980s the real discount rate was negative and both lending rate and deposit rate were controlled by the CBE. In the 1991, when the ERSAP was implemented, and until early 1998 the discount rate was 2-3% over the 3-month Treasury bills rate. In addition, the reserve requirement ratio was not used by the CBE as a determinant of the monetary stance

during the period 1985-2009 (Noureldin, 2005). The CBE had liberalized the lending and deposit rates in January 1991 (Ikram, 2006). Also, short-run nominal interest rates were affected by open market operations as these operations affected the liquidity and international reserves positions (Moursi *et al.*, 2006). In addition, the repurchasing operations of Treasury bills (repos) were used heavily in 1997-1998 to provide liquidity and to encourage economic growth see figure 2.10. After that, in 2003-2004, the CBE introduced the reverse repos of Treasury bill and permitted outright sales of Treasury bills between the CBE and the banks. Moreover, the Treasury bills reverse repos balance was replaced by CBE notes in August 2005 as a monetary policy instrument (Moursi *et al.*, 2006).

Figure 2.10: Treasury Bills Interest Rates and Corridor System (Overnight Rates)



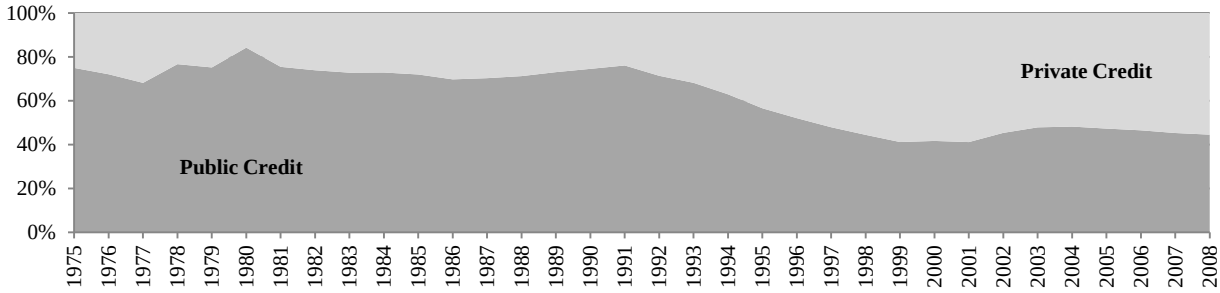
Source: Reuters (2012).

The CBE used a corridor system, i.e. overnight lending and deposit rates, as the operational target of the monetary policy from June 2005. The spread between the overnight lending and deposit rates was about 3% in July 2005, but declined to 2% by December 2005. The spread remained at 2% until April 2009, and then declined to 1.5%. Later, another decrease occurred in December 2011 which made the spread equal to only 1%, see figure 2.10.

2.5.3. Bank Credit (Lending)

Banks are the major player in the Egyptian financial market. Their main two roles are to collecting savings and deposits, and to provide funds, credit or lending. The public sector obtained over 70% of domestic credit, i.e. from banks and other sources, leaving less than 30% to private sector between 1975 and 1990. From 1991, a sharp decline occurred in credit to public sector to be less than 40% in 1990s on average. However, the share of public sector rose slightly in 2000s but it was less than 45%, figure 2.11.

Figure 2.11: Distribution of Domestic Credit between Public and Private Sectors



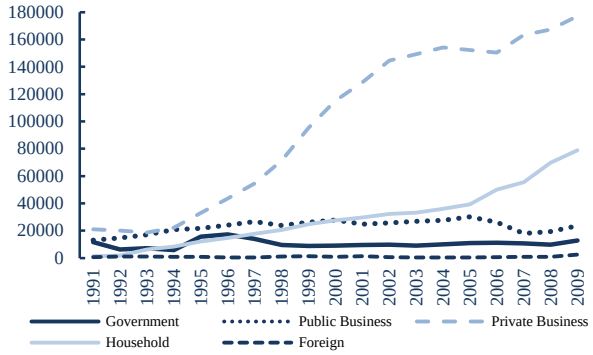
Source: IMF (2012b).

The Private sector was the main borrower, in local and foreign currencies, from commercial banks after the ERSAP, figure 2.12. Until 2005, credit in local currency to households sector and to public business sector were close, but the difference increased when household sector share grow faster than public business sector, when consumer credit encouraged by commercial banks. From 1998 the bank's credit in local currency to government was, approximately, stable. Additionally, banks' lending to these two sectors in foreign currency grew slower than that in local currency. Nevertheless, credit in foreign currencies to public business sector declined from 2003, when the exchange rate regime changed. Foreign currency credit to government had increased from 2006, when the subsidies expenditure, mainly on foodstuff, extended. Also, the share of foreign sector in banks' credit was at very low level, in local and foreign currencies, during all the period.

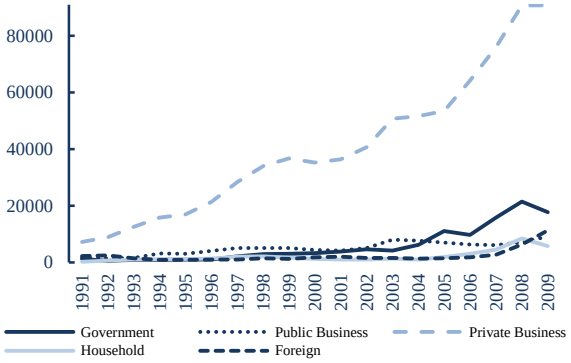
Figure 2.12: Banks' Lending by Sector

(In Million L.E.)

(a) Local Currency Lending



(b) Foreign Currency Lending



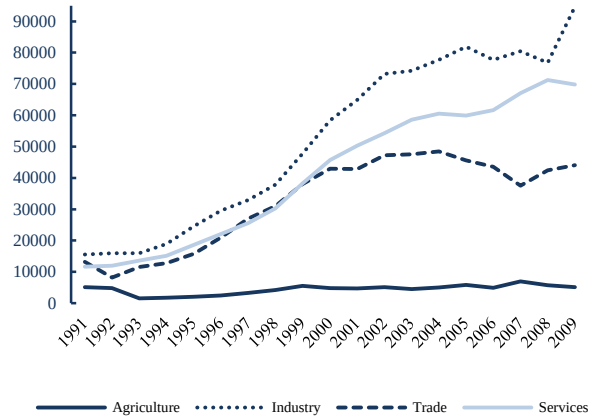
Source: CBE (2012).

Financing economic activities by banks credit was concentrated in some economic activities, figure 2.13. Industry got the lion's share in banking credit in 1991-2009, in local and foreign currency, with services being the second largest activity. The trade share was very close to the services share in local currency but then declined from 2000; a similar pattern was witnessed for banking credit in foreign currencies. In addition, the share of agriculture in banking credit was very low in both local and foreign currencies.

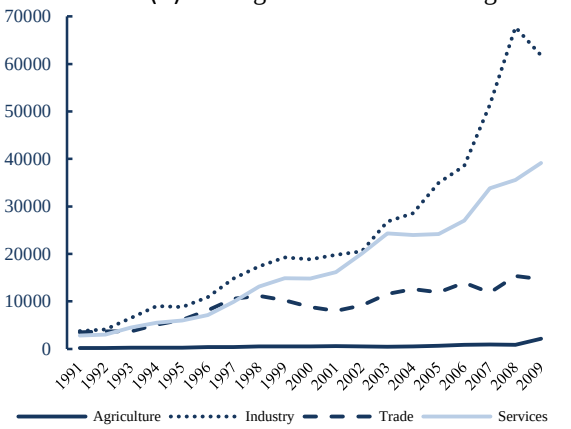
Figure 2.13: Banks' Lending by Economic Activity

(In Million L.E.)

(a) Local Currency Lending



(b) Foreign Currencies Lending



Source: CBE (2012).

2.6. Exchange Stock Market

The Egyptian stock market had two centres; Alexandria, which had established in 1883, and Cairo, which had founded in 1903 (Billmeier and Massa, 2007). The international condition in the 1940s and the 1950s, especially the cotton prices, affected the equities market (Ikram, 2006). The market was very active, for instance in 1955 turnover reached L.E. 115 million, which equals to 30% of market value of listed securities (Ikram, 2006). The nationalisation and expropriation diminished the role of this market in the economy (Ikram, 2006). The Egyptian stock market provided 25-50% of new capital to the private sector in 1958-1961, but the nationalisation and the Arab Socialism resulted in decreasing the number of listed companies to 55 in 1975 from 275 in 1958. Likewise, turnover declined to an average of L.E. 4 million in 1963-1974, from a peak of L.E. 66.7 million in 1958 (Ikram, 2006).

From the mid-1970s to the end of 1980s the stock market did not see any improvements. The ERSAP was the lifeline for the Egyptian stock market. The two markets, Alexandria and Cairo, merged to establish the Cairo and Alexandria Stock Exchange (CASE). The privatisation programme encouraged the private sector to lead the economy, which reflected on the CASE positively. However, the number of companies listed on the CASE increased from 635 in 1992 to 1136 in 2002, see table 2.11, and number of shares, in million units, increased from 396 to 4510, respectively. But, the market was relatively inactive; even if the difference between market and nominal values of capital was high, for example, it was L.E. 2.4 billion in 1994 and it doubled in 2003. The main reason behind inactivity was the non-dealing companies, which just listed in the CASE in order to beneficiate from tax advantages (Ikram, 2006).

There was a large number of non-active trading companies and a limited role of mutual funds (Mecagni and Sourial, 1999). According to the reform started in 2000, the CASE cancelled 500 stock companies from registration list for inactive and non-trading reasons, and the remaining 600 companies have a very low turnover (Billmeier and Massa, 2007). Additionally, Billmeier and Massa (2007) suggested some required enhancements in the CASE, for example appropriate secondary market supervision, develop the securitised and derivative products, improving accounting standards, and strengthen the data system.

Table 2.11: Companies Listed on the Stock Exchange (Shares and Capital)

Year	Number of Companies	Number of Shares	Nominal Value of Capital	Market Value of Capital
	Units	Million Units	In Million L.E.	
1992	635	396	6489	
1993	654	411	8433	
1994	672	424	8926	11324
1995	718	950	9476	21965
1996	680	1259	12552	29743
1997	661	1548	14964	61503
1998	702	2505	23172	70873
1999	960	3534	40897	94843
2000	1036	4450	69535	119734
2001	1072	5146	76737	110317
2002	1136	5410	89127	118673
2003	1123	5933	99029	150214
2004	803	6252	96527	172866
2005	770	6985	108209	337059
2006	656	10457	109165	377070
2007	544	14993	121072	601826
2008	377	19859	137974	813341
2009	333	22430	149587	463644

Source: CBE (2012) and CMA (2012).

The stock exchange market in Egypt is dominated by stocks comparing to bonds. In 1996 the value of bonds was 9% of stocks value, however this ratio increased in 2012 to 12% but it is still small, table 2.12. The difference between the transactions on stocks and bonds is clear and very large. Moreover, The share of foreigners in the stock exchange market declined to 24%, in the first quarter of 2012, from 35%, in the same quarter of 2011, which reflects the effect of the 25th January 2011 revolution (EFSA, 2011, 2012).

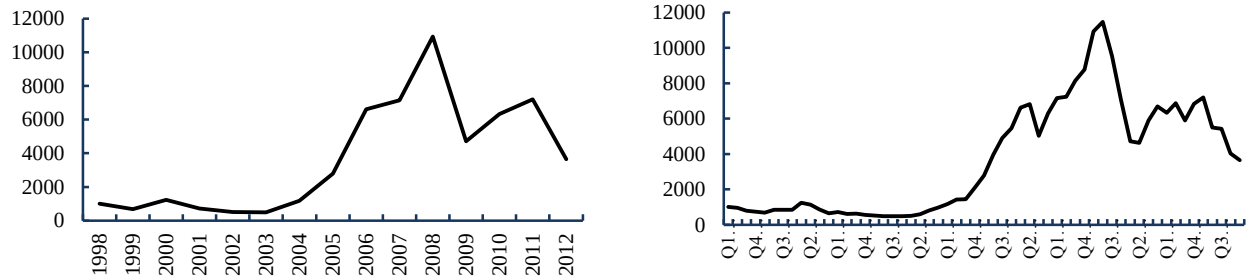
Table 2.12: The Stocks and Bonds on the Stock Exchange

Year	Stocks			Bonds		
	Transactions (In 1000)	Volume Traded (In 100000)	Value Traded (In Million)	Transactions (In 1000)	Volume Traded (In 100000)	Value Traded (In Million)
1996	479.3	1.3	4668.2	2.9	48.0	441.3
1997	2715.2	2.8	19332.3	2.1	171.3	299.9
1998	924.6	4.0	21209.2	2.4	58.6	792.4
1999	759.9	7.6	29064.5	2.2	18.5	1813.5
2000	1142.3	12.2	48750.0	1.2	26.0	2532.5
2001	1195.4	10.6	31596.4	1.2	51.5	4446.4
2002	1028.0	10.8	22157.5	1.6	133.1	13310.6
2003	889.0	10.7	21380.6	1.2	96.4	9030.0
2004	1500.3	21.1	30784.3	0.6	25.3	1632.8
2005	2435.5	32.4	76016.2	0.6	71.6	7458.9
2006	5903.4	70.1	245332.0	0.7	123.0	11348.0
2007	7706.7	112.4	260934.3	0.9	168.4	15266.1
2008	12972.8	235.9	586467.9	1.1	231.7	23941.4
2009	13145.4	318.5	290996.0	24.1	1028.5	28014.2
2010	12115.1	328.3	393886.3	1.2	464.9	47889.8

Source: CBE (2012) and CMA (2012).

The main indicator of the Cairo and Alexandria Stock Exchanges is CASE30, a free-float capitalisation weighted index of the 30 most highly capitalized and liquid stocks traded on the Egyptian Exchange.[13] Other indexes were introduced later, however CASE30 still the main and most important index of the CASE market. Figure 2.14 illustrates the fluctuations of CASE30, in annual and quarterly terms, from 1998 to 2012. CASE30 was stable and declining gradually until 2003. From 2004 it increased sharply until its peak in 2008, but it declined in 2009 due to the global financial crisis. In 2010 there was a clear improve in the index, while it declined again in 2011-2012 when the Egyptian Revolution of 25th of January started.

Figure 2.14: Annually and Quarterly CASE30 Index Developments



Source: ESE (2012) and Reuters (2012).

[13] CASE30 started in January 1st 1998 with a base level equals 1000.

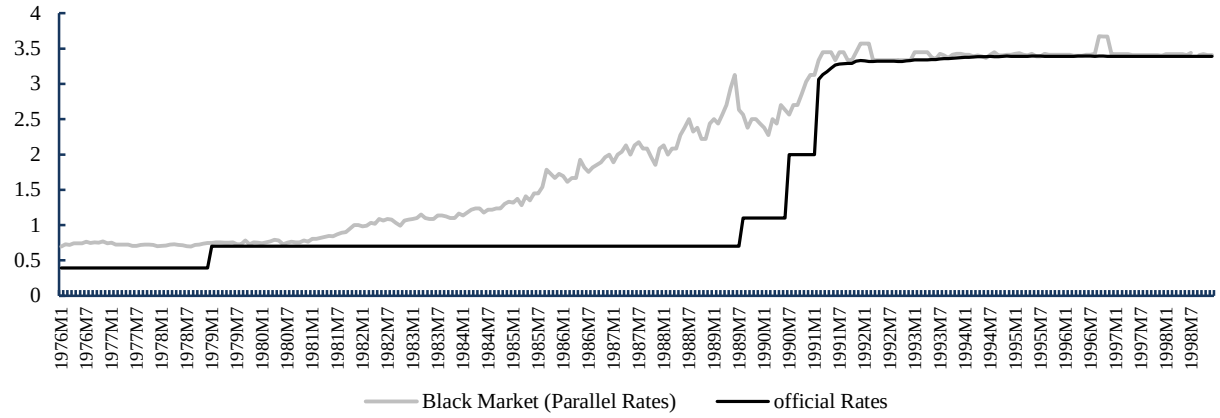
2.7. Exchange Rate Regime

The exchange rate system's structure in Egypt changed periodically in the last half century. One exchange rate of the Egyptian pound (L.E.) existed between 1953 and 1975. Then, between 1976 and 1980, two exchange rates of the pound are used in the economy, the official rate and the rate with premium (MOP, 2000). Additionally, in the period 1981-April 1987 the foreign exchange market is divided into the *central bank pool* and the *commercial bank pool*[14](MOP, 2000). However, the *central bank pool* handled the government and the public business sector transactions, the *commercial bank pool* handled mainly the private business sector and households sector transactions (Mongardini, 1998). The *non-bank free* market, which is illegal but the government did not stop it, was responsible with the *commercial bank pool* for demand and supply of non-public sectors (Mongardini, 1998). Mongardini (1998) pointed out that the exchange rate was L.E.0.7 per US dollar in the *central bank pool*, L.E. 1.36 per US dollar in the *commercial bank pool*, and it was negotiable in the *non-bank free* market.

A parallel (black) exchange rate market was active in Egypt before the ERSAP, although it was prohibited by law. The big difference between the official rate and the parallel market rate encouraged many dealers in foreign currencies to do their transactions outside of the official market, see figure 2.15. This difference, premium, widened in 1980s when the Islamic Capital Investment Companies (ICIC) entered the parallel marked and benefitted from the high premium, see figure 2.16. The parallel market dried up from 1991, after unification of the exchange rate, and the premium declined sharply until it approached to 0% by the end of 1998 by effect of the floating of the exchange rate that began with the devaluation of the currency from 1999 to 2003.

[14]This pool watched two exchange rates, the official rate between 1981 and 1986, and the rate with premium during the period 1984-1986 (MOP, 2000).

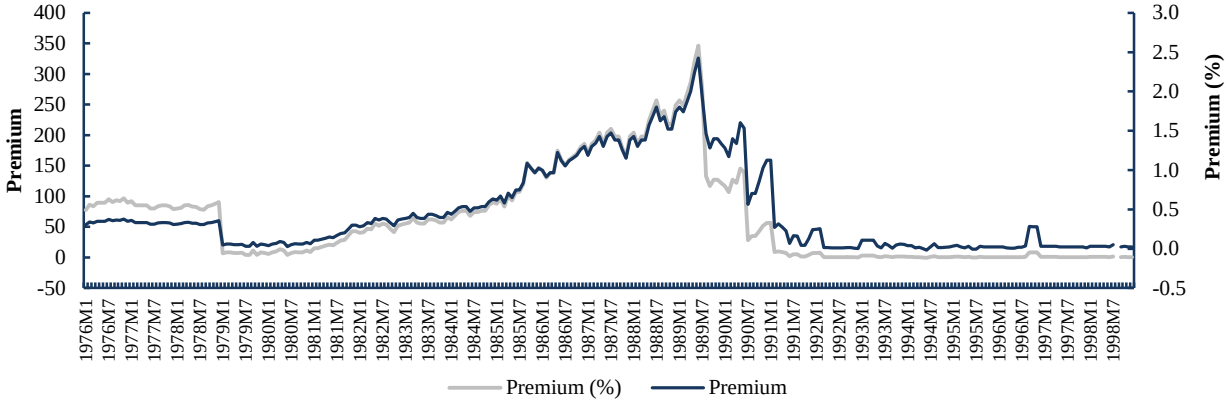
Figure 2.15: Official and Black Market Exchange Rates Developments



Source: Reinhart (2012).

Starting from May 1987 a *new bank foreign exchange* market beginning to work, which mainly contained all authorised commercial banks, with exchange rate equals *L.E.* 2.165 per US dollar (Mongardini, 1998). The exchange rate in this new market was very close to that in *non-bank free* market. Then, the commercial bank pool was dissolved in March 1989 (Mohi-Eldin and Kojok, 2002; Mongardini, 1998). A dual exchange rate system was introduced in February 1991 and divided into a primary market and a secondary market (Mongardini, 1998). The unification of the exchange rate occurred in November 1991, and then only one exchange rate is traded in the Egyptian economy (Abou-El-Eyoun, 2003).

Figure 2.16: Premium between Official and Black Market Exchange Rates



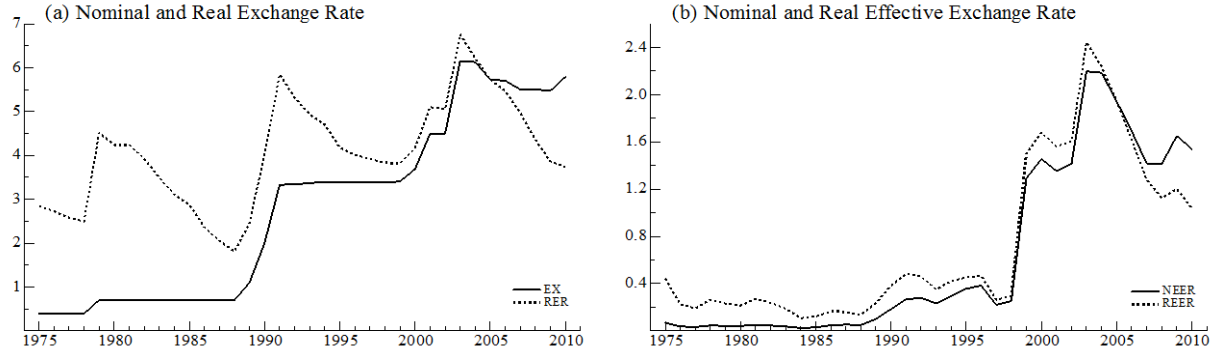
Source: Reinhart (2012).

The relation between the Egyptian pound and US dollar was stable in the 1990s. This stability can be explained by the ERSAP, declining imports due to the recession and contractionay policy, and real interests rates becoming positive (El-Bawab, 2002). The stability of the exchange rate and high interest rates encouraged foreign inflows, which resulted in an increasing trend in international reserves, see figure 2.17. However, from 1991 the US dollar appreciated which, in turn, caused the Egyptian pound, L.E, to appreciate, and this had a negative impact on exports.

In 1994, the capital mobility became full after imposing the Foreign Exchange Law no. 38, which liberalised the capital transactions in the balance of payments and banks, i.e. local and foreign, became free to deal in local and foreign currencies and transfer currencies across borders. Also, in 1997 the equity market was liberalised in Egypt (Edison *et al.*, 2004).

The Egyptian pound was pegged to the US dollar between January 1997 and December 2000 (Al-Mashat and Billmeier, 2007). The CBE intervened in the exchange rate market by decreasing the international reserves to maintain the pegged system after the sustainable balance of payments deficits (Al-Mashat and Billmeier, 2007). A series of devaluations of the Egyptian pound started in April 1999, in order to prevent the sharp decrease in the international reserves balance (Al-Mashat and Billmeier, 2007, p.15).

Figure 2.17: Exchange Rate Fluctuations



Source: IMF (2012a) and IMF (2012b).

The exchange rate was allowed to change within a band of ±1% and eventually expanded to ±3% in period between January 2001 and December 2002 (Al-Mashat and Billmeier, 2007). The official market rate was less than that in the parallel market by 15% in 2002, by the effect of the shortage of foreign exchange in the official market and the reluctance of the central bank to devaluate the currency or to decrease its international reserves less than 14 billion US dollar (Al-Mashat and Billmeier, 2007). The CBE adopted a full float exchange rate regime in January 2003 to solve the deterioration situation in the foreign exchange market (Al-Mashat and Billmeier, 2007). The expectation of public and low credibility in the new system reflected in speculative activities which, in turn, reflected in activating the parallel market at the time that interbank market was not active (Al-Mashat and Billmeier, 2007). After that, In December 2004, a new interbank foreign exchange rate market is introduced by the CBE. The nominal exchange rate fluctuated narrowly until 2009, while the real exchange rate enhanced.

2.8. Unemployment

Unemployment in Egypt has been a chronic problem. The female unemployment was always higher than that for males, with the unemployment ratio being 4 times the male rate, in 1980-1984, table 2.13. The period after the war saw a dramatic increase in international migration particularly to Arab oil countries, which eased the unemployment ratio, 5.8% in 1980-1984, figure 2.18. However, Chouri and Eckaus (1979) found that during the second half of the 1970s, the immigration of Egyptians to Arab oil countries prevented the unemployment from increasing, but it was responsible for shortages of some types of labour.

Table 2.13: Unemployment Ratio in Egypt

Period	*Unemployment (%)*		
	Female	*Male*	*Total*
Average of Period (1980-1984)	*16.1*	*4.5*	*5.8*
Average of Period (1989-1990)	*14.3*	*5.3*	*7.8*
Average of Period (1991-1995)	*21.5*	*7.0*	*10.4*
Average of Period (1996-1999)	*19.9*	*5.6*	*8.4*
Average of Period (2000-2004)	*23.5*	*6.1*	*9.9*
Average of Period (2005-2009)	*22.0*	*6.2*	*9.8*

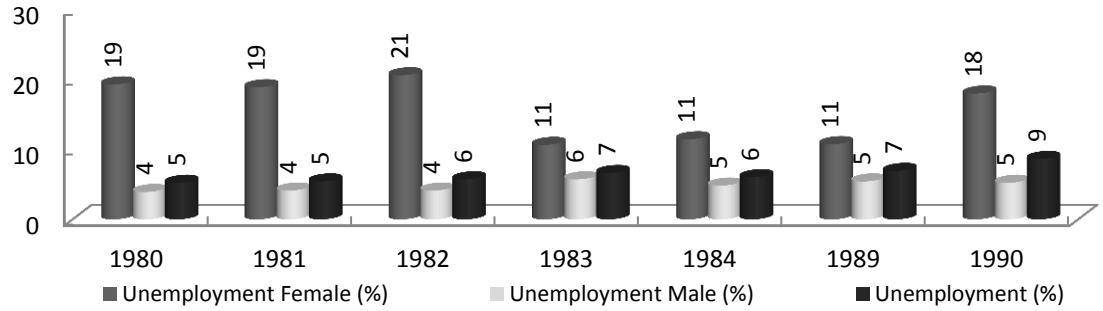
Source: WorldBank (2012b).

The unemployment ratio increased to 7.8% in 1989-1990 when the sharp decline of international oil prices handicapped the government. This restriction made the finance of the employment guarantee programme (EGP) very difficult, since the duration of unemployment increased (Ikram, 2006). Also, the unemployment ratio continued to rise in 1991-1995 when the ERSAP was applied and the privatisation programme decreased the number of workers in privatised companies[15], figure 2.19. The ratio was about 9.4% per annum in 1996-2009.

Fawzy (2002) pointed out that investment policies during 1960-2001, failed to achieve the required growth of jobs. The economic policies applied in this period, in general, resulted in a relatively low investment level which undermined the possibility of creating the required level of jobs. However, the private labour market in Egypt is fairly efficient, as there were no minimum wages and liberal hire and fire policy were common, but the unemployment was still high (Hassan and Sassanpour, 2008). This problem may be explained by skill mismatch, high reservation wage, and limited labour mobility (Hassan and Sassanpour, 2008). Furthermore, it is argued that the growing economic sectors were not those responsible for generating new jobs in last decade.

[15] See Paczyńska (2009) for the effect of the privatisation programme in Egypt on the labour market.

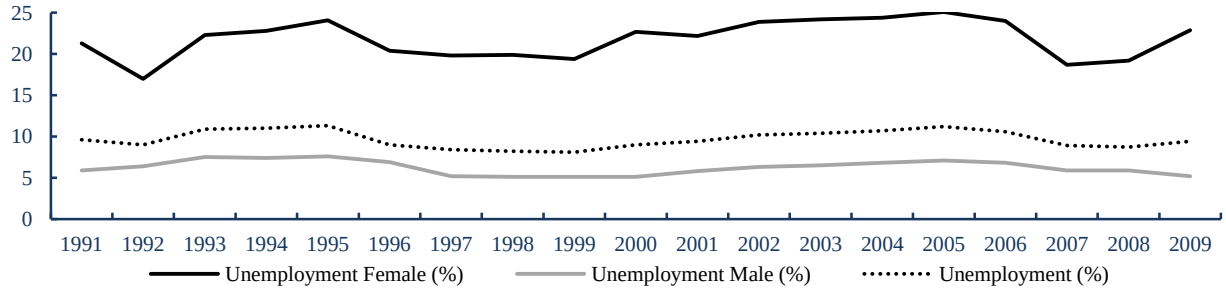
Figure 2.18: Unemployment Ratio (1980-1990)



Source: WorldBank (2012b).

Wahba (2009) found that the new labour Law of 2003, which smooth the hiring and firing, had a positive effect on those employed in formal employment in the private non-agricultural regular sector, but its effect was insignificant for new entrants to the labour market looking for first jobs.

Figure 2.19: Unemployment Ratio (1991-2009)



Source: WorldBank (2012b).

The share of the informal sector in small enterprises in Egypt was stable between 1988 and 1998, being 82.9% and 83.6% in these two years respectively (El-Mahdi, 2002). Furthermore, the share of informal sector in the Egyptian labour market is about 40%, and it includes 88% of self-employed labour (Garcia-Bolivar, 2006). This sector had assets equivalent US$ 248 billion, which is 6 times more than savings and time deposits in commercial banks and 30 times more than the market capitalization of all the firms trading on the CASE (Garcia-Bolivar, 2006).

2.9. Conclusion

Many changes in the Egyptian economic policies can be observed from a look at its history. Moving from a kingdom, in early 1950s, to a republic led Egypt to move from a free market to a planned economy. Not only was the desire of *Free Officers*, under the leadership of President Abdel-Nassir, to reduce the wealth inequality between Egyptian, but also increasing their popularity behind the transfer from free market economy to an Arab Socialism country. The political position of the Western countries concerning the Arab-Israel conflict pushed Egypt, as an Arab country, toward Eastern campaign under the leadership of the Soviet Union. When the war period, 1967-1973, ended up and President *El-Sadat* accepted the intermediation of Western countries, under the leadership of the USA, to settle the Egyptian-Israeli situation, Egypt moved toward the Western free market economy. The first step toward the free market was the open-door policy, *Al-Infitah*, in 1974.

Economic growth in Egypt was high in the second half of 1970s and in 1980s when the foreign inflow, from workers' remittance, grants and external debt, increased sharply. The accumulation of external debt induced many restrictions on the economy at the end of the 1980s. The Paris Club agreement in 1991 and the ERSAP in early 1990s were the main weapons that Egypt used in its fight against the massive economic difficulties. Budget deficits were curbed, which declined the inflationary pressures. The interest rates increased and it became positive in real terms, which resulted in a decrease of dollarization and the high accumulation of international reserves in the 1990s. The CBE became able to conduct monetary policy relatively free in recent years. The bank credit to economic sectors changed to increase the share of non-public sectors. Also, the exchange rate floated gradually from 1999 to become full floated system in 2003. However, the unemployment ratio fluctuated during the period of study but it was relatively high in recent years.

To sum up, the Egyptian economy witnessed some ups and downs. The ERSAP stabilised the economy in the 1990s and succeed in providing the basic structural reform required for economy. Egypt requires more reforms through active players in economic sides like the government, the private sector, public and civil society associations. Also, high quality data with a high frequency should be provided and updated regularly in order to help the researchers and policy makers to determine the source of economic problems and propose the suitable remedies.

Appendix (2.1): The Developments of Monetary Policy in Egypt

This appendix summarise the chronology of developments in monetary policy. This developments concentrate on the policy objectives, targets (operational and intermediate), and instruments. Table 2.14 summarises briefly this chronology from 1991 to 2011.

Table 2.14: Chronology of the Monetary Policy Objectives, Targets and Instruments in Egypt

Year	Objective	Target		Instruments
		Operational	Intermediate	
1990/1991	PLS ERSTAB	ERES SNIRM	NAB	• Nominal interest rate liberalization with 12%. • Floor on 3-month deposit rate. • Modify calculations of RRR. • DLR=20%, FLR=25%. • Use OMO. • Exchange rate liberalization and unification. • DRRR=FRRR=15%. • Relate discount rates to Tb interest rates. • Ceilings on bank credit to control monetary expansion.
1991/1992	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Interest rate liberalization without interest rate ceilings. • Eliminate credit ceilings for private sector. • Exchange rates unification. • Issue Tb with different maturities. • DRRR=FRRR=15%. • DLR=20%, FLR=25%. • Increase 3-month deposits interest rate to 16.7%. • Decrease 182 days Tb interest rate to 17.9%. • Modify banking and credit legislation. • Decrease DR to 19.8%.
1992/1993	PLS ERSTAB Control ME Reduce interest rate on L.E.	ERES SNIRM	DOMLIQ	• Eliminate credit ceilings for public sector. • Cancel 12% floor for 3-month deposits. • Decrease issue of Tb. • Increase credit available to private sector. • DRRR = FRRR = 15%. • DLR=20%, FLR=25%. • Decrease DR to 17%.
1993/1994	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Decrease DR to 15.25%. • Decrease 3-month deposits interest rate to 10.81%.
1994/1995	PLS ERSTAB Control ME Output growth	ERES SNIRM	DOMLIQ	• Decrease DR to 14%. • Decrease 3-month deposits interest rate to 10%. • Decrease 182 days Tb interest rate to 11.1%. • Decrease interest rate on (≤ one year) loans to 14.6%. • Issue Tb with 5 years maturity.
1995/1996	PLS ERSTAB Control ME	ERES SNIRM	DOMLIQ	• Decrease DR to 13.5%. • Decrease 182 days Tb interest rate to 10.2%. • Increase 3-month deposits interest rate to 10.2%. • Decrease interest rate on (≤ one year) loans to 13.8%.

1996/1997	Promote invest Economic growth Monetary stability	ERES SNIRM	DOMLIQ	• Decrease DR to 12.25%. • Decrease 3-month deposits interest rate to 9.9%. • Decrease 182 days Tb interest rate to 8.9%. • Decrease interest rate on (≤ one year) loans to 13.2%. • Issue government bonds with value L.E. 4 Billion. • Maintain RRR at 15%.
1997/1998	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Maintain DR at 12.25%. • 19 Repos injecting liquidity by LE 7.5 Billion. • Decrease 3-month deposits interest rate to 9%. • Maintain interest rate on (≤ one year) loans at 13.2%. • Maintain 182 days Tb interest rate at 8.819%. • Increase bank lending to the private sector.
1998/1999	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Decrease DR to 12%. • Increase Repos to LE 60.1 Billion. • Issue treasury bonds with value LE 6 Billion. • Increase 3-month deposits interest rate to 9.14%. • Decrease interest rate on (≤ one year) loans to 12.8%. • Increase 182 days Tb interest rate to 8.848%.
1999/2000	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Maintain DR at 12%. • Increase 3-month deposits interest rate to 9.3%. • Increase 182 days Tb interest rate to 9.095%. • Increase interest rate on (≤ one year) loans to 13.1%. • Increase Repos to LE 209 Billion. • Maintain DRRR 15%, FRRR 10%. • DLR=21.4%, FLR=38.8%. • Issue new Treasury bonds.
2000/2001	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Decrease DR to 11%. • Modify calculations of RRR and LR. • Set central ER at 3.85pt/$ with band ±1%. • Increase 3-month deposits interest rate to 9.43%. • Decrease 182 days Tb interest rate to 9.077%. • Increase interest rate on (≤ one year) loans to 13.57%. • Increase actual reserve ratio to 15.9%. • DLR = 25.6%, FLR = 43.6%. • Issue Tb with LE 3.1 Billion. • Decrease Repos to LE 122 Billion.
2001/2002	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Decrease RRR from 15% to 14%. • Maintain DR at 11%. • Modify the calculation of RRR. • Maintain 3-month deposits interest rate at 9.4%. • Decrease 182 days Tb interest rate to 7.651%. • Increase interest rate on (≤ one year) loans to 14.1%. • Modify central ER to 451pt/$ and increase band of movement to ±3%. • Decrease Repos to L.E. 51 Billion.
2002/2003	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Abolish the system of US $ central rate. • Announce floatation of L.E. exchange rate. • Decrease DR to 10%. • Modify calculation of RRR. • Decrease 3-month deposits interest rate to 8.46%. • Increase 182 days Tb interest rate to 10.23%. • Decrease interest rate on (≤ one year) loans to 13.45%. • Decrease Repos to L.E. 6.3 Billion. • Increase in the balance of Tb to L.E. 55.3 Billion.
2003/2004	PLS ERSTAB	ERES SNIRM	DOMLIQ	• Maintain RRR at 14%. • Maintain DR at 10%. • Use OMO to absorb excess liquidity. • Update base year of CPI to (99/2000=100). • Start primary dealers system. • Increase in the balance of Tb to LE 83.3 Billion. • Introduce reverse Repos and outright sales.

				• Decrease interest rate on (≤ one year) loans to 13.27%. • Increase 182 days Tb interest rate to 11.3%. • Decrease 3-month deposits interest rate to 7.68%.
2004/2005	PLS ERSTAB Soundness of Banking sector	ONIGHT	DOMLIQ	• Decrease DR to 9%. • Issue central bank notes. • Use OMO; reverse Repos, outright sale of Tb. • Maintain 3-month deposits interest rate at 7.7%. • Maintain interest rate on (≤ one year) loans at 13.4%. • Apply non-expansionary monetary policy. • Increase overnight interbank interest rates.
2005/2006	PLS	ONIGHT	DOMLIQ	• Decreasing the overnight interest rate on lending to 12.5%. • Decreasing the overnight interest rate on deposit to 9.5%. • Reduced the CBE lending and discount rate to 9%.
2006/2007	PLS	ONIGHT	DOMLIQ	• Increase the overnight interest rate on lending to 10.75%. • Increase the overnight interest rate on deposit to 8.75%. • Increase the certificates of deposits (CDs) and notes.
2007/2008	PLS	ONIGHT	DOMLIQ	• Increase the overnight interest rate on lending to 13.5%. • Increase the overnight interest rate on deposit to 11.5%. • Increase the 6-month deposit interest rate to 7.3%. • Increase the one-year or less loans interest rate to 11.6%. • The CBE used auctions for accepting bank deposits.
2008/2009	PLS	ONIGHT	DOMLIQ	• Decrease the overnight interest rate on lending to 10.5%. • Decrease the overnight interest rate on deposit to 9%. • Decrease the 6-month deposit interest rate to 6.5%. • Maintain the one-year or less loans interest rate at 11.6%. • Decrease the discount interest rate to 9%. • Absorb the excess liquidity through increasing foreign exchange sales to banks (from LE 182.7 billion to LE 82.9 billion at end of June 2009).
2009/2010	PLS	ONIGHT	DOMLIQ	• Decrease the overnight interest rate on lending to 9.75%. • Maintain the overnight interest rate on deposit at 9%. • Decrease the 6-month deposit interest rate to 6.3%. • Decrease the one-year or less loans interest rate to 11.1%. • Maintain the discount interest rate at 9%. • Increase liquidity through increasing foreign exchange purchase from banks (from LE 82.9 billion to LE 101.5 billion at end of June 2009).
2010/2011	PLS	ONIGHT	DOMLIQ	• Maintain the overnight interest rate on lending to 9.75%. • Decrease the overnight interest rate on deposit to 825%. • Increase the 3-month deposit interest rate to 6.6%. • Decrease the one-year or less loans interest rate at 11%. • Decrease the discount interest rate to 8.5%. • Increase Repos return to 9.25%. • Absorb the excess liquidity through increasing foreign exchange sales to banks (from LE 101.5 billion to LE 83.1 billion at end of June 2009).

Note: PLS: price level stability; NAB: controlling net domestic assets of banks; ERSTAB: exchange rate stability; ERES: excess reserves with the CBE in local currency; SNIRM: short-term nominal interest rate management; DOMLIQ: control domestic liquidity (M2) growth; ME: monetary expansion; TB: Treasury Bill; DR: discount rate; RRR: Required reserve ratio; DRRR/FRRR: domestic/foreign required reserve ratio; DLR/FLR: domestic/foreign liquidity ratio; Repos: repurchasing operations of Tb; M1: money supply; CPI: consumer price index; OMO: open market operations; BS: banking sector; ER: exchange rate, and ONIGHT: overnight interest rate.
Source: CBE (2012) and Moursi *et al.* (2006).

CHAPTER 3 : MODELLING THE CONSUMERS' EXPENDITURE IN EGYPT

3.1. Introduction

The effects of the MTM's channels on income and inflation occur through its effects on intermediate variables like consumption and investment first. Before analysing these channels, it is better to investigate consumption and investment in the Egyptian economy. Furthermore, the estimation of consumption and investment functions in Egyptian economy is scarce and rare. Consequently, this chapter will concentrate on consumption function, and the next is dedicated to the estimation of the investment function in Egypt.

Households' consumption decisions are not only important to the growth process in the short run but also in the long run. The pattern of consumption in any country is an important concern of policymakers, at the macroeconomic level. As a result, many economists were interested in modelling household consumers' expenditure.

This chapter will estimate the households' consumption function in the Egyptian economy during period 1975-2010. In order to achieve this, the chapter will start by discussing the literature of consumption function and its determinants. Then it will discuss the econometric methodology, data and econometric model. Finally, the chapter will be ended by the summary of results and the conclusion.

3.2. Consumption Function in the Literature

Literature on consumers' expenditure tries to establish a theoretical framework that can describe effectively the relationship between household consumption in one hand side and variables like income, interest rate, and wealth (Muellbauer, 1994).

According to Keynes (1936) the fluctuations in real income and changes in expectations of the relationship between the present and future income, both affect the consumption expenditure through their impacts on marginal propensity to consume. In addition, fiscal policy, i.e. taxes and government expenditure, plays a role in changing the level of consumption expenditure and its pattern. Furthermore, Keynes (1936) adds one more factor which is called *rate of time-discounting*. Although, the rate of time-discounting is not as the same as interest rate, however, for simplicity, both of them are used as an alternative for each other. Also, the influence of interest rate on consumption is significant and negative, according to the economic theory, whereas this influence is secondary and relatively unimportant in the short-term. Furthermore, the consumption function according to Keynesian model describes the relation between households' consumption, *C*, and their income, *Y*, at aggregate level.

Cross-sections data give us different results from those we get from using time series data, especially, if the first one was for a short time period and the second one was for a very long time period. Consequently, the marginal propensity to consume (MPC) will be less than the average propensity to consume (APC) in case of using cross-sections data and they will be equal if we use time series data for a very long time.[16] In addition, the consequence of the previous result is that the constant term in consumption function greater than zero with cross

[16] See Ackley (1961) for cross-sections data results in short time and Kuznets (1946) for results of time series data in a very long time.

sections data and it is equals zero with time series data. Subsequently, we can imagine that the consumption is proportional to income (Sargent, 1979).

Friedman (1957) used the idea of the proportional relationship between consumption and income, assuming appropriate estimation of this relationship. Moreover, Friedman assumes that households seek to maximise their life-time utility function, U, where $U = \sum_{t=1}^{T} u(C_t)$, C_t is the household's consumption in time t and T is the household's lifetime. The consumption utility function, $u(C_t)$, is strictly concave, $u'(\bullet) > 0$, and $u''(\bullet) < 0$ (Romer, 2006; Sargent, 1979).

The consumer's budget during his/her lifetime can be divided into initial wealth, A_0, and labour incomes, $\sum_t^T Y_t$. The consumer's budget constraint will be the equation (3.1).

$$\sum_{t=1}^{T} C_t \leq A_0 + \sum_{t=1}^{T} Y_t \tag{3.1}$$

The maximisation problem can be solved using the Lagrangian technique, then (3.1) become (3.2) and by taking the first-order condition for C_t the result will be (3.3), and this means that the marginal utility of consumption will be a constant value, λ.

$$\mathcal{L} = \sum_{t=1}^{T} u(C_t) + \lambda\left(A_0 + \sum_{t=1}^{T} Y_t - \sum_{t=1}^{T} C_t\right) \tag{3.2}$$

$$u'(C_t) = \lambda \tag{3.3}$$

The previous situation cannot happen except in one case, where consumption is constant during the consumer's lifetime, as in equation (3.4). Then, the total lifetime resources $(A_0 + \sum_{t=1}^{T} Y_t)$ of consumer should divide equally among each period of life. The right hand side of (3.4), according to Friedman (1957), is the permanent income and the difference between this and current income is the transitory income.

$$C_t = \frac{1}{T}\left(A_0 + \sum_{\tau=1}^{T} Y_t\right) \tag{3.4}$$

Transitory income and transitory consumption are assumed to be uncorrelated with permanent income and permanent consumption, respectively. Also, the mean of these transitory income and transitory consumption is equal to zero (Friedman, 1957, p.222).

While Friedman argues that income has a predictive power of consumption expenditure, Hall (1978), on the contrary, asserts that the consumption function is following the random walk process, as an unexpected decline in output leads to a decline in consumption by the amount of the fall in permanent income, i.e. it is not expected to recover. This random walk hypothesis was developed under the life cycle-permanent income hypothesis, where permanent income was treated as unobserved variable (Hall, 1979). Also, according to Hall's view, there is no existing variable that can improve the prediction of consumption except for current consumption. Consequently, the lags of income have no effect on consumption, as the relationship between consumption and real disposable income is statistically marginal and small.

Flavin (1981) criticised the rational expectations-permanent income hypothesis (REPIH). Although Hall and Mishkin (1982) argue that changes in permanent income have a strong effect on consumption when comparing to transitory income. They found that the effect of transitory income become vigorous only if the interest rate is 20% or more. Additionally, Hall and Mishkin (1982) reject the pure life cycle-permanent income hypothesis (LCPIH), and they suggest that 80% of consumption is compatible with the previous hypothesis, but the remaining (i.e. 20%) follows the simple proportionality of consumption and income.

After more than a decade after Hall's random walk hypothesis in their research, which includes United Kingdom, Canada, France, Japan, and Sweden, Campbell and Mankiw (1991) emphasised that the permanent income hypothesis (PIH) model fits the data well in certain dimensions and poorly in others. They assume that aggregate consumption is affected by changes in current income and permanent-income; which can weaken the permanent-income hypothesis. Their estimation of the effect of current income on consumption varied between 0.2 and 1.0, which is called the *rule-of-thumb model*. Moreover, they found that there is no direct effect of nominal or real interest rate on consumption, when current income enters the estimated model. In addition, financial deregulation may decrease the effect of current income on consumption.

Campbell and Mankiw (1989) assert that the statistical relationship between consumption growth, in one hand side, and income growth and interest rate, in other hand side, is spurious. In spite of this, Christiano (1989) argues that the previous result can come from measurement error or econometric bias. Further, Campbell and Mankiw's rule-of-thumb model is not a convincing case. Additionally, Christiano (1989) pointed out the percentage of disposable income goes to the rule-of-thumb consumers, i.e. 50%, is more in time series data and less, if it is not near to zero, in case of micro data (Hall and Mishkin 1982; Runkle, 1991), and this can be a result of a model misspecification, i.e. a constant ratio of the rule-of-thumb.

3.3. Determinants of Consumption Expenditure

Almomani (1996) points out that current domestic income, previous consumption spending, wealth, population, workers' remittances, and inflation are suitable determinants of private consumption in developing countries, like Jordan.

Raut and Virmani (1990) assert that there exists a positive relationship between private consumption and the real interest rate. However, they pointed out that inflation rate has more significant impact on private consumption than the nominal interest rate, and both of them have a negative effect on consumption expenditure. Moreover, the higher impact of the inflation rate can be attributed to the uncertainty of future income that increased when inflation rate rose, through its effect on precautionary saving. In addition, the second possible reason is the inverse relationship between real financial wealth and inflation, as households reduce their consumption to maintain their real balance of savings.[17]

Craigwell and Rock (1995) pointed out that signs of the interest rate and relative prices in the consumption function may be uncertain as these variables can have both income and substitution effects. Also, they argue that the sign of the inflation in the consumption function can be ambiguous.

Interest rate changes have two different effects, i.e. substitution and income, on the consumption expenditure. The substitution effect has a negative impact on the consumption expenditure, as an increase in the interest rate will encourage individuals to save more (Romer, 2006). However, the income effect has a positive impact on consumers' expenditure as an increase in the interest rate will raise the individual income if he/she is a net saver. Furthermore, the stock wealth is positive in the economy, which means that individuals are savers rather than borrowers (Romer, 2006).

The positive interest rate effect on consumers' expenditure were found in some studies, like Barrell and Davis (2004), Springer (1975, 1977), and Weber (1970, 1975). Weber (1970) found that an increase of the interest rate will rise the current consumer expenditure, because the income effect of that increase in the interest tare is greater than its substitution

[17] This study includes 23 developing countries during the time period of the study, which was varying from country to another country, from 1973 to 1982. Egypt was one of these countries and the period of study was started from 1975 and ended up in 1982.

effect. Furthermore, Weber (1975) pointed out that an increase in the nominal interest rates would increase consumer expenditures on nondurables and durables goods. Springer (1975) argued that changes in the interest rate will have a positive effect on consumers' expenditure, as the income effect dominates the substitution effect. Moreover, the interest rate increase will increase the financial wealth of households, then it will rise consumers' expenditure (Saad, 2011). Furthermore, sometimes the impact of the interest rate on consumers' expenditure is insignificant, this can be explained by the approximately equal substitution effect and income effect which they cancel each other (Saad, 2011).[18]

The positive relationship between inflation and consumers' expenditure were pointed out in some studies, like Howrey and Hymans (1978), Gylfason (1981), Juster and Wachtel (1972), Saad (2011), Sandmo (1970), and Springer (1975, 1977).

Sandmo (1970) argues that inflation is a measure of uncertainty, and the later has two different effect, i.e. income and substitution effect. The income effect tends to decrease the consumers' expenditure as it stimulates savings to prevent unexpected financial difficulty in future. However, the substitution effect will encourage consumers, i.e. risk-averse, to increase their spending to prevent any unexpected lose in the future. Moreover, Juster and Wachtel (1972) suggested that a fully anticipated inflation will increase consumer expenditures on nondurables goods and services and reduce spending on durables goods. Also, Weber (1975) argued that an increase in the price level of durable goods will increase the total expenditure, because the decrease of consumers' expenditure on durable goods has less effect than the increase in their expenditure on non-durable goods and services.

Blinder *et al.* (1985) used non-durable consumers' expenditure for estimating the consumption function. They find no effect of lagged and anticipated income and wealth on

[18] See Campbell and Mankiw (1989), Elmendorf (1996), Hahm (1998) and Giovannini (1985) for more discussion about the interest rate effect on consumers' expenditure.

consumption spending. Also, they point out that the nominal and not the real interest rate has an influence on consumption, but this influence is not statistically significant. Additionally, both inflation and relative prices have an effect on consumption spending. Furthermore, Blinder *et al.* (1985) assert that, in a short period, a change (increase/decrease) in the relative price of non-durable goods leads to a slow movement (growth/decline) in spending on services and non-durable goods.

Households in developing countries usually use credit less than cash in their transactions, so it is expected to found the relationship between consumption and interest rate only exists for durable goods (Kaynak *et al.*, 1995).

The government spending effect on consumption occurs through its effect on the marginal propensity to consume and the sensitivity of consumption to interest rate changes (i.e. interest rate channel). Then, the final effect will be in the direction of the channel that will dominate (Kandil and Mirzaie, 2007). Similarly, the effect of the money supply on private consumption will occur through its effect on income or interest rate or liquidity effect. In addition, the changes in money supply will change expectations of the inflation path, i.e. Fisher effect, and this may increase the interest rate, if liquidity effect was dominated by Fisher effect (Kandil and Mirzaie, 2007).

Kandil and Mirzaie (2007) state that the fluctuations of the exchange rate will be reflected in the cost of imports, and that will affect the pattern of tradable and non-tradable goods. Finally, the impact of exchange rate fluctuations on private consumption will depend, initially, on the relative changes in tradable and non-tradable consumption.

3.4. Econometric Methodology

The increasing concern with dynamic economic relationships sheds light on the importance of the time series modelling, as it was widely used in economic research, especially in empirical macroeconomics area (Hamilton, 1994). Time series data can be more useful in answering empirical quantitative questions when cross-section data are inefficient or inadequate; as time series econometrics can explain the dynamic causal effect and gives a reasonable forecast (Stock and Watson, 2007).

In time series models the past values of a variable are used to forecast its future value. One way to increase the predictability of autoregressive models it is better to add some extra regressors, i.e. explanatory variables, and in this case the autoregressive model will become an autoregressive distributed lag (ADL) model (Verbeek, 2002). Additionally, the optimal lag length of an ADL model can be chosen by a suitable information criterion, like Bayes information criterion (BIC) or Schwarz information criterion (SIC) or Akaike information criterion (AIC) (Stock and Watson, 2007).[19]

The ADL model, in case of there is a constant but there is no trend exists in the model, can be described as in equation (3.5)

$$Y_t = \alpha + \sum_{j=1}^{J} \beta_j \, Y_{t-j} + \sum_{i=1}^{N} \sum_{k=0}^{K} \delta_{ik} \, X_{i,t-k} + \varepsilon_t \qquad (3.5)$$

$$\forall \, i = 1, 2, \dots, N \quad , j = 1, 2, \dots, J \quad , k = 0, 1, \dots, K$$

where Y is the explained variable and $X_i s$ are explanatory variables. The intercept is α, and β and δ are coefficients of the model. Moreover, the error term in this model is ε_t.

[19] There is another simple rule of thumb can be used here, according to the frequency of the data; for instance, if the data are annually then use one lag, if the data are quarterly then use 4 lags and so on (Brooks, 2008).

Unfortunately, many macroeconomic variables are non-stationary (Granger, 1966; Nelson and Plosser, 1982). Whereas the standard econometric estimation process of a dynamic time series model requires the existence of stationarity between the model's variables. In addition, the core idea of stationarity is that the probability distribution does not change over time or, in simple words; stationarity depends on the assumption that future and past are the same at least in the probability sense (Stock and Watson, 2007, p.545).

If the variables are not stationary then the result may be a spurious regression, which means that estimators and test statistics are misleading (Granger and Newbold, 1974). Actually, there is special case, an exception, that is even if variables are non-stationary[20], but there exists a linear combination of these variables that is stationary, i.e. $I(0)$ which also could mean a white noise series. In other words, these non-stationary variables are cointegrated, which implies that a long-run, i.e. equilibrium[21], relationship exists (Verbeek, 2007).

Economic theory suggests that economic variables which have long-run relationships will not diverge away from their equilibrium in long run, whereas they may diverge away in the short run. Consequently, the equilibrium relationship returns again by economic forces which exist in the economic system, like the market mechanism and governmental intervention (Granger, 1986).

A starting point for estimating a plausible dynamic time series model is undertaking a unit root test for variables before estimating the model. One of the widely used unit root tests is the Dickey-Fuller (DF) test (Dickey and Fuller, 1979). This test considers the null hypothesis, $H_0: \emptyset = 1$, against the alternative hypothesis, $H_1: \emptyset < 1$, of equation (3.6).

[20] However some econometricians argue that variables with different orders of integrability cannot be cointegrated, but some other econometricians assert that those variables can be cointegrated if there are more than three series (Craigwell and Rock, 1995). For more details about this issue see: Hall and Henry (1988).

[21] Here equilibrium does not have the same meaning as in studying the behavior of economic agents, but instead it is using here to refer to *"the tendency of an economic system to move towards a particular region of the possible outcome space"* (Granger, 1986).

$$y_t = \emptyset y_{t-1} + u_t \tag{3.6}$$

In addition, the unit root test can be written as the equation (3.7) instead of equation (3.6). Also, in this case $\psi = \phi - 1$, so the null hypothesis becomes $H_0: \psi = 0$ and the alternative hypothesis is $H_1: \psi < 0$.

$$\Delta y_t = \psi y_{t-1} + u_t \tag{3.7}$$

The DF-test can be expanded to contain an intercept only or an intercept and deterministic trend, thus equation (3.6) can be written as (3.8) or (3.9).

$$y_t = \mu + \phi y_{t-1} + \lambda t + u_t \tag{3.8}$$

$$\Delta y_t = \mu + \psi y_{t-1} + \lambda t + u_t \tag{3.9}$$

The test statistic, $\tau_{statistic}$, for the null hypothesis $\psi = 0$, is given by the ratio of the estimated ψ to the estimated standard error, equation (3.10).

$$\tau_{statistic} = \frac{\hat{\psi}}{\widehat{SE}(\hat{\psi})} \tag{3.10}$$

One of requirements of the DF-test is that the error term, u_t, is a white noise series. Accordingly, when autocorrelation is present lags of the dependent variables are added, creating an Augmented Dickey-Fuller (ADF) test, which can be summarised as (3.11).

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^{P} \alpha_i \Delta y_{t-i} + u_t \tag{3.11}$$

There are many other tests for unit roots. The Phillips-Perron (PP) test takes into account the probability of serial correlation in the residuals by using a nonparametric method, through modifying the non-augmented DF-test (Phillips and Perron, 1988). Moreover, the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test is using the null hypothesis that the series is

stationary around a deterministic trend, where the series is assumed to be the sum of deterministic trend, random walk and stationary error (Kwiatkowski *et al.*, 1992). The Lagrangian multiplier (LM) test is used, under the KPSS-test, to test the hypothesis that the random walk component has zero variance.

Many macroeconomic variables are integrated of degree one, i.e. *I*(1). One simple solution to deal with these non-stationarity data is using the first difference technique. Although, the pure first difference technique is acceptable from a statistical view as a remedy for *I*(1), this method will be inadvisable in the long run as the differences among variable's mean values will disappear. If the long-run relationship contains important information first difference technique will not have a long-run solution. This problem can be solved if cointegration exists so a combination of first differenced and cointegrated variables are used together in one model. The previous model called the error-correction model (ECM) or equilibrium-correction model (Brooks, 2008, pp 337-339).

The concept of cointegration can be described in a simple way; so, for example, if there is a variable x_t which is non-stationary and it needs to difference d times to induce a stationary autoregressive moving average (ARMA) representation, this variable is called integrated of degree d, i.e. $x_t \sim I(d)$. In the same line, if there is a vector of variables x_t, it will be cointegrated of order d, b, i.e. $x_t \sim CI(d, b)$, if the following two conditions exist (Granger, 1981):

- All components of x_t are integrated of degree d,i.e. $x_t \sim I(d)$.
- There is a vector $\alpha \neq 0$ so that $z_t = \alpha' x_t \sim I(d-b)\ \forall b > 0$.[22]

[22] When the number of variables in vector x_t is greater than 2, then α will not be necessarily a unique vector (Craigwell and Rock, 1995).

In this case α is called the cointegrating vector which describes the static long-run relationship. Moreover, if variables are $CI(1,1)$ so that the error-correction model (ECM) for those variables can be used efficiently (Craigwell and Rock, 1995; Granger, 1981).

The ADL model in equation (3.5) can be modified to become an ECM as in equation (3.12).

$$\Delta Y_t = \alpha + \sum_{i=1}^{N}\sum_{k=0}^{K} \beta_{i,k}\Delta X_{i,t-k} + \theta\left(Y_{t-1} - \alpha_0 - \sum \gamma_i X_{i,t-1}\right) + \varepsilon_t \quad (3.12)$$

where $\left(Y_{t-1} - \alpha_0 - \sum \gamma_i X_{i,t-1}\right)$ is the error-correction term and γ_i is the cointegration coefficient between Y and X_i, and defines the long-run relationship between Y and X_i. The short-run relationship between Y and X_i is measured by β_i, while θ describes the speed of adjustment which is negative to return to the equilibrium.

Pesaran and Shin (1999) proposed an approach, which is known as the ARDL bounds test, to test the existence of a relationship between variables in levels regardless the underlying regressors are purely *I(0)*, purely *I(1)* or mutually cointegrated. They used Wald or F-statistic in a generalized Dicky–Fuller type to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium-correction model (ECM). Pesaran *et al.* (2001) provided two sets of asymptotic critical values for the two polar cases, i.e. Purely *I(0)* and purely *I(1)*. If the computed Wald or F-statistic is higher than the upper bound then the cointegration relationship between the variables exists, i.e. rejecting the null hypothesis. And, if computed F-statistic is smaller than lower bound we cannot reject the null hypothesis, i.e. no cointegration between variables. However, if the computed F-statistic falls between the two bounds, then we cannot have a conclusive inference.

3.5. Data

This chapter uses Egyptian annual data from 1975 to 2010. The sample period is determined by the availability of the data. Households' consumption (*c*), gross national income (*y*), credit to households sector ($cred^h$), money measures (*m2*) which also can represent liquidity and wealth (i.e. financial assets), are natural logarithm of real values. However, both interest rate (i^l)[23] and inflation rate (*inf*) are nominal values. The sources of data are in the data appendix at the end of the thesis. Finally, table 3.1 provides a summary of major macroeconomic variables in Egypt.

Figure 3.1 shows developments of the consumers' expenditure and GNI in nominal and real terms between 1975 and 2010. This figure asserts the identical trend of both variables in nominal and real terms. The ratio of real consumption to real GNI is given in table 3.2. It is clear that the average ratio of private consumption started at 65.7% in 1975-1980 and peaked in 1996-2000 at 75.7%, it then declined to 73.1% in 2006-2010. Over the whole sample period the average ratio was 72.7%, which represent how important private consumption was in the Egyptian economy comparing with other countries.

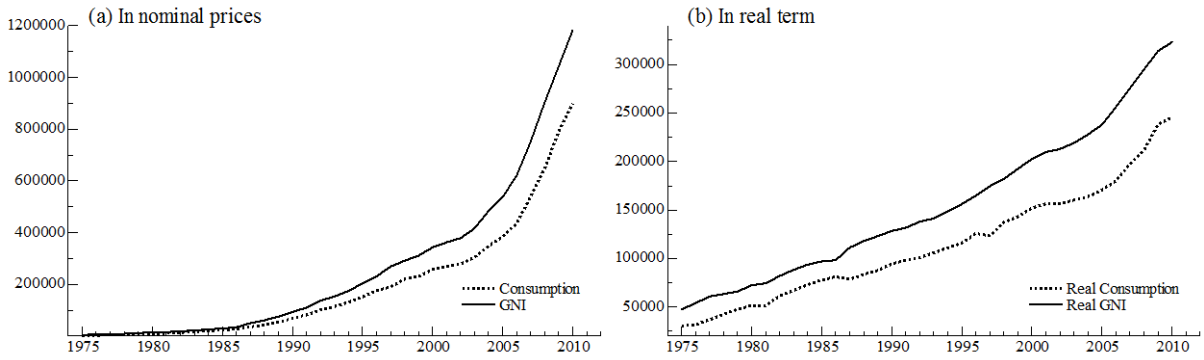
Table 3.1: Average Values of Major Macroeconomic Variables

Period	Households' Consumption	GNI	Credit to Households	M2	Inflation Rate (%)	Real Lending Interest Rate (%)	Real Exchange Rate ($/L.E.)
	In Millions L.E. (in real term)						
1975-1980	40217	60747	508	98578	12.42	-2.45	3.23
1981-1985	63170	87178	5416	180547	14.07	0.93	3.53
1986-1990	84058	115834	4271	211110	19.85	-2.71	2.26
1990-1995	106944	142931	13124	239111	13.87	4.56	4.92
1996-2000	138311	182911	35578	288544	4.29	9.42	3.90
2001-2005	161522	222054	43198	431230	5.13	8.30	5.61
2006-2010	214649	292708	55939	539684	11.66	0.42	4.48

Source: IMF (2012b), WorldBank (2012b), and CBE (2012).

[23] The value of annual lending interest rate is not available for year 1991 but instead the monthly lending rates were available from September to December in this year, and its values were 20.16%, 20.31%, 21.15% and 20.68%, respectively. I calculated the average for these four months as year 1991 lending interest rate.

Figure 3.1: Consumers' Expenditures and Income Developments



The real deposit interest rate was negative for the majority of the period 1975-1995 as a result of high inflation rates, which reach 23.9% in 1986. However, in 1994, the real deposit rate was positive when the inflation declined from 12.1% to 8.2%. In contrast, this interest rate was positive between 1996 and 2003 as a consequence of the sharp decline in inflation which reach 2.3% in 2001, as a result of economic reforming programme which was applied in Egypt. After this period the real deposit interest rate became negative. The real lending interest rate, which is always above the real deposit rate, was only negative for periods of high inflation, as can be seen in figure 3.2, while figure 3.3 shows the development in the inflation rate.

Table 3.2: Average Ratio of Consumption Expenditure to GNI

Time Period	Real Households' Consumption to Real GNI (%)
1975-1980	65.7
1981-1985	72.4
1986-1990	72.9
1991-1995	74.2
1996-2000	75.7
2001-2005	72.8
2006-2010	73.1
Minimum	59.0
Maximum	82.7
Average of Period	72.7

Source: The Author.

Figure 3.2: Interest Rates

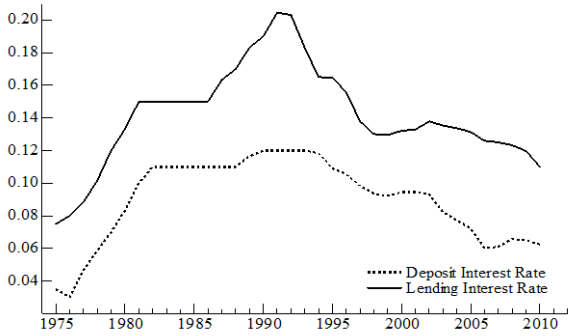
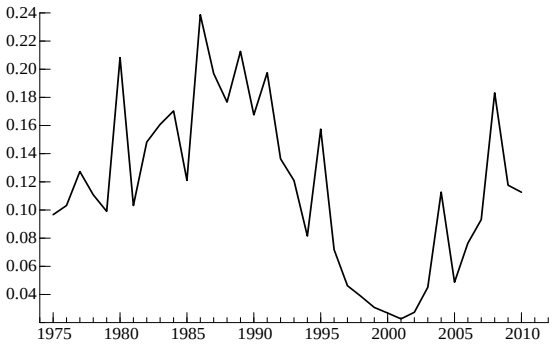


Figure 3.3: Inflation Rate



The period between 1976 and 1991 saw a slow growth in real credit to household sector; as the commercial banks did not interest in borrowing the households and they were preferred to lend business sector especially the public business sector. This was because the large banks, which are controlling the majority of funds of the banking sector, are public banks and owned to the government, which gives the power to the government and the CBE to direct the funds toward the public business sector and away from the households sector. Furthermore, the interest rates on loans to individuals were higher than those imposed for firms (Abou-El-Eyoun, 2003). The growth in the real credit to the households sector was sharp after the ERSAP in 1991. Notwithstanding, the growth in real credit to the households sector was rapid and sharp from 1992 because commercial banks started to encourage the consumer credit widely, figure 3.4.

Figure 3.4: Bank Lending to Households

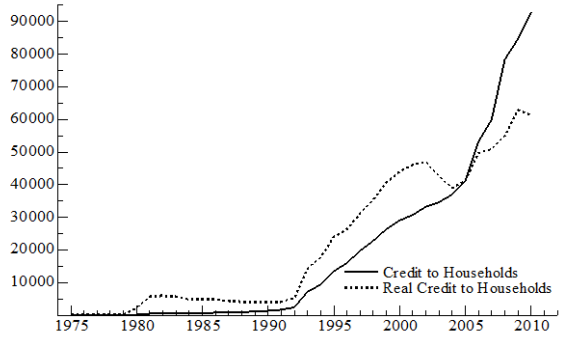
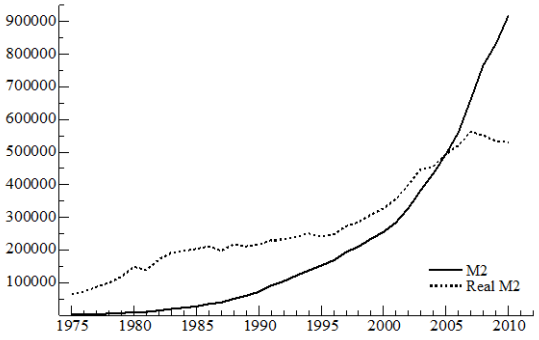


Figure 3.5: The Domestic Liquidity (M2)



Finally, a measure of domestic liquidity, M2, which could be used as a proxy of wealth, are measured in real terms to see their developments as potential independent variables in the consumption function in Egyptian economy. Figure 3.5 shows that real M2 growth was steadily compared to nominal M2 especially during the ERSAP.

3.6. Econometric Model

According to the econometric methodology used in this chapter, the starting point of the econometric estimation will be the unit root test of all key variables. The result of the unit root tests are presented in table 3.3. The ADF-test, PP-test and KPSS-test show that all variables are integrated of order one, *I* (1).

Table 3.3: Unit Root Test of the Consumption Function's Variables

Variables	ADF-test						PP-test						KPSS-test					
	Level			*Difference*			*Level*			*Difference*			*Level*			*Difference*		
c	-3.529	2	*t*	-4.994*	0	*c*	-2.957	4	*t*	-5.06*	2	*c*	0.167	4	*t*	0.362**	2	*c*
y	-2.407	3	t	-5.431*	2	c	-4.089**	1	t	-5.494*	2	c	0.181	4	t	0.424**	1	c
inf	-1.645	4	*c*	-10.129*	0	-	-2.564	2	*c*	-10.902*	3	-	0.469	2	*c*	0.110**	2	*c*
$m2$	-3.226	4	*t*	-4.837*	0	*c*	-2.864	2	*t*	-3.886*	2	*c*	0.423	3	*t*	0.306**	4	*c*
i^l	-1.811	3	c	-2.262**	2	-	-2.056	3	c	-2.601**	2	-	0.720	0	c	0.423**	4	c
$cred^h$	-1.797	1	*c*	-3.669*	0	-	-2.093	4	*c*	-3.610*	3	-	0.735	4	*c*	0.177**	3	*c*

Note: (*) and (**) mean that the variable is stationary at 1% and 5%, respectively. The critical value of KPSS-test, at 5%, in case of the series has trend is 0.146 and in case of the series has constant only is 0.463. Critical values of ADF-test and PP-test are following MacKinnon (2010), see table 3.4, while those for KPSS-test are following Kwiatkowski *et al.* (1992). The numbers beside the critical values represent the number of lags, while *t, c,* and – after the critical values represent the variant of the series trend and constant, constant, and no constant or trend, respectively.

The critical values of the unit root tests are discussed intensively in the econometric literature. MacKinnon calculated these critical values in his researches during the last two decades (Ericsson and MacKinnon, 2002; MacKinnon, 1991, 1992, 1996; MacKinnon *et al.*, 1999; MacKinnon and Nielsen, 2010). The precise unit root tests' critical values are

calculated by following MacKinnon (2010) and summarised in table 3.4. The calculations of these critical values are obtained by the following formula:

$$\hat{C}_{P/T} = \hat{\beta}_{\infty} + \hat{\beta}_1 T^{-1} + \hat{\beta}_2 T^{-2} \quad (3.13)$$

where $\hat{C}_{P/T}$ is the critical value for sample size T, $\hat{\beta}_{\infty}$ is the estimated asymptotic critical values, $\hat{\beta}_1$ and $\hat{\beta}_2$ are the coefficients of T^{-1} and T^{-2} in response surface regression.

It is possible to summarise the consumption function as a relationship between consumption and income, inflation, wealth, interest rate, and credit to households. Figure 3.6 illustrates the developments of these variables, and the lending interest rate and inflation rate are in figure 3.2 and figure 3.3, respectively. The first step of Engle-Granger two-step approach is estimating the consumption function in levels. Equation (3.14) estimates the consumers' expenditure in Egypt, and the errors, $\hat{u}$, are calculated to test if it is stationary or not. This equation, (3.14), represents the aggregate demand on consumers' goods and services. According to the economic theory there is a positive relationship between consumers' expenditure on goods and services, in one side, and the income level, in other side, as an increase in consumers' income is expected to raise their demand on goods and services. Similarly, the relationship between consumers' expenditure and their wealth is positive, because an increase in consumers' wealth will raise their demand on goods and services and vice versa. Additionally, the relationship between demand on goods and services, in one side, and changes in prices, measured by inflation rate, of these goods and services is a reverse relationship, since an increase in goods' price will decline the demand on these goods. It is clear that equation (3.14) satisfies all the expectations of the economic theory, as the signs of income, y, and wealth, $m2$, are positive, however inflation rate, inf, has a negative sign in equation (3.14).

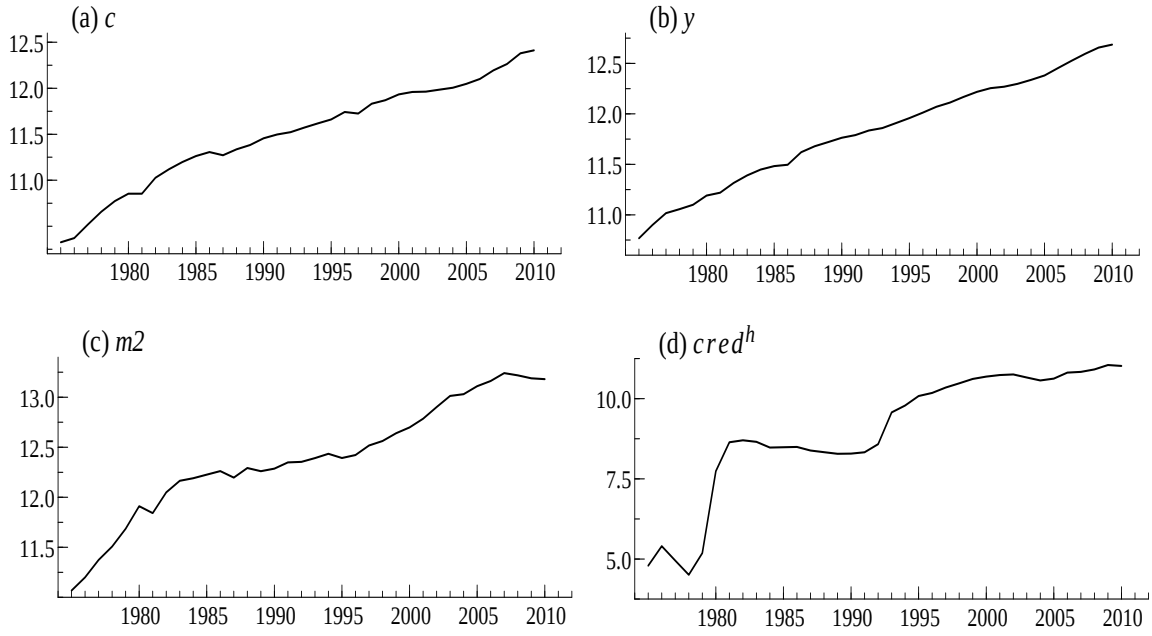
Table 3.4: The Critical Values of the Unit Root Tests (ADF and PP)

Variant	*Significance Level*	*Critical Values*
No Constant or Trend	1%	-2.628
	5%	-1.950
	10%	-1.621
Constant	1%	-3.623
	5%	-2.945
	10%	-2.610
Trend	1%	-4.232
	5%	-3.539
	10%	-3.201

Note: The critical values are calculated by using MacKinnon (2010) for sample size *T*=36.

Both DF-test and ADF-test asserts that $\hat{u}$ is stationary at 1%, as the t-statistics were -4.33 and -3.55 respectively. According to Engle-Granger two-step approach, the cointegration relationship exists between these variables and the lagged $\hat{u}$ can be used as the error-correction mechanism. However, using $\hat{u}_{t-1}$ can give a very high speed of adjustment in a developing country like Egypt.

Figure 3.6: The Consumption Function's Variables



$$c_t = -6.823 + 1.378\, y_t - 0.111\, inf_t + 0.207\, m2_t - 0.028\, t \qquad (3.14)$$

$$T = 36 \;\; R^2 = 0.994 \quad R^2_{adj} = 0.993 \quad RSS = 0.068 \;\; \sigma = 0.047 \;\; F = 1260\,[0.00]$$

Where t is time trend, T is number of observations, R^2 is the determination coefficient[24], R^2_{adj} is the adjusted determination coefficient, RSS is the residual sum square, σ is the standard deviation and F is the *F-statistic*.

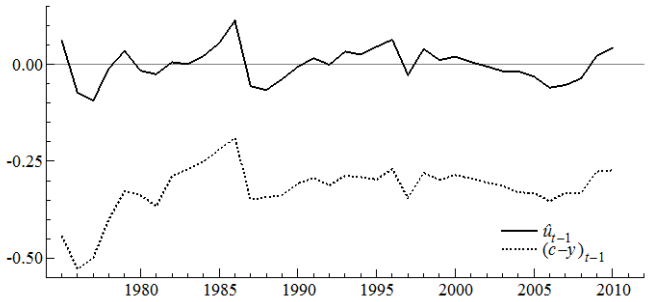
According to the economic theory, the average propensity to consume, *APC*, is generally constant value or converges toward a constant value, which means it is stationary (Cerrato *et al.*, 2008). Davidson *et al.* (1978) argue that consumption is homogenous of degree one in income, i.e. the unit-income elasticity, and the logarithm of *APC* should be constant. The lagged natural logarithm of *APC*, i.e. $(c-y)_{t-1}$, was used as a correction mechanism in the consumption function under Engle-Granger approach in many studies, like Davidson *et al.* (1978), Davidson and Hendry (1981), Hendry (1994) and Hendry (2000). One of advantages of using $(c-y)_{t-1}$ in the error-correction equation of the consumption function that it gives a reasonable speed of adjustment.

The average propensity to consume is stationary in case of Egypt. The DF-test and ADF-test assert that *APC* is stationary at 1%, as its *t*-statistics were -4.83 and -4.58 respectively. Figure 3.7 shows the similarity between $\hat{u}_{t-1}$ and $(c-y)_{t-1}$. This gives evidence that $(c-y)_{t-1}$ can be used instead of $\hat{u}_{t-1}$ in case of Egypt.

First, the effect of liquidity and financial wealth will be estimated, and then both interest rate and credit effects. As a consequence, we can determine the effect of these variables on the consumers' expenditure in Egypt between 1975 and 2010.

[24] The equation (3.14) shows that the bias is small in the cointegrated vector according to Banerjee *et al.* (1986) who are using $(1-R^2)$ as indicator of the bias in OLS estimator, where the bias becomes zero when R^2 goes to 1. Consequently, in this model R^2 =0.994, which means that the model does not suffer form a bias problem.

Figure 3.7: The Errors and APC as Error-Correction Mechanisms



3.6.1. The Liquidity and Financial Wealth Effect

The error-correction model, i.e. the second step of Engle-Granger two-step approach, was estimated starting by 2 lags and the result is equation (3.15). This model shows that changes in consumers' expenditure are depending on the changes in income, inflation rate and financial wealth. Moreover, the model's coefficients differ significantly from zero, and they explain about 70% of changes in consumers' expenditure. Additionally, the diagnostic tests of this model show no evidence of autocorrelation or heteroskedacticity (see Engle, 1982; Godfrey, 1978; White, 1980), and the residuals are normally distributed (see Doornik and Hansen, 1994, 2008; Jarque and Bera, 1980). Moreover, this model does not suffer from misspecification (see Ramsey, 1969).

$$\begin{aligned}\Delta c_t = &\underset{[-3.38]}{-0.108} + \underset{[2.25]}{0.258}\Delta c_{t-2} + \underset{[1.70]}{0.372}\Delta y_{t-1} + \underset{[1.88]}{0.353}\Delta y_{t-2} - \underset{[-2.70]}{0.308}\ \Delta inf_{t-2} \\ &+ \underset{[2.70]}{0.208}\Delta m2_t - \underset{[-3.54]}{0.285}\ \Delta m2_{t-1} - \underset{[-2.99]}{0.376}\ (c-y)_{t-1}\end{aligned} \tag{3.15}$$

$R^2 = 0.710 \quad R^2_{adj} = 0.628 \quad RSS = 0.018 \quad \sigma = 0.027 \quad F = 8.723[0.00]$
$F_{ar}\,[2,23] = 0.756[0.48] \quad F_{arch}\,[1,31] = 0.415[0.52] \quad F_{het}\,[14,18] = 1.181[0.36]$
$\chi^2_{nor}\,[2] = 0.580[0.75] \quad F_{reset}\,[2,23] = 0.237[0.79]$

where F_{ar} is the *F-test* of serial correlation, F_{arch} is *F-test* of autoregressive conditional heteroskedasticity, F_{het} is *F-test* of heteroskedasticity, χ^2_{nor} is *chi-square-test* for normality, F_{reset} is the *Ramsey-test*. *P-values* are in [ ] after statistics' values, and t-statistics are in [ ] under coefficients.

The signs of variables are as those expect by the economic theory, for instance, income has a positive impact on consumers' expenditure, while inflation has a negative impact. In addition, this model has a reasonable speed of adjustment, as the error-correction coefficient is of a plausible magnitude being -0.376, which means that after one time period approximately 38% of the disequilibrium in relationship will be corrected and within two years and half the equilibrium will be achieved. Furthermore, The assumption of homogeneity between consumption and income cannot be rejected according to Wald-test, i.e. $F(1.25)$ = 0.003[0.96].

The parsimonious model of equation (3.15) is equation (3.16). The model (3.16) has less number of parameters, RSS and σ, and higher *F-statistic* comparing to model (3.15). Also, model (3.16) does not suffer from any statistical problems or misspecifications. Furthermore, it has a smaller speed of adjustment.

$$\Delta c_t = \underset{[-2.57]}{-0.083} + \underset{[2.31]}{0.355}\Delta_2 y_{t-1} + \underset{[3.04]}{0.170}\Delta^2 m2_t - \underset{[-2.63]}{0.323}\ (c-y)_{t-1} \qquad (3.16)$$

$R^2 = 0.590 \quad R^2_{adj} = 0.548 \quad RSS = 0.025 \quad \sigma = 0.029 \quad F = 13.94[0.00]$
$F_{ar}\,[2,27] = 0.312[0.73] \quad F_{arch}\,[1,31] = 1.817[0.19] \quad F_{het}\,[6,26] = 1.022[0.43]$
$\chi^2_{nor}\,[2] = 0.880[0.64] \quad F_{reset}\,[2,27] = 0.158[0.85]$

Figure 3.8: Goodness of Fit and Residual Graphical Tests

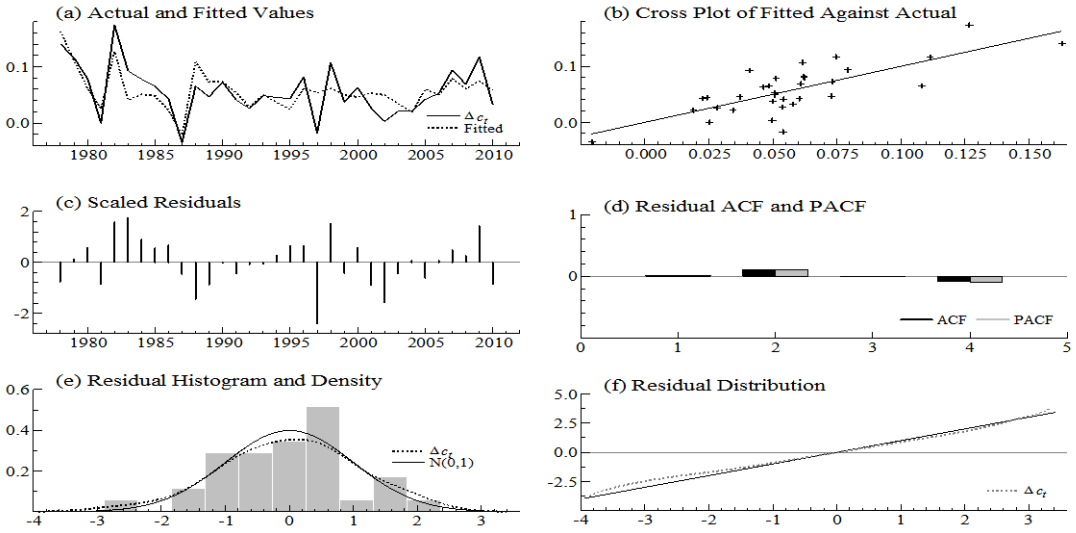


Figure 3.8 represents the goodness of fit and residual tests graphs. Figure (a) shows the actual and fitted values of Δc_t, conditional on the regressors' values; figure (b) shows the cross plot of fitted values against the actual values; figure (c) shows the scaled residuals, which include the forecast errors; and figure (d) shows residual autocorrelation function (ACF) and partial autocorrelation function (PACF), figure (e) shows the residual histogram and density of residuals, and figure (f) shows the model residual distribution. Figures (a) and (b) show how the estimated model captures the changes in consumers' expenditure. Figure (c) shows that all scaled residuals are small, except one observation in 1997 exceeds two standard errors. Also, figure (d) asserts that the model does not suffer from autocorrelation and figures (e) and (f) give a strong evidence for the normality of residuals.

Figure 3.9: Recursive Estimates of Coefficients ±2SE

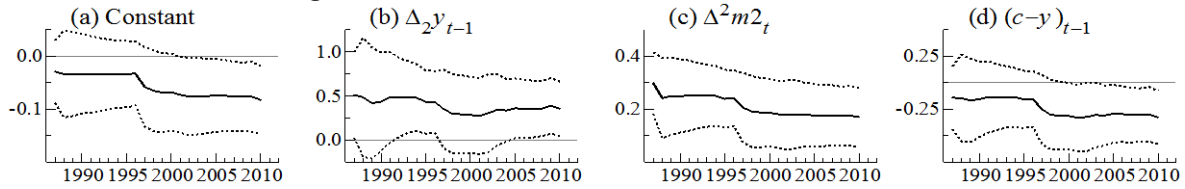
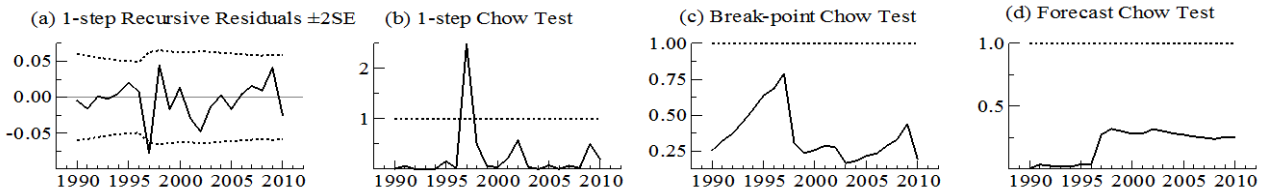


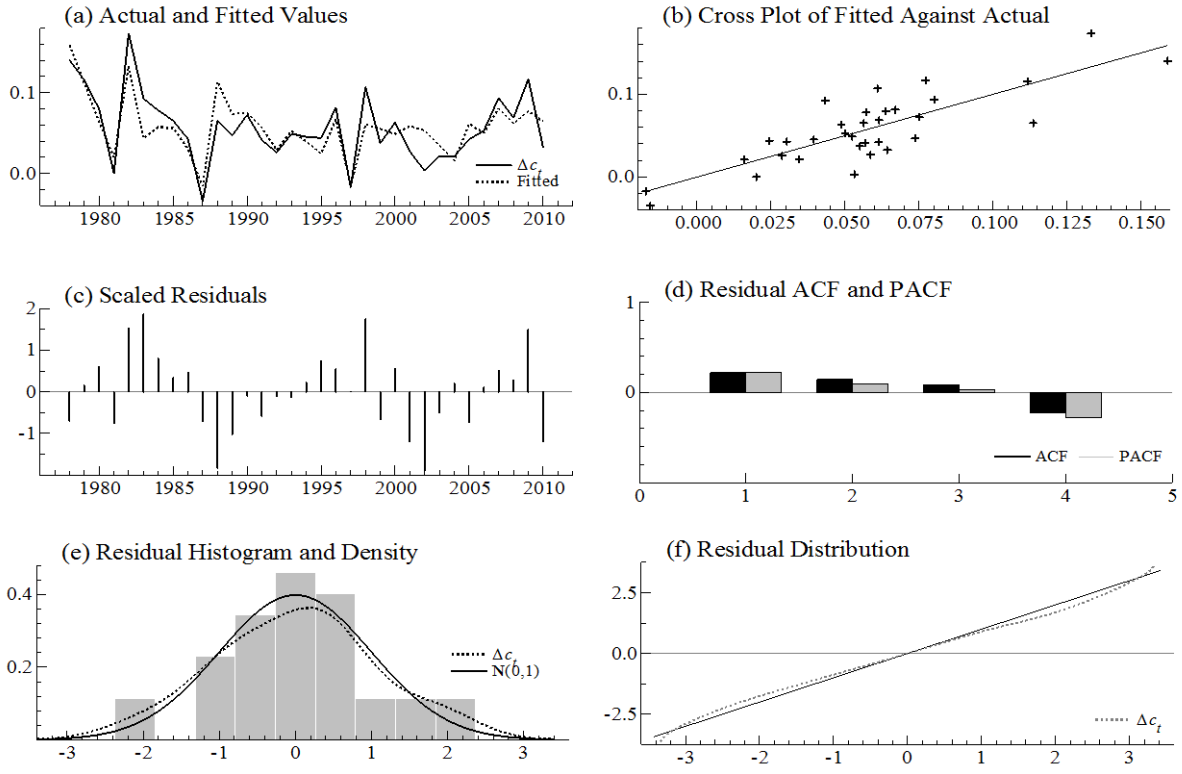
Figure 3.10: Recursive Stability Tests (5%)



Recursive estimation was carried out to examine whether the relationship remained constant over the sample period (See: Doornik and Hendry, 2009a), which is particularly important given the regime changes that took place in Egypt. The recursive estimated coefficients had been drawn in figure 3.9, however not all coefficients remained constant over the sample period. Additionally, the Chow tests of the model stability (Chow, 1960) had been drawn in figure 3.10, which indicates the instability of the model, as both 1-step recursive

residuals and 1-step Chow-test refer to an outlier in 1997. This is expected as 1997 was the end of the ERSAP and the Asian crisis year. To get rid of this, an impulse dummy variable, which takes value of one in 1997 and zeros otherwise, will be introduced to this model.

Figure 3.11: Goodness of Fit and Residual Graphical Tests of Model (I)



Including the dummy variable, i.e. D97, to the estimated model gives equation (3.17), which will be called model (I). The coefficient of $D97$ is negative as the growth rate of real consumption was -2% in 1997, which reflect the effect of the Asia crisis and the end of the ERSAP. The model (I) is better than model (3.16), as the former has less RSS and σ, and higher R^2, R^2_{adj} and *F-statistic*. Also, model (I) has smaller speed of adjustment and does not suffer from any statistical or misspecification problems, figure 3.11. However, the recursive coefficients, figure 3.12, of model (I) are constant over the sample period, and the Chow tests, figure 3.13, asserts the stability of the model.

$$\Delta c_t = \underset{[-2.20]}{-0.065} + \underset{[2.89]}{0.402}\Delta_2 y_{t-1} + \underset{[3.82]}{0.194}\Delta^2 m2_t - \underset{[-2.30]}{0.263}\,(c-y)_{t-1} - \underset{[-2.82]}{0.078}\,D97_t \qquad (3.17)$$

$R^2 = 0.681 \quad R^2_{adj} = 0.635 \quad RSS = 0.019 \quad \sigma = 0.026 \quad F = 14.94[0.00]$
$F_{ar}\,[2,26] = 1.717[0.20] \quad F_{arch}\,[1,31] = 0.710[0.41] \quad F_{het}\,[6,26] = 0.946[0.48]$
$\chi^2_{nor}\,[2] = 0.121[0.94] \quad F_{reset}\,[2,26] = 0.215[0.81]$

Figure 3.12: Recursive Estimates of Coefficients ±2SE of Model (I)

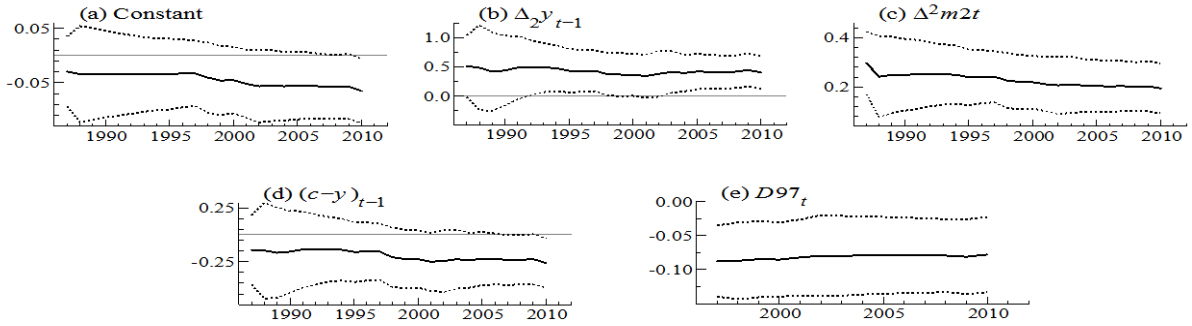
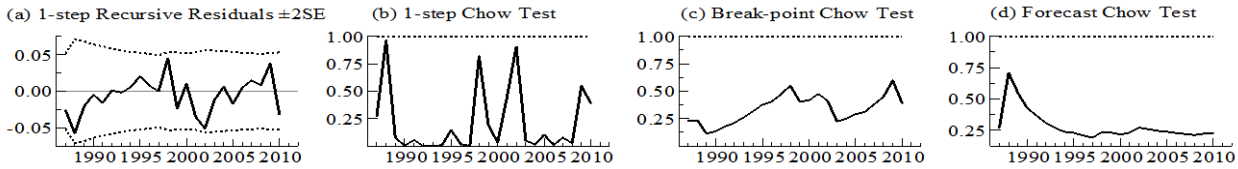


Figure 3.13: Recursive Stability Tests (5%) of Model (I)



3.6.2. The Interest Rate Effect

The interest rate effect on consumers' expenditure can be clear if we estimate the error-correction model with the interest rate as independent variable. Equation (3.18) shows the relationship between consumption and income, inflation, wealth and the interest rate. All coefficients' signs are in a line with the economic theory, as both income and wealth have a positive impact on consumers' expenditure, while both inflation and the interest rate have a negative effect on consumers' expenditure. The model (3.18) can explain about 80% of changes in consumption according to the changes in income, inflation, wealth and the interest rate. And the model passed all statistical diagnostic tests. Also, the homogeneity between consumption and income cannot be rejected according to Wald-test, i.e. *F*(1.20) =

0.036[0.85]. But, this model has a relatively high speed of adjustment as it is expected in a developing country like Egypt.

$$\begin{aligned}\Delta c_t = &\underset{[-4.87]}{-0.154} + \underset{[3.19]}{0.331}\Delta c_{t-2} + \underset{[1.59]}{0.257}\Delta y_t + \underset{[2.19]}{0.418}\Delta y_{t-1} + \underset{[2.31]}{0.381}\Delta y_{t-2} - \underset{[2.55]}{0.221}\Delta inf_t \\ &- \underset{[-3.46]}{0.357}\ \Delta inf_{t-2} + \underset{[2.04]}{0.142}\Delta m2_t - \underset{[-3.80]}{0.293}\ \Delta m2_{t-1} - \underset{[-1.78]}{0.285}\ \Delta i^l_{t-1} - \underset{[4.18]}{0.467}(c-y)_{t-1}\end{aligned} \quad (3.18)$$

$R^2 = 0.810 \quad R^2_{adj} = 0.723 \quad RSS = 0.011 \quad \sigma = 0.023 \quad F = 9.359[0.00]$
$F_{ar}\,[2,20] = 0.395[0.68] \quad F_{arch}\,[1.31] = 0.059[0.81] \quad F_{het}\,[20,12] = 1.380[0.29]$
$\chi^2_{nor}\,[2] = 2.570[0.28] \quad F_{reset}\,[2,20] = 0.197[0.82]$

The parsimonious version of model (3.18) is model (3.19). In the later model, the interest rate is insignificant even at 10%. The speed of adjustment is smaller and the disequilibrium will be totally corrected after two years and half. However, model (3.19) can explain only about 64% of changes in consumers' expenditure, σ is higher comparing to model (3.18), and RSS is double of that in model (3.18). Also, the residuals of model (3.19) do not normally distributed, figure 3.14. The scaled residuals are within 2 standard errors except that one in 1997, which can reflect the effect of the Asian financial crisis. The Chow tests, figure 3.15, refer to instability in 1997. As similar as what had done before the dummy variable will be included to deal with the non-normality and instability of the model.

$$\Delta c_t = \underset{[-3.12]}{-0.108} + \underset{[1.77]}{0.212}\Delta c_{t-2} + \underset{[2.01]}{0.312}\Delta_2 y_{t-1} + \underset{[2.69]}{0.152}\Delta^2 m2_t - \underset{[-1.02]}{0.612}\ \Delta i^l_{t-1} - \underset{[-3.05]}{0.384}\ (c-y)_{t-1} \quad (3.19)$$

$R^2 = 0.638 \quad R^2_{adj} = 0.571 \quad RSS = 0.022 \quad \sigma = 0.029 \quad F = 9.50[0.00]$
$F_{ar}\,[2,25] = 0.696[0.51] \quad F_{arch}\,[1,31] = 0.529[0.47] \quad F_{het}\,[10,22] = 0.899[0.55]$
$\chi^2_{nor}\,[2] = 6.830[0.03] \quad F_{reset}\,[2,25] = 0.055[0.95]$

The model (3.20), which will be called model (II), gives reasonable results. The signs of all variables are as those expected and all coefficients are significant at 5% or less. The diagnostic tests confirm the goodness of the model, figure 3.16. The speed of adjustment is at

plausible level, as within about 3 years the equilibrium will be achieved. Model (II) has less RSS and σ, and higher R^2, R^2_{adj} and *F-statistic*. Model (II), with $D97$, has a constant recursive coefficients, figure 3.17, and it is stable over the sample period, figure 3.18.

Figure 3.14: Goodness of Fit and Residual Graphical Tests

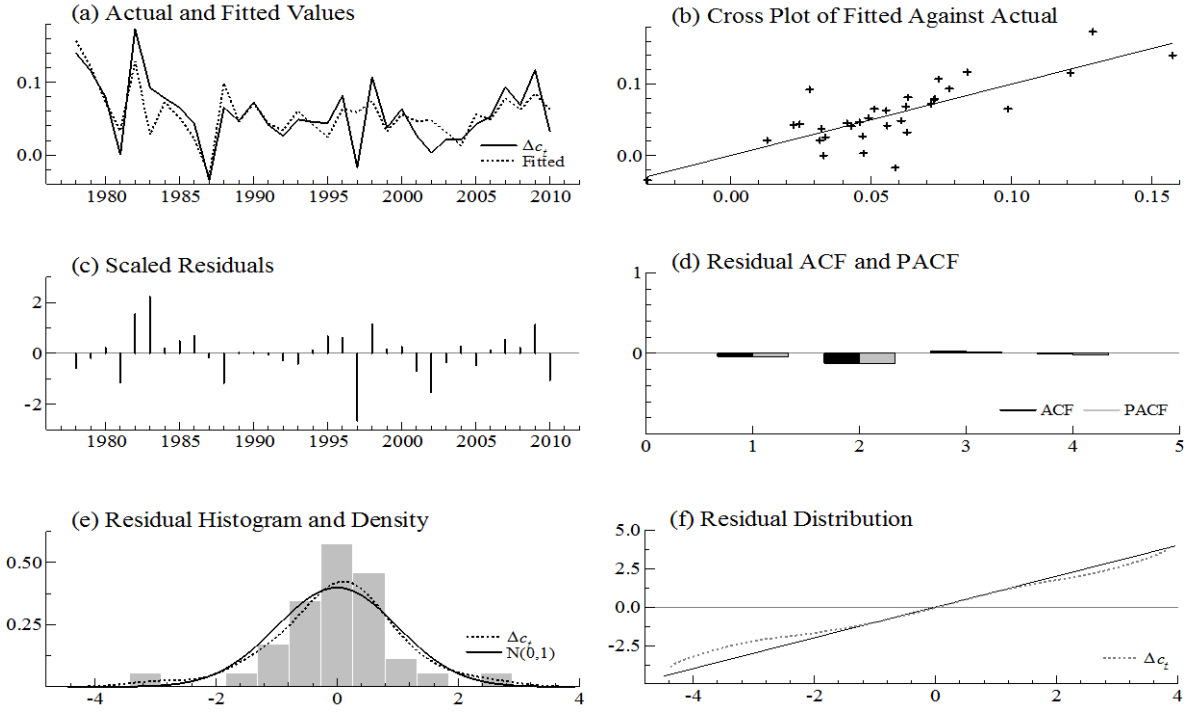
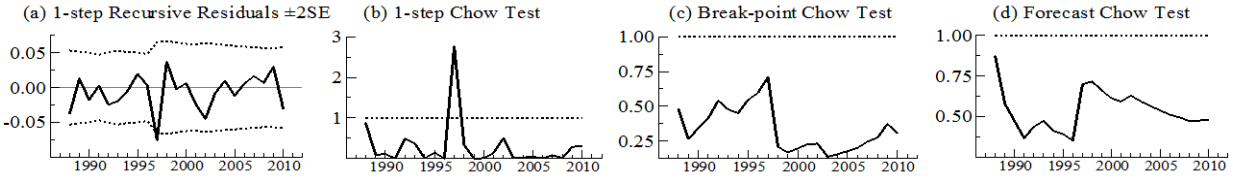


Figure 3.15: Recursive Stability Tests (5%)



$$\Delta c_t = \underset{[-3.27]}{-0.096} + \underset{[2.07]}{0.209}\Delta c_{t-2} + \underset{[2.95]}{0.391}\Delta_2 y_{t-1} + \underset{[3.51]}{0.168}\Delta^2 m2_t - \underset{[-2.21]}{1.174}\ \Delta i^l_{t-1} - \underset{[-3.07]}{0.330}\ (c-y)_{t-1} - \underset{[-3.46]}{0.092}\ D97_t \quad (3.20)$$

$R^2 = 0.752$ $R^2_{adj} = 0.695$ $RSS = 0.015$ $\sigma = 0.024$ $F = 13.14[0.00]$
$F_{ar}\,[2,24] = 0.518[0.60]$ $F_{arch}\,[1,31] = 0.801[0.38]$ $F_{het}\,[10,21] = 0.586[0.81]$
$\chi^2_{nor}\,[2] = 4.049[0.13]$ $F_{reset}\,[2,24] = 0.110[0.90]$

Figure 3.16: Goodness of Fit and Residual Graphical Tests of Model (II)

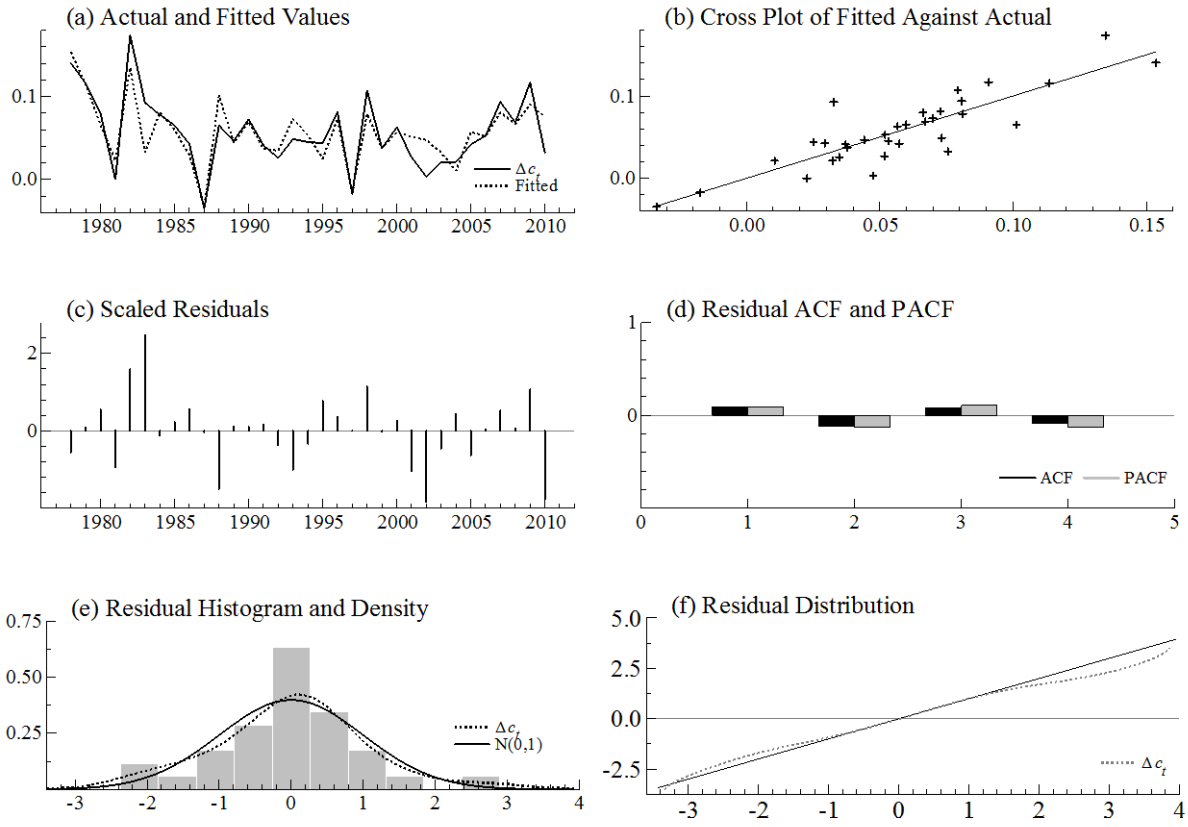


Figure 3.17: Recursive Estimates of Coefficients ±2SE of Model (II)

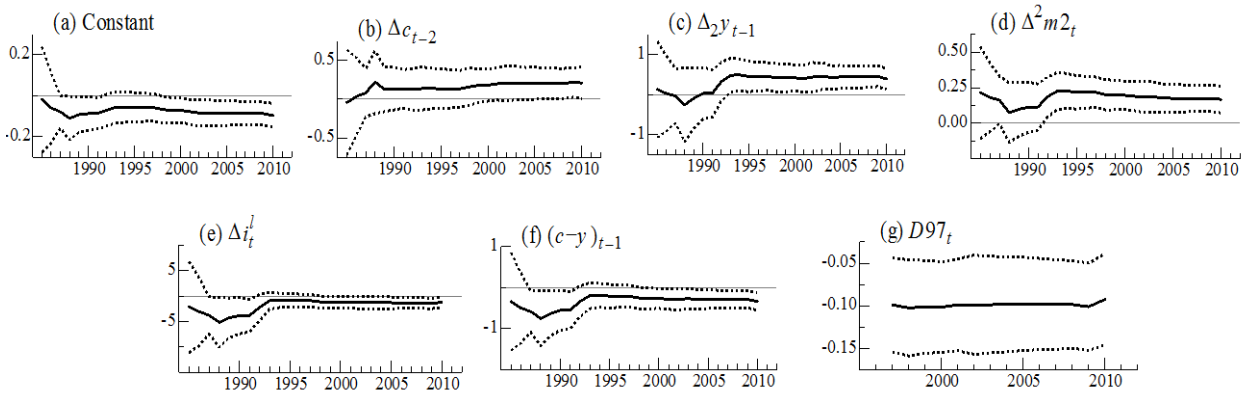
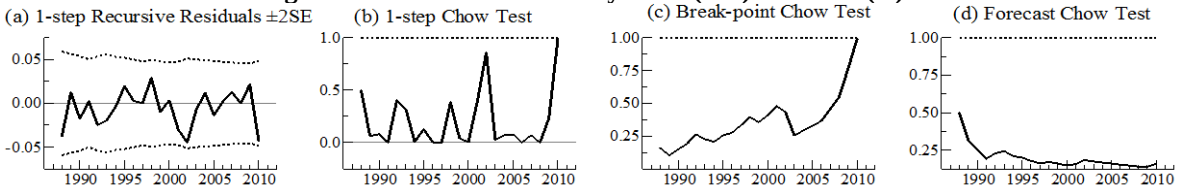


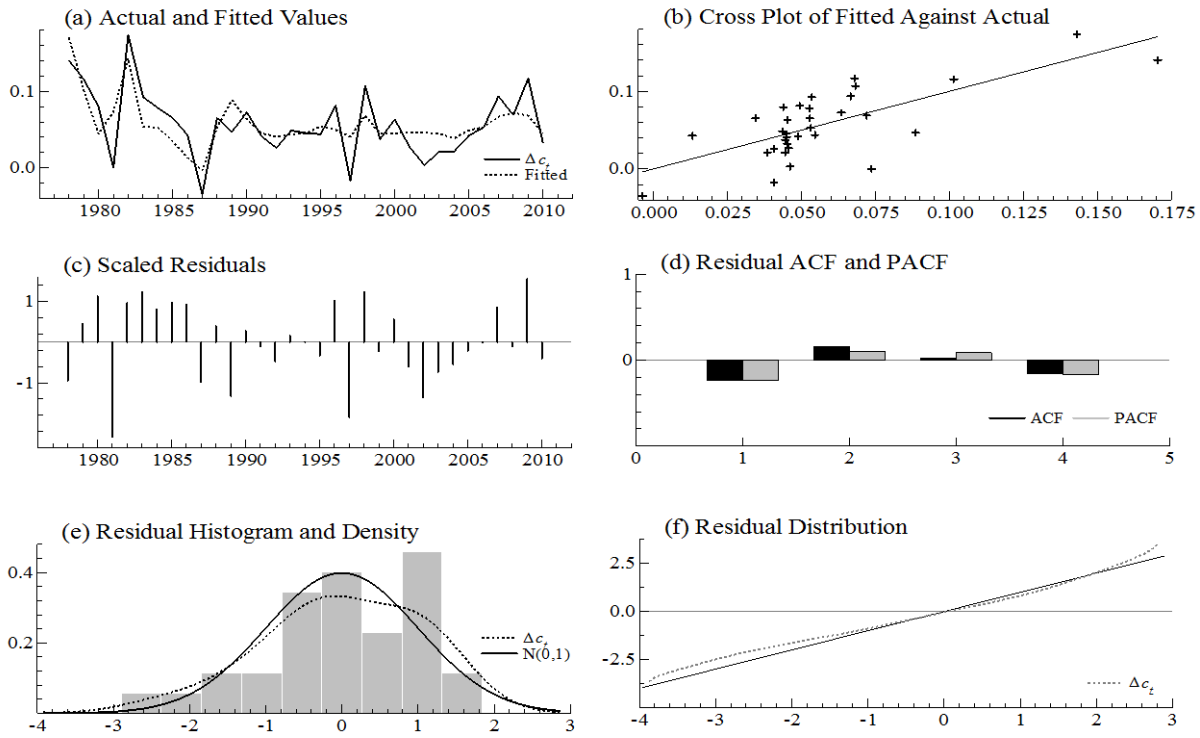
Figure 3.18: Recursive Stability Tests (5%) of Model (II)



3.6.3. The Bank Lending Effect

The credit impact on consumers' expenditure is estimated in model (3.21), which will be called model (III). This model describes the relationship between consumers' expenditure and income and bank lending to households. All coefficients are significant and the signs of coefficients as those expected from theory. Also the speed of adjustment is not too high. All diagnostic tests assert that model (III) passed all of these tests, figure 3.19. The coefficients of model (III) are constant over the sample period, figure 3.20, and Chow tests show no evidence for instability, figure 3.21.

Figure 3.19: Goodness of Fit and Residual Graphical Tests of Model (III)



$$\Delta c_t = \underset{[-2.76]}{-0.093} + \underset{[1.74]}{0.368}\Delta y_{t-2} + \underset{[2.00]}{0.022}\Delta cred^{h}_{t-2} - \underset{[-3.40]}{0.404}\ (c-y)_{t-1} \qquad (3.21)$$

$R^2 = 0.533 \quad R^2_{adj} = 0.485 \quad RSS = 0.029 \quad \sigma = 0.031 \quad F = 11.03[0.00]$
$F_{ar}\,[2,27] = 1.350[0.28] \quad F_{arch}\,[1,31] = 0.292[0.59] \quad F_{het}\,[6,26] = 0.681[0.67]$
$\chi^2_{nor}\,[2] = 1.706[0.43] \quad F_{reset}\,[2,27] = 0.324[0.73]$

Figure 3.20: Recursive Estimates of Coefficients ±2SE of Model (III)

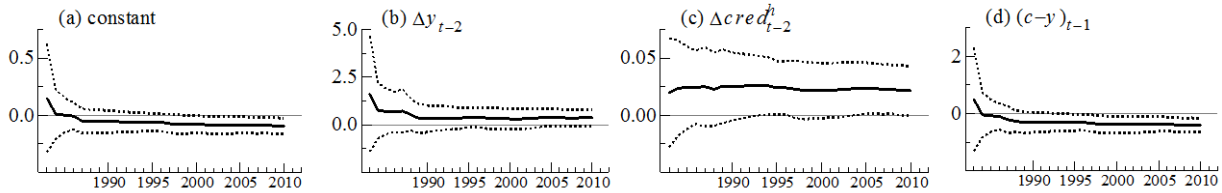
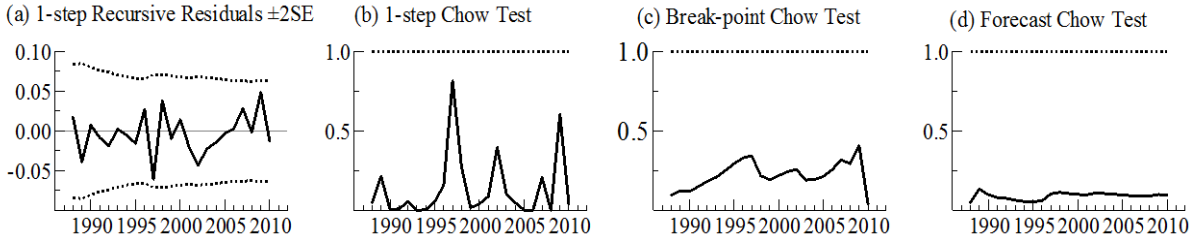


Figure 3.21: Recursive Stability Tests (5%) of Model (III)



3.6.4. The Bounds Test

The ARDL bounds test is used to confirm the existence of the cointegration relationship between the variables in models (I), (II) and (III). The models are estimated first with 2 lags, i.e. equations (3.22), (3.23) and (3.24), then the lag significance test (Doornik and Hendry, 2009a) is used and the lag length 2 was irrelevant in all models, however the first lag cannot be removed without a significant deterioration in the fit of the models, see table 3.5. Therefore, the models are estimated with one lag only. The results of the bounds test, table 3.6, confirm the existence of the cointegration relationships between the variables of models (I), (II) and (III) at 1%.

$$\Delta c_t = \alpha + \beta_1 c_{t-1} + \gamma_1 \Delta c_{t-1} + \gamma_2 \Delta c_{t-2} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \delta_3 \Delta m2_{t-1} + \delta_4 \Delta m2_{t-2} + \theta_1 y_{t-1} + \theta_2 m2_{t-1} + \epsilon_t \quad (3.22)$$

$$\Delta c_t = \alpha + \beta_1 c_{t-1} + \gamma_1 \Delta c_{t-1} + \gamma_2 \Delta c_{t-2} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \delta_3 \Delta m2_{t-1} + \delta_4 \Delta m2_{t-2} + \delta_5 \Delta i^{l}_{t-1} + \delta_6 \Delta i^{l}_{t-2} + \theta_1 y_{t-1} + \theta_2 m2_{t-1} + \theta_3 i^{l}_{t-1} + \epsilon_t \quad (3.23)$$

$$\Delta c_t = \alpha + \beta_1 c_{t-1} + \gamma_1 \Delta c_{t-1} + \gamma_2 \Delta c_{t-2} + \delta_{t-1} \Delta y_{t-1} + \delta_{t-2} \Delta y_{t-2} + \delta_1 \Delta cred^{h}_{t-1} + \delta_2 \Delta cred^{h}_{t-2} + \theta_1 y_{t-1} + \theta_2 cred^{h}_{t-1} + \epsilon_t \quad (3.24)$$

Table 3.5: Wald-test of the Significance of Each Lag

	Lag 1	Lag 2
Model (I)	3.140 [0.021]**	0.809 [0.502]
Model (II)	2.842 [0.028]**	0.720 [0.588]
Model (III)	3.176 [0.020]**	2.814 [0.062]

Note: *p-values* are between [ ] and ** means significant at 5%.

Table 3.6: Results of the Bound Tests

	Model (I)		Model (II)		Model (III)	
	CI(ii)	***CI(iii)***	***CI(ii)***	***CI(iii)***	***CI(ii)***	***CI(iii)***
Null hypothesis	$\alpha = \beta_1 = \theta_1 = \theta_2 = 0$		$\alpha = \beta_1 = \theta_1 = \theta_2 = \theta_3 = 0$		$\alpha = \beta_1 = \theta_1 = \theta_2 = 0$	
F-statistic	7.8376 [0.0003]*		6.6134 [0.0005]*		6.3705 [0.0010]*	
Upper bound [*I(1)*]	4.66	5.61	4.37	5.06	4.66	5.61
Lower bound [*I(0)*]	3.62	4.29	3.29	3.74	3.62	4.29

Note: The Critical values obtained from Pesaran *et al.* (2001), where CI(ii) is restricted intercept and no trend case and CI(iii) is unrestricted intercept and no trend case. Also, *p-values* are between [ ] and * means significant at 1%.

3.7. Summary of Results

This section will discuss briefly the empirical results of models (I), (II) and (III). The three models show the positive effect of changes in income on the changes of consumers' expenditure, and this effect dominates the other variables effect. In model (I), if the income increased by 100% the consumers' expenditure will increase by 40.2% one year later. In addition, the effect of wealth, i.e. financial wealth, was positive and equals about 50% of income effect. If the consumer's wealth was doubled his/her consumption will increase by 19.4% in the same year. The disequilibrium will be corrected by 26.3% each year.

In model (II), changes in consumers' expenditure two years before will affect the current consumption positively by 20.9%. The effect of income is greater than twice of the wealth effect, and both of them are positively correlated to consumers' expenditure. However,

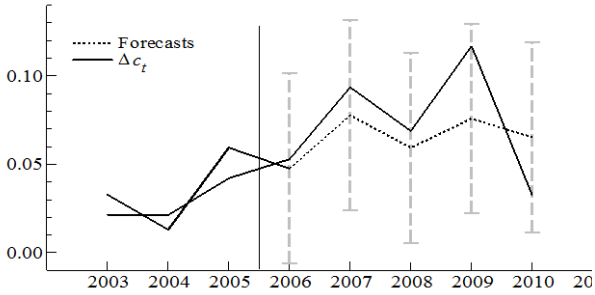
the interest rate impact is negative and statistically significant. If the interest rate coefficient transformed to logarithm scale, in order to ease the comparison, it will be equals -0.160. The income effect is about 2.4 times the interest rate effect, but it is negative, while the effect of wealth is approximately equivalent to the interest rate effect but with a different sign. This model, i.e. model (II), shows the impact of the interest rate on consumption, which in turn gives an indication to the existence of the interest rate channel in Egypt during the period 1975-2010.

Model (III) describes the relationship between the bank lending to households, as a measure of credit, and the behaviour of consumers' expenditure in the Egyptian economy in the last four decades. According to this model the changes in bank lending to households have a positive and significant effect on the consumers' expenditure, while this effect is at a small magnitude. The effect of income is about 17 times of credit effect during the period of study. This result is expected in the light of the small proportion of credit that the banks in Egypt allocated to the households sector for a long period, mainly before the ERSAP. Although, the effect of bank lending to households is expected to increase in the future as a response to the change in the banks' plans for the credit allocation between households and business sectors (see: Farouk, 2003). This model refers to the existence of the bank lending channel in Egypt during 1975-2010.

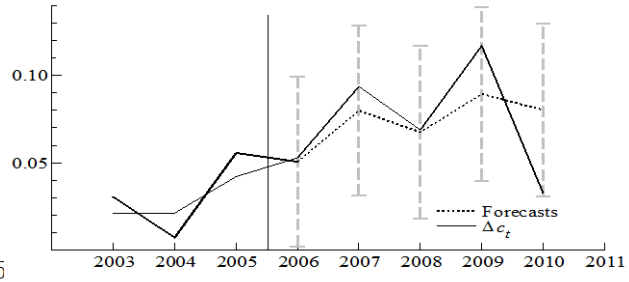
Comparing these three models will shows that model (II) has the smallest σ and RSS and the highest R^2 and R^2_{adj} comparing to the other two models. Furthermore, these three models have a good in-sample forecasting ability to predict the consumers' expenditure, figure 3.22. Though, these models have relatively large forecasting errors in 2009 which reflect the impact of the financial crisis in 2008. But, model (II) is the best in forecasting as it has the smallest forecasting errors and all its values are inside the error bands.

Figure 3.22: In-Sample Forecasts of Consumers' Expenditure in the Three Models

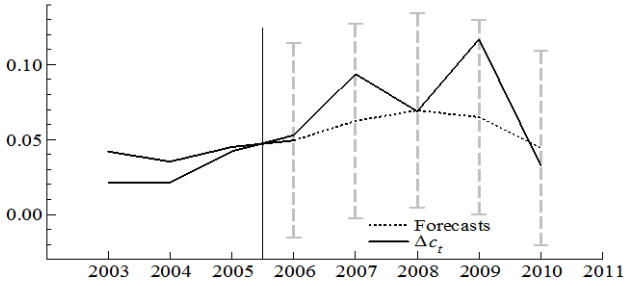
(a)Model (I)



(b) Model (II)



(c) Model (III)



3.8. Conclusion

Consumers' expenditure in the Egyptian economy was estimated econometrically using the annually data from 1975 to 2010. The final results were models (I), (II) and (III), which explain the effect of income, wealth, the interest rate and bank lending to households on consumption, respectively. These three models do not suffer from autocorrelation or heteroskedasticity, and their residuals are normally distributed. Moreover, the Ramsey-RESET test confirms that these models are well specified. These models have constant coefficients and there is no evidence for structure change after including an impulse dummy variable for year 1997 which can reflect the Asian crisis, the end of the ERSAP and the liquidity crisis in Egypt in this year.

The cointegration relationships between variables, in these models, were estimated using Engle-Granger two-step approach. And, the speed of adjustments was at plausible

levels. Additionally, the bounds test asserts the existence of the long-run, i.e. cointegration, relationships in these models.

The signs of all variables were in a line with economic theory, because income, wealth, and bank lending have a positive impact on consumption, while both the interest rate and inflation have a negative impact on consumption. The effect of income dominated other variables effects in the three models. The wealth effect, measured by M2, on consumption was important and higher in magnitude than the effect of the interest rate, after transferring the interest rate coefficient to log scale, and bank lending to households. The effect of interest rate was greater than the effect of bank lending and both of them are statistically significant. Therefore, there is an indication of the existence of both the interest rate and the bank lending channels, as the changes in the interest rate and bank lending affected consumption, which, in turn, will be reflected on real income.

CHAPTER 4 : ESTIMATING THE INVESTMENT EXPENDITURE UNDER UNCERTAINITY IN EGYPT

4.1. Introduction

The interaction between firms' investment demand and households' saving supply, together, determines the majority of investment volume in any economy. Depending on the investment volume, aggregate demand will be determined, and then the living standard of the country's population will be determined, in turn. Therefore, the welfare level, the economic growth and other leading variables will be under the effect of the investment function behaviour. Additionally, the investment volume is a volatile variable, especially in short run, so that it is important for policy makers, especially, in the macroeconomics field to concern the investment function, when they are planning for the country's future.

Regarding the main purpose of this thesis, assessing the monetary transmission mechanism in Egypt, it is essential to know the behaviour of variables which play a core role in this mechanism. Consumers' expenditure and firms' investment are the chief intermediary variables through which the effects of monetary policy are transmitted to income. Consequentially, the econometric estimation and testing of the investment function becomes essential in this study. There is a dearth of work on the investment function in Egypt and this chapter is devoted this gap. Also, this chapter and the previous one, consumers' expenditure in Egypt, together, establish the keystone that the next chapters will beneficiate from.

The current chapter is divided into seven parts, excluding the introduction. A survey of the literature, which discusses the different main theories of firm's investment decision,

will be in the next section. A discussion of the chief determinants of the firm's investment decision will follow. Econometric methodology, data, and econometric model presented in separate sections, respectively. The summary of results represented at the end of the chapter and followed by the conclusion.

4.2. Investment Function in the Literature

The literature about private investment theories is widespread topic; however it can be classified into main theories. These theories can divided into the Keynesian-Kalecki, the accelerator, the neoclassical and the Tobin's *q*. In addition, the uncertainty and irreversibility of investment can play an important role in investment decisions

4.2.1. The Keynesian- Kalecki Theory

According to Keynes (1936), the investment decision relies on the prospective returns of this investment. The determinants of the investment decision are the replacement cost, i.e. supply price, and the prospective yield of the investment. In addition, the relationship between the replacement cost and the perspective yield is summarised in the marginal efficiency of capital, which is defined by Keynes (1936) as "*that rate of discount which would make the present value of the series of annuities given by the returns expected from the capital-asset during its life just equal to its supply price*". Also, the aggregate demand and the stock of accumulated capital are playing the major role in determining the marginal efficiency of capital (Oruko, 2000).

Keynes (1936) asserts that an increase in any type of investment will diminish the marginal efficiency of this type by effect of the fall of the prospective yield and the rise of the supply price, which both result from demand and supply forces. Furthermore, investment will

increase as long as the marginal efficiency of capital is higher than the market rate of interest (Keynes, 1936).

Two variables were thought to describe investment behaviour by Kalecki (1989), these being the firm's retained profits, i.e. internal finance, and availability of funds, i.e. external finance. In addition, internal or self-finance is preferred to borrowing if the firm is small because it is difficult for this firm to go to the stock market to issue financial instruments or to get bank loans easily. The position of equity on the firm's balance sheet is an important indicator of the ability of the firm to borrow from external sources such as banks. In a line with the previous point, the higher the equity-to-assets ratio the easier it is to obtain external finance.

Kalecki concentrated on finance and the firm's financial constraints. Additionally, he describes the investment as a function of savings, profits and capital stock as follows:

$$D = aS + b\,\frac{\Delta P}{\Delta t} - c\,\frac{\Delta K}{\Delta t} + d \tag{4.1}$$

where D denotes the investment rate, S is gross savings, P is profits, K is capital stock, d is deterministic trend and t denotes the time period. Furthermore, it is clear from the previous equation that investment is an increasing function in savings and profits but it is decreasing function in the capital stock (Alexiou, 2010).

4.2.2. The Accelerator Theory

According to Clark (1917), the accelerator model assumes that there is no direct relationship between investment, in one side, and prices, wages, taxes and the interest rate, in other side, however, they may have be an indirect relationship. Furthermore, the cornerstone of the accelerator model is the assumption that the capital-output ratio is constant and the

capital stock is always optimally adjusted in each time period (Berndt, 1991, p.233-234). This model can be summarised by the following equations (4.2), (4.3) and (4.4).

$$K_t^* = \mu \cdot Y_t \tag{4.2}$$

$$K_t^* = K_t \tag{4.3}$$

$$I_{nt} = K_t - K_{t-1} = \mu(Y_t - Y_{t-1}) \tag{4.4}$$

where K_t is the capital stock in period t, K_t^* is the optimal capital stock at time t, μ is capital-output ratio, I_{nt} is the net investment at time t, Y_t is the output in period t.

This '*rigid* or *naive'* accelerator theory assumes that there is no excess capacity, which means that firms are always in equilibrium (Antonakis, 1987). Also, the optimally adjusted capital stock assumption is a comparative static analysis of investment, which it is a dynamic phenomenon. Empirically, this accelerator model did not work well which is returned to the restrictive instantaneous adjustment assumption (Berndt, 1991, p.234), also the estimated values of capital-output ratio were less than the observed average of this ratio (Berndt, 1991, p.234).

A modified version of the accelerator model, the *flexible accelerator model*, was introduced by Koyck (1954). In the flexible accelerator model the adjustment of the capital stock to the optimal capital stock is not instantaneous, but it is a proportion, λ, of the difference between the optimal capital stock and the capital stock. So, we can express about that by the following equations from (4.5) to (4.7).

$$I_{nt} = \lambda(K_t^* - K_t) \tag{4.5}$$

$$I_{nt} = K_t - K_{t-1} = \lambda\mu K_t^* - \lambda K_{t-1} \tag{4.6}$$

$$K_t = \mu\lambda Y_t + (1-\lambda)K_{t-1} \tag{4.7}$$

4.2.3. The Neoclassical Theory

The substitution of input in the accelerator model was not allowed by assumption. Conversely, the neoclassical model concentrates on the relationship between input, and it considers the impact of factor prices, including taxes, on the desired capital stock. The model starts with a profit function in case that the main inputs are capital, K, and labour, L.

$$\pi_t = P_t Y_t - w_t L_t - c_t K_t \tag{4.8}$$

where, π_t is the profit at time t, P_t is the prices of output Y_t, w_t is the wage rate and c_t is the cost of capital or the user cost of capital.

The profit maximisation will be subject to a neoclassical production function constraint as in equation (4.9)

$$Y_t = f(K_t, L_t) \tag{4.9}$$

To avoid the empirical sophistication of the neoclassical model Jorgenson (1971) made some assumptions, for example the perfect markets of capital goods, i.e. inputs and outputs, are existed, the adjustment between K^* and K is costless, and physical capital decays exponentially.

Using the Lagrangian multiplier procedure the optimisation of profit function for capital and labour will be as in functions (4.10) and (4.11).

$$P_t \cdot \frac{\partial Y_t}{\partial K_t} = c_t, \qquad \frac{\partial Y_t}{\partial K_t} = \frac{c_t}{P_t} \equiv MPP_{K,t} \tag{4.10}$$

$$P_t \cdot \frac{\partial Y_t}{\partial L_t} = w_t, \qquad \frac{\partial Y_t}{\partial L_t} = \frac{w_t}{P_t} \equiv MPP_{L,t} \tag{4.11}$$

Where $MPP_{K,t}$ and $MPP_{L,t}$ are the marginal physical products for capital and labour, respectively. Therefore, the optimal capital stock, K^*, will be such that the marginal physical product of capital equals the real user cost of capital.

Hayashi (1982) criticised the neoclassical theory because the rate of investment cannot be determinant by this theory. The neoclassical theory deficiencies are solved by introducing a new component, the new investment's installation costs, to the firm's optimisation problem.[25]

4.2.4. The Tobin's q-Theory

Tobin (1969) illustrated the framework of monetary analysis using the q-ratio, which is *"the value of capital to its replacement cost"*. The ratio can be interpreted as representing an increase in the present value of the firm by q as a result of an increase in the capital stock by one unit, through increasing the present value of the firm's profit by q (Romer, 2006; Tobin and Brainard, 1976). Also, the investment is an increasing function of the marginal q-ratio according to q-theory, and the firm will continue to invest as long as the q-ratio is above unity. Also, the q-theory can describe the relationship between investment and the stock market as the transactions in this market depend on the firm's value (Oruko, 2000).

While, marginal q is the key determinant according to q-theory but only average q is observable so it is used by researchers (Romer, 2006). Hayashi (1982) defines the average q as "*the ratio of the market value of existing capital to its replacement cost"*. Some economists like von-Furstenberg *et al.* (1977) used average q as a proxy for marginal q. Additionally, Hayashi (1982) asserts that the difference between average and marginal q will disappear if the firm is a price-taker and constant returns to scale exists in production and installation cost. Nevertheless, if the firm is price-setter then average q will exceed marginal q by the monopoly rent. Furthermore, taxes and depreciation should be taken into account when the q-ratio is calculated.

25 See Lucas (1967), Gould (1968), Treadway (1969) and Uzawa (1969).

The empirical studies show that the *q*-ratio did not perform successfully. For instance, in case of UK, Blundell *et al.* (1992) found that the q-ratio has a small significant effect on a firm's level of investments. Although, the *q*-theory is widely used as a theory to explain the movements in private investment, it is disappointing in empirical studies (Bond and Jenkinson, 1996).

4.2.5. Uncertainty and Irreversibility of Investment

Uncertainty can affect investment decisions from many sides, like future profits, interest rates, and tax policy. Romer (2006) pointed out that if a firm is uncertain about its future profits this will affect the expected future value of its investment. Under asymmetric adjustment costs, the uncertainty about the future profits will reduce the expectations about the profitability in the future, which, in turn, will affect investment inversely (Romer, 2006).

The asymmetric adjustment costs will create the irreversible investment, which means that it is easier to increase the investment than to reverse this increase (Romer, 2006). If investment is irreversible then it is better for the firm to wait rather than to invest, as if does not invest, it will be able to maintain its capital stock at low level, however if it invests then it will commit a high capital stock (Romer, 2006).

4.3. Determinants of Investment Expenditure

An investment decision is a complicated process which is determining by several variables, for example output, internal funds and the cost of external finance (Jorgenson, 1971; Jorgenson and Siebert, 1968). As well as these variables which affect private investment, there are several variables that play a role in determining the investment, such as

demand expectation, the public investment level, the tax system, prices level, exchange rate regime, external debt services payment, terms of trade and the stability of the economy.

The relationship between the income measure and the investment level has been examined in a number of studies, and it has found to be positive and statistically significant. Acemoglu (1993) asserts that there is Granger causality from output to investment. However, the expected demand of a firm's output is a major determinant of the investment level of the firm; it is unobservable and extremely difficult to be measured. Hence, empirical studies frequently use output or output gap as a proxy of demand (Bond and Jenkinson, 1996).

Oshikoya (1994) argues that private investment is an increasing function of income per capita, and countries with a high expected income per capita have a high domestic saving ratio which provides, in turn, a source of finance to private investment. The empirical results support the previous assumption, where in two African country groups[26] the relationship between real income growth and private investment was positive and significant (Oshikoya, 1994). In low and middle-income countries, Oshikoya (1994) found a positive significant relationship between public investment spending and the changes in the private investment in these African countries during the period 1970-1988, while the impact was stronger in the middle-income countries.

Sakr (1993) found that private investment in Pakistan is positively correlated to public investment, GDP growth rate and credit to the private sector. Separating the public investment into infrastructure and non-infrastructure spending gave different results. The correlation between private investment and the public infrastructure spending was positive, but the correlation was negative between the private investment and the public non-infrastructure spending.

[26] These two groups are the middle income countries, which include Cameron, Mauritius, Morocco and Tunisia, and the low-income countries, which contain Kenya, Malawi and Tanzania.

A positive complimentarily relationship between public and private investment exists in developing countries (Serven and Solimano, 1991). In the case of Ghana, Asante (2000) found that the relationship between public and private investment was a positive complimentary relationship, especially when public investment is concentrated on infrastructure. Additionally, the positive effect of public investment can be reduced by the negative effect of the crowding-out with the net effect depending upon the magnitude of the two influences (Wai and Wong, 1982).

Fawzy and El-Megharbel (2004) found in their study on Egypt, a complementary and crowding-in relationship between public investment in infrastructure, like roads and ports, electricity, education and health, and private investment. Public investment in non-infrastructure was found to crowd out private investment.

Shafik (1992) argues that the period between 1960 and 1986 watched an insignificant relationship between private investment and interest rates in Egypt. In addition, crowding-out occurred through credit rationing, while, a significant positive complementary relationship between the public infrastructural investment and private investment founded (Shafik, 1990).

Agenor *et al.* (2005) used the variance decomposition technique to estimate the impact of public infrastructure investment on private investment, and the results show that, in the case of Egypt and Tunisia, it was responsible for about 33% of the changes in private investment in these countries. Additionally, Loayza and Odawara (2010) assert a significant positive relationship between public investment in infrastructure and private investment in Egyptian economy during the period 1961-2005.

Although, the public debt in Egypt has a negative crowding-out effect on GDP growth, and for the purpose of infrastructure finance it had a preferable impact on private investment between 1970 and 2004 (ESCWA, 2005).

Aggregate fluctuations of a firm's investment could be a result of the effect of the financial constraints that the firm faces in funding its new investment (Fazzari *et al.*, 1988). In addition, the equivalence between internal and external finance is rejected by empirical studies (Bond and Jenkinson, 1996). Also, the growth of real credit to the private sector plays a significant effect on the private investment, and the relationship between them is positive in Ghana (Asante, 2000).

The expected direct effect of the decline of credit to the private sector decreases private investment (Wai and Wong, 1982). This effect will propagate if the internal funding of the firm is limited and less than the desired level of investment. Fielding (1993) found that the availability of domestic funds, aid and concessional debts will play a significant role in determining the path of investment growth in Kenya and the Cote d'Ivoire. Also, the return on investment is an essential variable that can explain movements in investment.

Credit to the private sector had a significant positive effect in African countries on private investment during period 1970-1988 (Oshikoya, 1994). Abdel-Kader (2006) found that the non-performing loans problem in Egypt, during early twenty-first century, encourages banks to allocate the majority of their investment in more liquid and less risky assets, like Treasury bills and government bonds. The decline in the bank lending to the private sector, started from late twenty century, affected investment negatively in Egypt.

The tax system is one of the potential determinants of investment. The higher the taxes level the slower and lower private investment. An increase in taxes reduces the firm's after tax profits, i.e. it decreases the return of investment. Additionally, in most countries the tax system results in increasing the required rates of return (Bond and Jenkinson, 1996). Summers (1981) declares that the interaction between tax and inflation will have a severe effect on investment if the tax system is not indexed. In addition, the effect of tax on investment is

better to be measured by the marginal tax rate rather than the average tax rate (Fazzari *et al.*, 1988).

The tax incentive in developing countries was found to be one of major factors that determine the level of private investment and hence economic growth (Wai and Wong, 1982). Furthermore, the low after-tax return, which reflects the effect of tax system on the private investment, is one reason for the low private investment in African countries and West Bank and Gaza (Seruvatu and Jayaraman, 2001). However, the political uncertainty in these countries might also be an explanatory variable which determines private investment.

Kheir-El-Din *et al.* (2000) argue that the marginal effective capital tax rate in Egypt is higher than the average income tax rate; also the effective rate in Egypt is higher than its level in some Latin American countries. Additionally, the tax system in Egypt is favouring joint stock companies listed in the Stock Exchange over the other companies. Additionally, there is a preferable tax treatment of industry over services, land over capital investments, external over internal finance, and exports oriented firms over inward oriented firms.

The future expected prices of a firm's goods and services should affect the firm's production plan and, in turn, the investment volume. As long as the revenues of the firm are correlated positively with the fluctuations of its prices then investment will move in the same direction as the expected price changes (Bond and Jenkinson, 1996).

Gould (1968) argues that investment changes are positively correlated with fluctuations in prices level and negatively correlated with interest rate movements. Additionally, price expectations affect actual prices through effects on supply. Additionally, the long-run equilibrium level of investment is affected by interest rates, demand and adjustment costs (Lucas and Prescott, 1971). Although, the impact of price changes in low-income African countries on private investment was strongly negative (Oshikoya, 1994).

Although the correlation between output and investment is robust and stable, the correlation between investment and the interest rate is weak and insignificant (Bond and Jenkinson, 1996). Some explanation in the literature for the insignificance of interest rate changes on investment were uncertainty about internal rate of return and time inconsistency (Shafik, 1992).

Serven and Solimano (1991) assert that however the real output growth is correlated positively with private investment in developing countries, the effect of the real exchange rate in these countries is still small and insignificant. In addition, Buffie (1986) argues that currency devaluation will not be effective and may lead to a shrink of investment, if this devaluation is not combined with the proper mix of an expansionary monetary policy and a contractionary fiscal policy. While, Sakr (1993) asserts that the impact of the currency devaluation on private investment in low developing countries is ambiguous, the final effect depends on the structure of the economy, the imports share of domestic output, and exports and imports elasticities.

Wai and Wong (1982) argue that exchange rate regimes influence private investment through its impact on the capital account of the balance of payment. Oshikoya (1994) empirical results refer to a significant positive correlation between private investment, in one hand, and fluctuations in the real exchange rates in Mauritius, Morocco and Tunisia, while this correlation does not exist for Malawi, Kenya and Tanzania. Also, the coefficients of real exchange rate in private investment function were small and negative but statistically insignificant.

Serven and Solimano (1991) argue that one of the variables that induced a negative effect on private investment, especially in the highly indebted countries, is foreign debt burden. This negative effect is generated from credit rationing in world capital markets and

the high degree of uncertainty stemming from external debt. In contrast, Borensztein (1990) suggests that the effect of credit rationing on investment provides a disincentive influence. In his numerical simulations, he found that in order to maximise the effect on investment it was necessary to include additional foreign debt in the external debt reduction plan.

Oshikoya (1994) explains that the high external debt services to exports ratio is an indicator about macroeconomic instability. The external debt services burden is affected by many variables, such as the timing of external debt transfers, changes in the international interest rate, terms of trade movements, and the trend of exports.

The transfers of external debt services will affect the equilibrium level of the effective exchange rate according to the size of the cumulative debt and the cost of debt servicing. The higher level of external debt servicing will reduce the funds available for investment (Oshikoya, 1994). In addition, the highly indebted countries face difficult constraints in the world capital market, which reduce, in turn, the amount of funds that the country may obtain to finance the investment that exceeds the internal finance limits (Oshikoya, 1994). Oshikoya (1994) results refer to the negative effect of the movements of the external debt servicing to exports ratio on private investment changes during 1970-1988 in both low and middle-income African countries.

Unbearable fiscal deficits, high inflation and unstable exchange rates, as measures of macroeconomic instability, are responsible in many countries in determining private investment (Seruvatu and Jayaraman, 2001). In addition, the macroeconomic instability, measured by the variability of both the real exchange rate and real output growth, affects private investment negatively in developing countries (Serven and Solimano, 1991). While each individual macroeconomic instability measure was insignificant in Ghana, the constructed measure should play a role if all of these four measures are considered

simultaneously (Asante, 2000). Also, the political stability and government's creditability are expected to have a significant effect on investment (Asante, 2000).

One of indicators of external shocks is the change in the terms of trade. Unfavourable movements in the terms of trade result in increasing the cost of imports, which, in turn, reduces the purchasing power of exports. Consequently, the current account of the balance of payment will face massive deficits, and that represents a worsening in the external balances and macroeconomic stability. Therefore, private investment will be affected negatively (Oshikoya, 1994). A rise in the price of essential imported goods, with a large share in the family budget, will lead to imported inflation and raise the cost of living (Oshikoya, 1994). Asante (2000) found that the trade regime in the previous period affected the present level of investment in Ghana.

4.4. Econometric Methodology

The econometric methodology in this chapter is similar to this of chapter 3, see section 3.4. However, this chapter will use a generalised autoregressive conditionally heteroscedastic (GARCH) model to estimate the uncertainty. Uncertainty is usually estimated as the conditional variance of a GARCH model. Thereafter, the conditional variance, from a GARCH model, as an uncertainty variable will be used in the estimated ECM of investment expenditure in Egypt.

The classical linear regression model, CLRM, assumes that the residuals, u_t, is $u_t \sim N(0, \sigma^2)$. This implies that residuals are normally distributed with mean equal zero and a finite and constant variance, $Var(u_t) = \sigma^2$, i.e. homoscedastic. However, in some cases residuals are heteroscedastic, i.e. non-constant variance, so that the estimated errors, i.e. residuals, from the CLRM will not be correct. This problem was tackled by Robert F. Engle

when he introduced the autoregressive conditionally heteroscedastic (ARCH) models (Engle, 1982, 1983; Engle *et al.*, 1987). ARCH model consists from a mean, y_t, equation and a conditional variance, σ_t^2, equation. ARCH(q) model can be illustrated as following:

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \cdots + \beta_p x_{pt} + u_t \,, \qquad u_t \sim N(0, \sigma_t^2) \tag{4.15}$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 u_{t-2}^2 + \cdots + \alpha_q u_{t-q}^2 \tag{4.16}$$

The conditional variance, σ_t^2, usually called h_t in literature (Brooks, 2008). After running the regression of h_t equation we obtain R^2 and using the test-statistic TR^2, where T is the number of observations and compare it with X_q^2 for the null and alternative hypotheses (Brooks, 2008) as hollowing:

$$H_0: \alpha_1 = 0, and\ \alpha_2 = 0, and\ \ldots and\ \alpha_q = 0 \tag{4.17}$$

$$H_1: \alpha_1 \neq 0, and\ \alpha_2 \neq 0, and\ \ldots and\ \alpha_q \neq 0 \tag{4.18}$$

ARCH model had developed and the natural extension of it was the generalised autoregressive conditionally heteroscedastic (GARCH) models, which developed by Tim Bollerslev (Bollerslev, 1986). GARCH(*p*,*q*) model can be summarised as follow:

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \cdots + \beta_p x_{pt} + u_t \,, \qquad u_t \sim N(0, \sigma_t^2) \tag{4.19}$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \, u_{t-i}^2 + \sum_{j=1}^{p} \delta_j \, \sigma_{t-j}^2 \tag{4.20}$$

Generally, a high order of GARCH models usually do not add any significant capture to the volatility clustering in the data, so that it is scares to find any GARCH models higher than GARCH(*1*,*1*) in empirical research (Brooks, 2008, p.394) .

4.5. Data

This chapter uses annual data from the Egyptian economy during that period commences from 1975 to 2010. The selection of this period is determined by data availability and the stability of the economy. The sources of data are in the data appendix at the end of the thesis. Real private investment (*inv*), real gross national income (*y*), real credit to private sector ($cred^P$), and real exchange rate (*rer*) are in natural logarithm. However, the real lending interest rate (ri^l) is in nominal level.

The real private investment follows, approximately, the real income movements' trend during the study period, as both have upward trends. However, the fluctuations in the real private investment are wider than that in real income measure, GNI, especially during the period starts from 1990 up to 2009 which represents slow growth rates, figure 4.1.

Figure 4.1: Trends of Real Private Investment and Real GNI

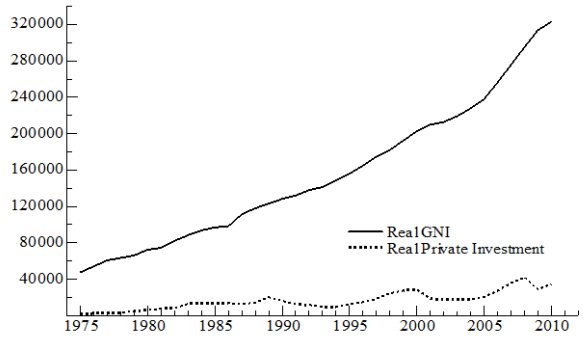


Figure 4.2: The Nominal and Real Lending Interest Rate

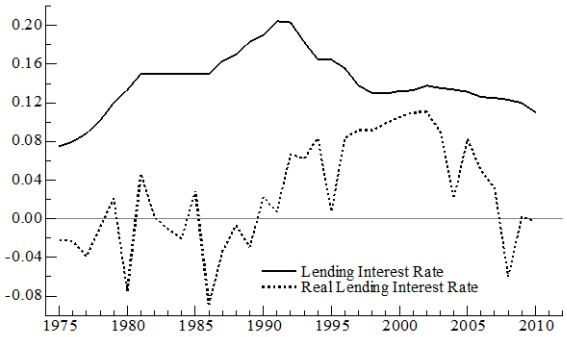


Figure 4.3: The Nominal and Real Credit to Private Sector

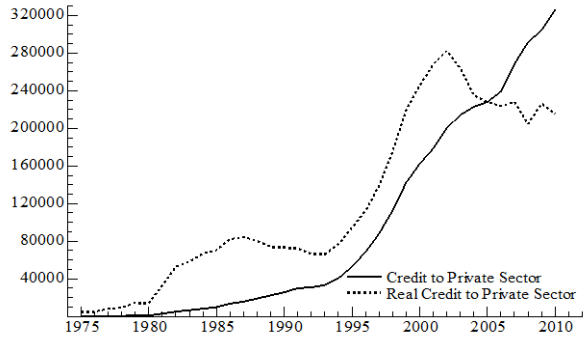
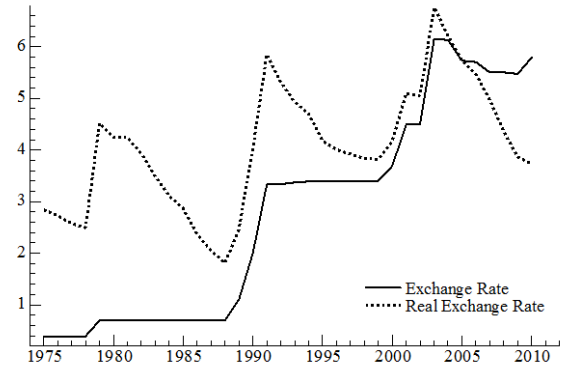


Figure 4.4: Nominal and Real Exchange Rate



Although, the nominal interest rate was stable over the majority of the study period as it was determining by the CBE. The real interest rate was affected by the movements in inflation rate, figure 4.2. Furthermore, the credit to private sector grew slowly before 1991 but it turns to grow quickly after that year. The rapid growth of credit was associated with the decline in interest rates and the wide credit expansion after 1994, figure 4.3.

The other variable that is expected, according to the literature, to have a significant impact on private investment is the exchange rate. The exchange rate was fixed in the case of Egypt before the currency floating which started in 1999. The change in the exchange rate was determined by the CBE centrally. Figure 4.4 demonstrates the developments in nominal and real exchange rate.

4.6. Econometric Model

The unit root tests, table 4.1, assert that all variables are non-stationary in levels, however, they are stationary in first difference, $I(1)$. So, it is possible to check the existence of the long-run relationship under cointegration approach of Engle-Granger.

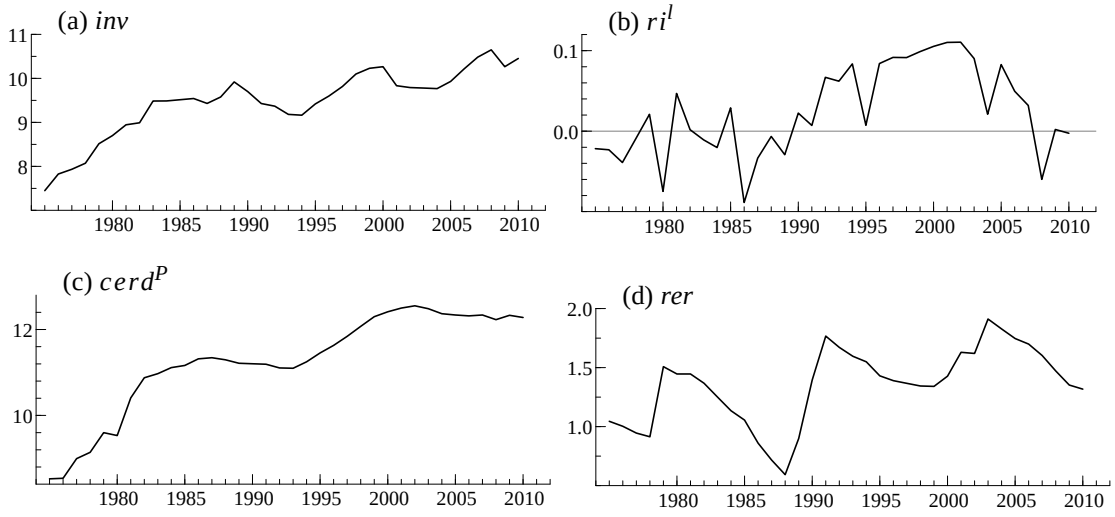
Table 4.1: Unit Root Tests of the Investment Function's Variables

Variables	ADF-test						PP-test						KPSS-test					
	Level			*Difference*			*Level*			*Difference*			*Level*			*Difference*		
inv	-2.956	4	*t*	-4.715*	0	c	-2.769	1	t	-4.716*	1	c	0.158	2	t	0.231**	2	c
y	-2.407	3	*t*	-5.431*	2	c	-4.089**	1	t	-5.494*	2	c	0.181	4	t	0.424**	1	c
i^l	-1.811	3	*c*	-2.262**	2	-	-2.056	3	c	-2.601**	2	-	0.720	0	c	0.423**	4	c
$cred^P$	-2.525	2	*t*	-4.319*	0	*c*	-1.662	2	*t*	-4.503*	3	*c*	0.156	3	*t*	0.338**	4	*c*
rer	-2.661	3	c	-4.180*	0	-	-2.186	2	c	-4.163*	3	-	0.429	4	c	0.071**	1	c

Note: (*) and (**) mean that the variable is stationary at 1% and 5%, respectively. The critical value of KPSS-test, at 5%, in case of the series has trend is 0.146 and in case of the series has constant only is 0.463. Critical values of ADF-test and PP-test are following MacKinnon (2010), see table 3.4, while those for KPSS-test are following Kwiatkowski *et al.* (1992). The numbers beside the critical values represent the number of lags, while *t, c,* and – after the critical values represent the variant of the series trend and constant, constant, and no constant or trend, respectively.

From many variables that can be used in estimating the private investment, like those mentioned in section 4.3, this chapter will concentrate on the most important ones, according to the literate and the purpose of this thesis. Figure 4.5 illustrates the developments and trends of the variables, except the income variable is depicted in figure 3.6, that will be used in estimating the investment function in Egypt,

Figure 4.5: The Investment Function's Variables



Model (4.21) represents the private sector's aggregate demand on investment goods. According to the economic theory the demand on investment goods has a direct relationship with income level, as an increase in income will include a higher level of savings which, in turn, will provide more funds to the private sector, which will raise the demand of this sector on investment goods. Furthermore, the interest rate is expected to have a reverse impact on the aggregate demand on investment goods, i.e. investment expenditure, since it represents the cost of funds and opportunity cost. Therefore, an increase of the cost of funds will decrease the number of projects which investors are willing to establish, because only those investment projects which have a marginal efficiency of capital higher than or equal to the new higher interest rate will be feasible from investors' viewpoint (see Keynes, 1936). Moreover, the

availability of funds plays a role in determining the volume of investment (see Kalecki, 1989). Accordingly, an increase in the availability of funds, measured by the bank credit to the private sector, is expected to raise the private investment volume in the country. Furthermore, the fluctuations in exchange rate can affect the investment volume negatively, since an increase, i.e. devaluation, in the exchange rate will raise the cost of imported investment goods, and this will decline investors' demand on imported investment goods, i.e. the reverse relationship between quantity demand and its price.

This model represents the private investment expenditure in Egypt as a function of income, the interest rate, bank lending to private sector and the exchange rate during the period 1975-2010. According to this model, the signs of variables are as the expectations of the economic theory. Both income and credit to the private sector have a positive effect on private investment expenditure. However, the signs of interest rate and exchange rate are negative. Also, the increase in the exchange rate will increase the cost of imported investment goods especially in the case of Egypt as a net imported country for this type of goods, therefore the Egyptian demand on imported investment goods will decline as a result of this increase in the price of this type of goods.

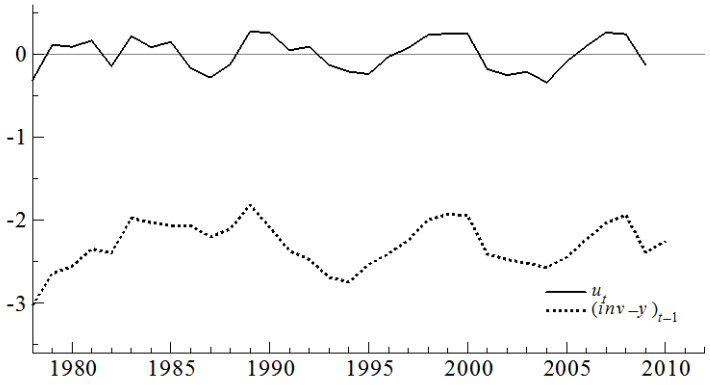
$$inv_t = -0.142 + 0.291\, y_t - 2.214\, ri_t^l + 0.575\, cred_t^P - 0.183\, rer_t \qquad (4.21)$$

$$T = 36 \quad R^2 = 0.924 \quad R^2_{adj} = 0.914 \quad RSS = 1.484 \quad \sigma = 0.222 \quad F = 91.25[0.00]$$

The second stage of Engle-Granger cointegration approach is to use the residuals of this estimated model in an error-correction model, after tests the stationarity of residuals. Following the technique that are used in many studies, like Davidson *et al.* (1978), Davidson and Hendry (1981), Hendry (1994) and Hendry (2000), it is possible to find a plausible speed of adjustment of the estimated model. The idea behind this is to use the log of average

propensity to invest, *API*, as the error-correction mechanism, and this error-correction term take the form $(inv - y)_{t-1}$. Figure 4.6 shows the similarity in the pattern between the residuals, u_t, and $(inv - y)_{t-1}$.

Figure 4.6: The Errors and API as Error-Correction Mechanisms



The model's residuals, u_t, is stationary at 1% for DF-test and ADF-test, with t-statistics equals -3.40 and -4.78 respectively. Furthermore, $(inv - y)_{t-1}$ is stationary at 5% for DF-test and ADF-test, with t-statistics equals -3.00 and -3.49 respectively.

4.6.1. The Uncertainty Measure

Uncertainty effect on investment decisions attracted many researchers to estimate this effect; however there is no one proxy for uncertainty. Carruth *et al.* (2000b) provide a survey for aggregate and disaggregate measures of uncertainty in many studies. Many studies used the condition variance of GDP as a proxy of uncertainty, like Fountas and Karanasos (2006) and Price (1995, 1996). Also, The effect of uncertainty about inputs and outputs prices on investment level are discussed in Hartman (1972) and Abel (1983).

Ingersoll and Ross (1992) pointed out the effect of uncertainty about the interest rates on investment. Also, Calcagnini and Saltari (2000) suggested that the uncertainty of demand and interest rate reduces the investment.

Servén (2003) used real exchange rate volatility as a measure of uncertainty and he found a negative effect of this variable on investment. Moreover, Servén (1998) used five uncertainty measures, i.e. capital growth, inflation, relative prices of investment goods, terms of trade and real exchange rate, to investigate the relationship between uncertainty and investment in developing countries. And, he found a significant negative impact of uncertainty on investment expenditure.

Ferderer (1993) mentioned that uncertainty, measured by the risk premium embedded in the term structure, has a negative impact on the aggregate investment spending. Furthermore, Carruth *et al.* (2000a) used movements in real price of gold as an uncertainty index.

In this chapter the conditional variance of GDP will be used as a proxy of uncertainty in order to represent the aggregate uncertainty in the economy. Model (4.22) is a $GARCH$ (1,1) model for the uncertainty. This model is well specified statistically, i.e. a very high R^2, small *RSS*, and a good size of information criterion. Furthermore, the model does not suffer from autocorrelation or non-normality. The conditional variance of GDP, h_t, is highly significant, where standard errors, SE, are in ( ) under the estimated coefficients. Furthermore, both DF-test and ADF-test statistics, -21.34 and -3.67 respectively, assert that h_t is stationary at 1%.

$$\begin{array}{l} y_t = 0.086 + 1.356\ y_{t-1} - 0.351\ y_{t-2} \\ (SE)\quad (0.013)\quad (0.120)\qquad (0.120) \\ h_t = 0.00002 - 0.221\ u_{t-1}^2 + 1.163\ h_{t-1} \\ \qquad (0.000008)\quad (0.122)\qquad (0.151) \end{array} \tag{4.22}$$

$$R^2 = 0.998 \quad R_{adj}^2 = 0.998 \quad RSS = 0.012 \quad AIC = -5.237 \quad SIC = -4.968$$
$$HQIC = -5.145 \quad F_{arch}\,[1,31] = 0.124[0.73] \quad \chi_{nor}^2\,[2] = 1.259[0.53]$$

Driver and Moreton (1991) found that including uncertainty in the investment model will improve the diagnostic tests, increase explanatory power and remove the parameter instability. Also, Driver and Moreton (1991, p.1456) assert that the output uncertainty has a significant long-run influence on investment. Also, Servén (1998) used the current, contemporaneous, term of uncertainty as an independent variable in an ECM of investment. Therefore, the estimated ECM of the private investment expenditure includes the current, first and second lags of the conditional variance, because it is expected that uncertainty may have a contemporaneous and long-run impact in case of country like Egypt, where investors may follow the wait and see approach.

4.6.2. The Investment Expenditure under Uncertainty Model

The final estimated ECM of investment expenditure is (4.23). This model is good theoretically and econometrically. First, the signs of variables are in a line with the economic theory. The effect of income is 3.5 times, approximately, that of credit, and 7 times the exchange rate effect in absolute values. While, the effect of real interest rate is small and insignificant but it is expected as the availability of funds, i.e. credit, is more important than the cost of these funds, i.e. real interest rates, because the limited sources of funds and the low levels of real interest rates in Egypt in the majority of the study period.

$$\begin{aligned} inv_t = {} & \underset{[1.16]}{0.371} + \underset{[3.38]}{1.743}\Delta_3 y_t - \underset{[-1.45]}{0.611}\ \Delta ri_t^l + \underset{[4.30]}{0.494} cred_{t-2}^P - \underset{[-2.10]}{0.246}\ \Delta rer_{t-1} - \underset{[-2.79]}{1085}\ h_t \\ & - \underset{[-3.41]}{2083}\ h_{t-1} - \underset{[-3.15]}{1120}\ h_{t-2} - \underset{[-4.43\}}{0.342}\ (inv-y)_{t-1} - \underset{[-3.97]}{0.480}\ D2001 - \underset{[-3.18]}{0.410}\ D2009 \end{aligned} \tag{4.23}$$

$R^2 = 0.812 \quad R^2_{adj} = 0.727 \quad RSS = 0.281 \quad \sigma = 0.113 \quad F = 9.51[0.00]$
$F_{ar}\,[2,20] = 0.167[0.85] \quad F_{arch}\,[1,31] = 0.476[0.50] \quad F_{het}\,[16,14] = 1.174[0.38]$
$\chi^2_{nor}\,[2] = 0.244[0.89] \quad F_{reset}\,[2,20] = 0.270[0.77]$

The error-correction term is highly significant and has a plausible speed of adjustment equals -0.342, which means that any diverge from equilibrium will be sorted out within three years. In addition, the current and lagged conditional variance coefficients are negative and highly significant, which supports the viewpoints of Driver and Moreton (1991) and Servén (1998). So that, the uncertainty about the macroeconomic conditions will affect the investment plans inversely.

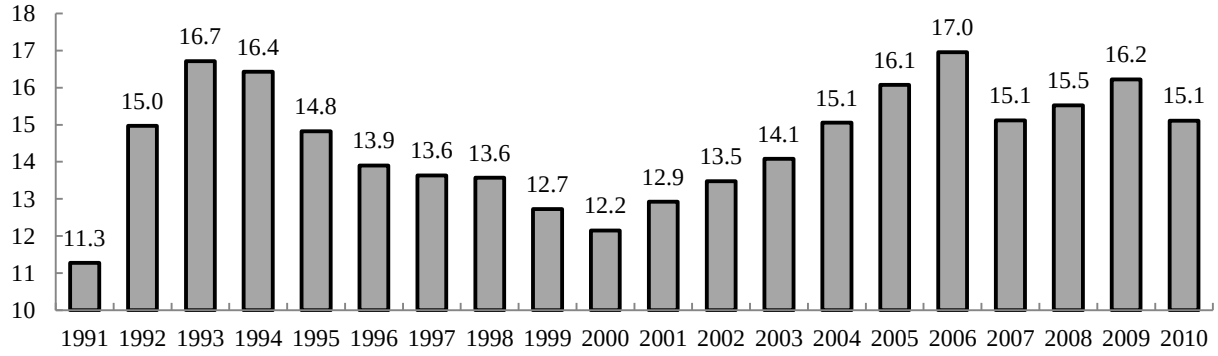
Two impulse dummy variables, i.e. $D2001$ and $D2009$, were included in the ECM to keep the diagnostic tests at the desired level and remove the effect of outliers that resulted from specific important events occurred in these two years. Mainly, these two years watched an international worse effect of 11th September 2001 attack and the financial crisis 2008 effect. In 2009 the effect of the financial crisis of 2008 was clear in Egypt as the Stock Exchange Market's index, CASE30, dropped sharply, see figure 2.14. However, the 11th September 2001 attack affect CASE30 index negatively but the most important event in this year was the Non-Performing Loans, NPL, problem, or the banking scandal, which reached to a dangerous level.

The ERSAP resulted in a stable exchange rate and high interest rates on deposits in local currency, which, in turn, decrease the dollarization in Egypt and accumulated a large amount of deposits in Egyptian banks. In the same time, the financial deregulation in 1990s liberalise banks to set their interest rates and removing credit restrictions. All of these pushed banks to extend their credit and became less caution in providing lending to customers depending on reputation, connections, and political influence instead of the correct credit procedures (Abdel-Kader, 2006). Starting from late 1997 many events[27] combine together to worsen the situation of the NPLs in banks. The recession in late 1990s and early 2000s

[27] Like the Asian crisis, the Luxor massacre of tourists in 1997, the liquidity shortage in 1997-1999 and the 11 September 2001 attack.

pushed defaulting businessmen to borrow more in order to pay off their old loans and overvalued their assets (Abdel-Kader, 2006).

Figure 4.7: Provisions to Loans and Discounts (%) in Banks

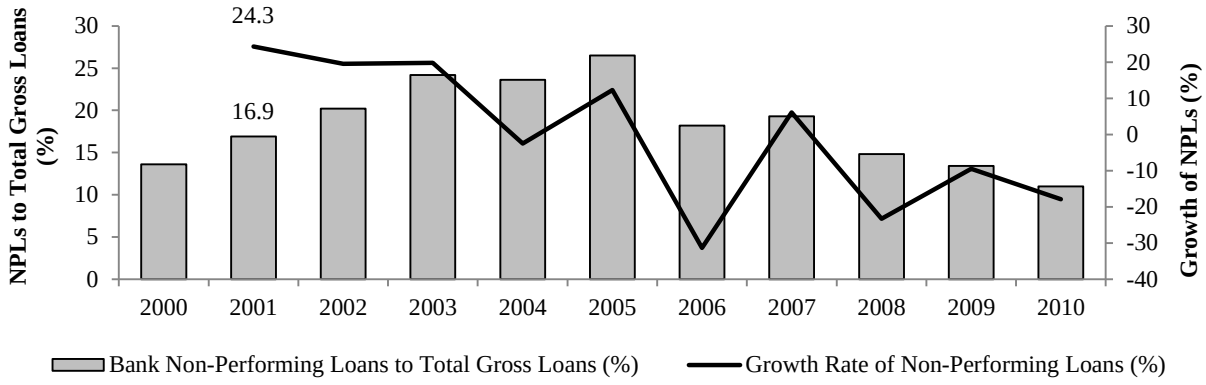


Source: WorldBank (2012b)

The ratio of banks' provisions to loans was declining between 1993 and 2000, and then beginning to increase from 2001, figure 4.7. The NPLs as a per cent of total loans in banks reached to 16.9% in 2001 and the growth of this ratio reached its peak, about 25%, figure 4.8, in the same year, during the period 2000-2010, (see IMF, 2005). The size of NPLs was estimated by L.E. 70-75 billion, divided between public banks, L.E. 50-55 billion, and private banks, L.E. 20 billion (Abdel-Kader, 2006). The CBE investigated the NPLs in banks and it found that many top banking officials were corrupted and provided a huge amount of loans to a small number of businessmen neglecting the appropriate credit procedures (Abdel-Kader, 2006). In 2001 and years later, some of these officials lost their positions and sent to prison and some of those defaulted businessmen escaped from the country without paying their loans to banks . Therefore, banks credit declined and banks became more risk aversion and preferred to invest in risk free assets like Treasury bills (Abdel-Kader, 2006). Starting from 2004, the CBE and public banks with the government tried to solve the NPLs problem

by rescheduling bad debts instead of sending defaulting businessmen to the court (CBE, 2008b).

Figure 4.8: Bank Non-Performing Loans to Total Gross Loans (%) and its Growth



Source: WorldBank (2012b)

The ECM model is able to explain about 81% of changes in investment according to the changes in the independent variables and the model's coefficients are jointly significant. Also, both RSS and σ are relatively small. The diagnostic tests assert that the model does not suffer from autocorrelation and heteroscedasticity problems. Furthermore, this model follows the normal distribution and well specified.

The goodness of fit and residual tests summarized in Figure 4.9. Figure (a) shows the actual and fitted values conditional on the regressors' values; figure (b) shows the cross plot of fitted values against the actual values; figure (c) shows the scaled residuals, which include the forecast errors; and figure (d) shows residual autocorrelation function (ACF) and partial autocorrelation function (PACF), figure (e) shows the residual histogram and density of residual, and figure (f) shows the model residual distribution. This figure proves that the ECM passed all the goodness of fit and residual test.

Figure 4.9: Goodness of Fit and Residual Graphical Tests

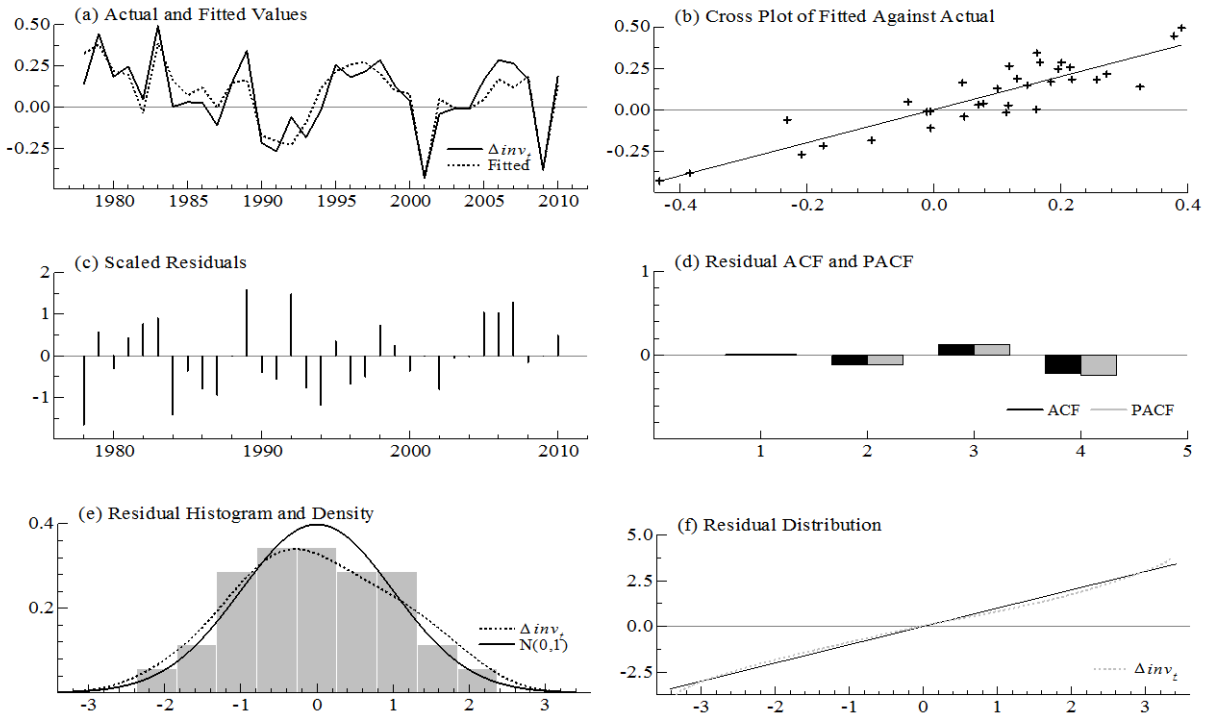
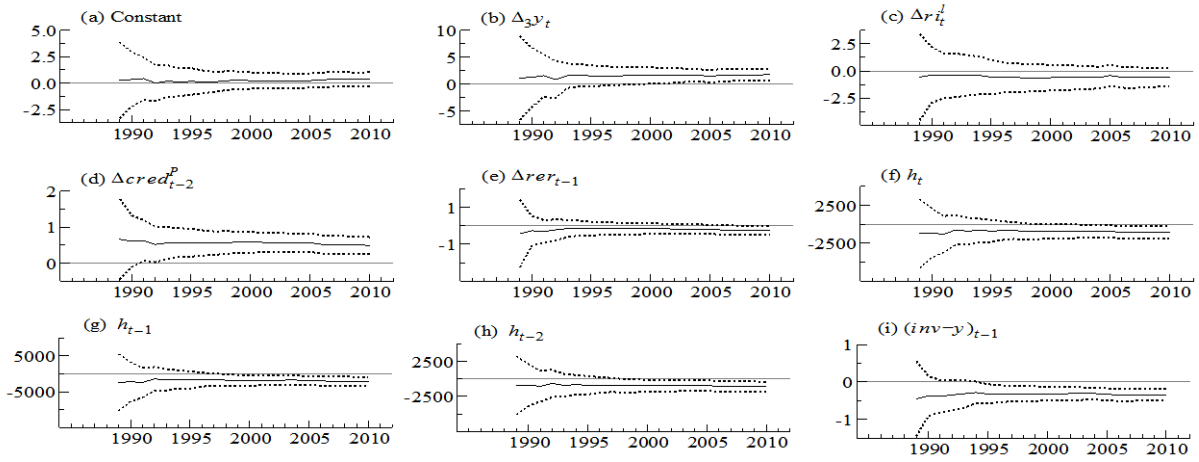
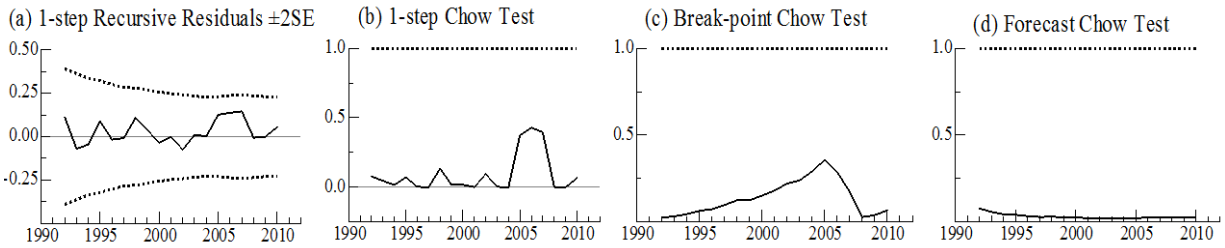


Figure 4.10: Recursive Estimates of Coefficients ±2SE



Recursive estimation was carried out to examine whether the relationship remained constant over the sample period. Figure 4.10 shows the recursive estimated coefficients which remain constant over the sample period. Also, figure 4.11 shows the Chow tests of the model which assert the stability of the ECM.

Figure 4.11: Recursive Stability Tests (5%)



4.6.3. The Bounds Test

The ARDL bounds test of Pesaran *et al.* (2001) is used to confirm the existence of the cointegration relationship between the variables in the investment expenditure models. Two models were tested, the first used inv and $cred^P$, however the second used investment to income ratio, $(inv - y)$, and credit to income ratio, $(cred^p - y)$. The first model was summarised in (4.24) and the critical value, i.e. *F-test*, was 3.384 and its *p-value* is 0.028. Additionally, the second model was (4.25) with critical value equals 2.928 and its *p-value* is 0.046. Both models confirm the existence of the cointegration relationship between the models' variables.

$$\begin{aligned}\Delta inv_t = &-0.730 + 0.357\,\Delta inv_{t-1} + 0.240\,\Delta cred^P_{t-1} - 0.317\,\Delta rer_{t-1} + 10.133\,\Delta h_{t-1} \\ &[-0.85]\quad[2.61]\qquad[1.70]\qquad[-1.97]\qquad[2.01] \\ &- 0.342\,(inv-y)_{t-1} + 0.048\,cred^P_{t-1} - 0.138\,rer_{t-1} - 17.435\,h_{t-1} \\ &[-4.43\}\qquad[0.99]\qquad[-1.02]\qquad[-1.76] \\ &- 0.385\,D2001 - 0.354\,D2009 \\ &[-2.55]\qquad[-2.16]\end{aligned} \tag{4.24}$$

$R^2 = 0.723 \quad R^2_{adj} = 0.852 \quad RSS = 0.376 \quad \sigma = 0.137 \quad F = 5.18[0.00]$
$F_{ar}\,[2,18] = 0.821[0.46] \quad F_{arch}\,[1,29] = 0.201[0.66] \quad F_{het}\,[16,12] = 0.429[0.94]$
$\chi^2_{nor}\,[2] = 3.30[0.19] \quad F_{reset}\,[2,18] = 0.964[0.40]$

$$\begin{aligned}\Delta(inv-y)_t = &\underset{[-0.20]}{-0.088} + \underset{[2.02]}{0.287}\Delta(inv-y)_{t-1} + \underset{[0.95]}{0.132}\,\Delta(cred^p-y)_{t-1} - \underset{[-2.30]}{0.362}\,\Delta rer_{t-1} \\ &+ \underset{[2.15]}{10.614}\,\Delta h_{t-1} - \underset{[-2.24\}}{0.383}\,(inv-y)_{t-1} + \underset{[0.54]}{0.043}(cred^p-y)_{t-1} - \underset{[-0.82]}{0.100}\,rer_{t-1} \\ &- \underset{[-1.93]}{18.645}\,h_{t-1} - \underset{[-2.42]}{0.370}\,D2001 - \underset{[-2.19]}{0.380}\,D2009\end{aligned} \quad (4.25)$$

$R^2 = 0.697 \quad R^2_{adj} = 0.546 \quad RSS = 0.386 \quad \sigma = 0.139 \quad F = 4.61[0.00]$
$F_{ar}\,[2,18] = 0.652[0.53] \quad F_{arch}\,[1,29] = 0.268[0.61] \quad F_{het}\,[16,12] = 0.385[0.96]$
$\chi^2_{nor}\,[2] = 3.99[0.14] \quad F_{reset}\,[2,18] = 1.32[0.29]$

4.7. Summary of Results

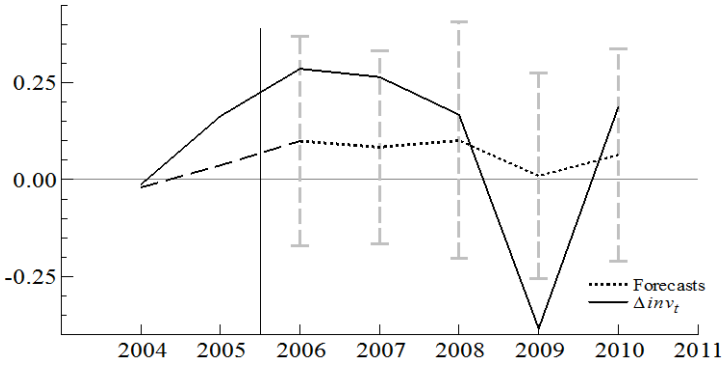
The ECM model shows positive effects of changes in income and bank lending to private sector on the changes of private investment, and these effects dominate the other variables effect, i.e. the interest rate and exchange rate effects. An increase in income by 100% will raise the investment by 174%, and if the credit to private sector increased by 100% the investment will rise by 50%. However, the depreciation in the exchange rate by 100% will decline the private investment by 25%. Also, the impact of real interest rate is negative and insignificant as it is expected.

The uncertainty about the future of the economy plays an important role in investment decisions in Egypt. It is clear that uncertainty impact lasts for a long-time period up to two years, as the current and lagged coefficients of uncertainty measure, i.e. the conditional variance of GDP, are at a very high magnitude and statistically significant.

The speed of adjustment is at reasonable level, -0.342, and statistically significant, which means that any disequilibrium will be corrected by 34% per annum, so that, the equilibrium will return within 3 years. Additionally, the ECM of investment in Egypt has a high goodness of fit and does not suffer from any econometric problems. Also, the effects of some events, like 11th September 2001 attack, NPLs problem, and the financial crisis of 2008,

were clear and were treated econometrically to sort out their impacts on the estimated model. The inverse effect of these two years, i.e. 2001 and 2009, on private investment was clear as the growth rates of private investment were -43% and -38%, respectively.

Figure 4.12: In-Sample Forecasts of Investment



The ability of the ECM of private investment in Egypt to predict the future was tested in order to ensure if the model can be used for forecasting purpose or not. Figure 4.12 shows the in-sample forecast of the private investment, which pointed out that the model is providing a good tool for forecasting the private investment. However, the only exception is year 2009 since the investment value was out of errors bands of forecasting, but this is expected by the effect of the financial crisis of 2008.

The significant effect of both the bank lending to private sector and the exchange rate on the private investment in Egypt gives an indication for the existence of both the bank lending and the exchange rate channels in the economy. However, the impact of the bank lending channel on investment is approximately the double of the exchange rate channel's effect. This result with the results of chapter 3, i.e. modelling the consumers' expenditure in Egypt, refer to the direction and magnitude of the interest rate, bank lending, and the

exchange rate on real GDP through their effect on consumers' expenditure and private investment decisions. These results make us ready to investigate these three channels of the transmission mechanism in the Egyptian economy.

4.8. Conclusion

This chapter estimated the short- and long-run private investment function in Egyptian economy over the period from 1975 to 2010. The variables that impose the private investment's fluctuations in the long run are income, credit to private sector and the exchange rate. Additionally, uncertainty plays a main role in determining the level of private investment in Egypt.

The income effect on investment dominates other variables impacts and it is 3.5 times the effect of credit and 7 times the exchange rate effect. But, the real interest rate effect, after transforming it to log scale, is small in magnitude and insignificant. Also, the disequilibrium will be corrected within three years as the speed of adjustment equals 34%.

This chapter and the one before pave the way to the next chapters that will investigate the channels of the transmission mechanism of monetary policy in Egyptian economy. Both of these chapters, the consumption and investment functions, indicate that interest rate, the bank lending and the exchange rate channels are expected to transmit the effects of monetary policy shocks to real income.

CHAPTER 5 : INVESTIGATING THE INTEREST RATE CHANNEL IN EGYPT

5.1. Introduction

The transmission mechanism of monetary policy is discussed intensively in the literature, both theoretically and empirically. The reason for the intensive research into the monetary transmission mechanism is due to its importance as a key feature in macroeconomics policy, especially how an increase in the money supply affects economic activity. This transmission mechanism not only describes the interrelationships among macroeconomic variables but also explains how monetary policy works, which variables respond to changes in the interest rate, when the effect occurs, and how this mechanism affects output and inflation (Mahadeva and Sinclair, 2002).

The new policy, i.e. inflation targeting which the CBE is applying recently, is requiring, as a prerequisite, to determine and identify the behaviour of monetary policy channels in Egypt. Consequently, the main aim of this thesis is to investigate the transmission mechanism of monetary policy in the Egyptian economy.

The previous two chapters, about consumers' expenditure and private investment expenditure, provide a portal bridge to examine the monetary policy channels, i.e. interest rate, credit and exchange rate channels. These two chapters provide the principle information about how the tools of monetary policy, especially the interest rate, banking credit, and the exchange rate, affect the final macroeconomic variables, i.e. income, through their impact on

the intermediary macroeconomic variables, i.e. consumption and investment, which are, in turn, the dominant share of GDP.

According to the empirical results of those two chapters, it is obvious that both interest rate and banking lending play significant role in affecting the consumption, however, bank lending and the exchange rate have a significant effect on the investment, and, in turn, the volume of GDP. Consequently, this chapter and the following will be devoted to investigate the behaviour of these three channels, i.e. the interest rate, the bank lending and the exchange rate channels, in order to fill a part of the wide gap of knowledge about the Egyptian economy, which can help the CBE in applying its new policy of inflation targeting.

This chapter will discuss the interest rate channel in Egyptian economy begin in 1975 and ended in 2010. The econometric model that will be used in this chapter is the Vector Error-Correction Model, VECM. However, VECM raises some difficulties that can be added to those rises from the Vector Autoregressive, VAR, models, but VAR models are widely used to estimate the monetary policy channels, since it is providing suitable results and a proper econometric methodology that can capture the interchangeable relationships between macroeconomic variables. One drawback is that VAR models include a large number of parameters which need to be estimated, as the number grows rapidly as the number of variables in the system increased, raising the parameterisation problems.[28] Furthermore, estimating a cointegrated VAR, i.e. VECM, of the monetary transmission mechanism is a sophisticated process (see Favero, 2001).

Potential variables capturing the interest rate channel need to be tested for their order of integration. Since, if the variables are non-stationary, $I(1)$, and cointegration relationships exist among them, a VAR in levels can be used to estimate the monetary transmission

[28] See Davidson and MacKinnon (1993) for the general idea about parameterisation definition, and see Johansen (1995b) for the parameterisation of the cointegrated models.

mechanism channels in Egyptian economy.[29] The estimation of these channels is for the purpose of discovering how they affect real GDP behaviour in Egypt. The impulse response function and variance decomposition will be used to explain the effects of the innovations on the macroeconomic variables. A VECM will be estimated, because a cointegration relationship among the variables is discovered, in order to *identify* the long-run relationship among the variables.[30]

The chapter is divided into eight sections. The next two sections are devoted to surveying the literature on the interest rate channel and the previous empirical studies. The following related three sections are on the econometric methodology, data, and econometric model. Finally, the chapter ended up with the summary of results section and then the conclusion.

5.2. Interest Rate Channel in the Literature

The mainstay of the monetary transmission mechanism, MTM, especially from Keynesian economists' view, is the interest rate channel. We can imagine how this channel work if we assume that the monetary authority adopted a tightening of the monetary policy. According to Mishkin (1995), this type of policy will decrease the quantity of money, then that will lead to an increase in the real interest rates, which, in turn, pushes up the cost of capital and this means that the level of investment will decline. Finally, we expect a fall in aggregate demand.

In spite of the previous illustration of the interest rate channel, the real story is more complicated than that mentioned above. The first stage of the interest rate channel happens

[29] This approach was supported by Sims (1980), Doan (1992), Enders (1995), Thomas (1997) and Phillips (1991). Also, it was followed in some studies, like Mousa (2010), Wibowo (2005) and Oladipo (2005).
[30] The same procedure is followed by Ford and Mohammad (2010), Muhammad (2010) and Bhattacharya *et al.* (2011).

when movements in short-term nominal interest rates are transmitted into long-term real interest rates, i.e. the interest rate pass-through. The second stage of this channel shows the effects of changes in real interest rates on components of aggregate demand and output (Égert and MacDonald, 2006).

The first stage, interest rate pass-through, focuses on the key monetary policy rate that affects the long-term market rates and then how the last rates, market rates, affect the level of banks' deposit and lending. In addition, the term structure of interest rates is used to explain the relation between the short-term and long-term market nominal interest rates. Clearly, the understanding of the theory underlying term structure is needed for example, the liquidity preference and, specially, the expectation hypothesis[31] (Égert and MacDonald, 2006).

Many approaches are used in explaining the interest rate pass-through. The marginal cost pricing approach was developed by Rousseas (1985) and was adopted later by De Bondt (2003). According to this approach, the bank interest rate, i^B, is determined by two factors: the constant '*mark-up*', μ, and market interest rates, i^M, i.e. marginal cost price. The relation between i^B and i^M is determined by the pass-through parameter, β, and this can be written as

$$i^B = \mu + \beta i^M \tag{5.1}$$

The pass-through parameter, β, depends on the demand elasticity of deposits and loans with respect to bank's retail interest rates. The value of this parameter will equal one if the demand for deposits and loans is fully elastic (De Bondt, 2003). The value of β not only is affected by elasticity of deposits and loans demand, but also the degree of competition in market, i.e. market power (Laudadio, 1987). Niggle (1987) argues that market power is a

[31] The distinguishing among these theories needs us to know the core idea of each one. According to the first theory, liquidity preference, the investor requests a liquidity premium to hold less liquid assets. Secondly, the other theory, expectation hypothesis, is more important and it explains the long-term interest rates as an average of expected future short-term interest rates. Many economists call the last theory the expectation channel.

multi-dimensional variable which includes the entrance restriction to the market, monopoly power and administrated pricing. Both inelastic demand and market power may appear as a result of switching and asymmetric information costs[32].

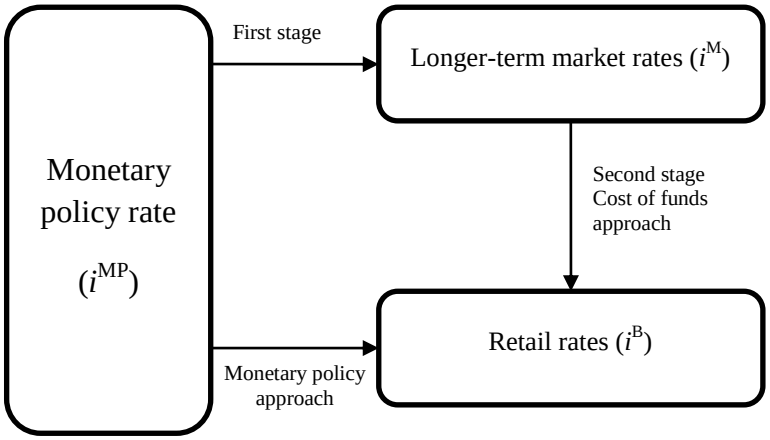
The changes in market interest rates will affect retail bank interest rates only if the fixed adjustment cost exists and it was less than the maintaining cost of the non-equilibrium bank rate (Hannan and Berger, 1991). In short term the demand curve is inelastic and switching costs are significant in the adjustment process of bank rates according to alterations in market rates. But, in the long term both market power and asymmetric information costs affect the adjustment process[33] (De Bondt, 2003). Lastly, macroeconomic circumstances play a major role in the pass-through mechanism. For instance, in times of a recession and in low-inflation regimes, the pass-through will be more effective and vice versa in boom and high-inflation regimes (Égert and MacDonald, 2006).

The choice of the suitable explanatory interest rate needs to consider three approaches. The first approach, cost of funds approach, discusses the transmission process from market interest rates to retail banks' interest rates. The second approach, the monetary policy approach, illustrates the effect of the interest rate change, which is controlled by monetary authority, on retail banks' interest rates (De Bondt, 2003; Égert and MacDonald, 2006). Lastly, the third approach goes through two directions: a) the pass-through from monetary policy to market rates and b) the transmission from market rates to retail bank interest rates, see figure 5.1, (Berstein and Fuentes, 2003; Égert and MacDonald, 2006).

[32] De Bondt (2003) argues that switching cost arise when customers switch from one bank to another one, and it is significant when there is a high cost for acquiring information or making transaction. In addition, switching cost is high when repeated transaction and long-term relationships exist. Klemperer (1987) supports the idea that inelastic demand and market segmentation can occur by switching cost. The other issue, asymmetric information cost, represents the cost of adverse selection and moral hazard (Stiglitz and Weiss, 1981).

[33] Adjustment process can be illustrated by using the error-correction technique as this technique shows the dynamics in short-term and cointegration or long-term equilibrium (Scholnick, 1991; Winker, 1999).

Figure 5.1: The Transmission Mechanism between Interest Rates



Source: Égert and MacDonald (2006, p. 12)

Finally, after discussing the first stage of the interest rate channel, the second stage of the interest rate channel emphasizes on the connection between the interest rates and the real sector of the economy. Given price stickiness and rational expectations, the innovations in short-term nominal interest rate will push up short- and long-term real interest rates. The movements in real interest rates, i.e. the cost of capital, will affect the firms' investment decisions. Not only firms' investment will be affected but also housing and durable goods spending. Consequently, the rise in real interest rates can be divided into two effects: a) *income effect* which means that the returns on assets related to the interest rate will increase which will lead to an increase in income and b) *substitution effect* reflecting the tendency to save more when the real interest rate goes up (Égert and MacDonald, 2006).

Although in theory, many interest rates are relevant to monetary policy, many researchers suggest focusing a single short rate.[34] Taylor (1995) argues that this should be the short-term private market rate.[35] Theoretically, it is difficult to specify which one has a greater effect on GDP components than other, the short-term or long-term interest rate. Roughly

[34] Brayton and Marquez (1990) support this approach.
[35] For instance, it is the federal funds rate in USA and call money rate in Germany.

speaking, when we consider the investment in long-term options, then the long-term interest rate will be more important and crucial than the short-term interest rate (Taylor, 1995).

The interest rate is a key component in the MTM but should it be the nominal or the real rate?. The financial market price models explain the relationship between the real and the nominal interest rate under rational expectations and rigidities of wages and prices (Taylor, 1995).[36] According to the expectations model of term structure, the long-term rate is calculated as the expected weighted average of the future short-term rate, taking the appropriate maturity in mind. This idea was supported by results of empirical studies (Taylor, 1995).

5.3. Empirical Studies on the Interest Rate Channel

There are a large number of studies of the monetary transmission mechanism channels, but not for Egypt. Research on the interest rate channel, which is, in turn, a part of the MTM, is scarce in the Egyptian economy. The following sub-section will summarise the findings of these studies which are devoted to test the interest rate channel in Egypt and some other countries, especially the developing and transition countries.

5.3.1. Evidence in Egypt

Al-Mashat and Billmeier (2007) analysed the interest rate channel in the Egyptian economy using a VAR model approach over the period from January 1996 to June 2005. They found that there is a relation between monetary policy stance and the 3-month deposit rate, according to Grange causality, but this does not work in the opposite direction, the 3-month deposit rate has partial effect on the lending rate, there is no effective policy interest

[36] One of rational expectations theory's assumptions is the perfect flexible wage and prices but in empirical studies, especially in field of the MTM, temporary rigidities of wages and prices are assumed (Taylor, 1995).

rate before the period of introducing the overnight corridor system[37], which obstructed the transmission mechanism from working well before this time. Also, they expect that the introduction of the new interest rate, i.e. the overnight corridor interest rate, will increase the effectiveness of the interest rate channel.

However, Al-Mashat and Billmeier (2007) was the first complete study on the four channels of the MTM, i.e. interest rate, credit, exchange rate, and asset price channels. From my point of view, it has drawbacks regarding the short time period, i.e. 10 years, which may be selected according to their research aims, and using interpolated data to transform the low frequency data, i.e. annual GDP, to monthly data. Moreover, they are used a computed monetary policy stance which is estimated by Moursi *et al.* (2007), who are used a semi-structural VAR methodology, instead of using the existence stance of monetary policy like reserve money, short-term nominal interest rates, and domestic liquidity, M2, that the CBE is using them as operational and intermediate targets (Moursi *et al.*, 2007).

Neaime (2008) applied a VAR model with four macroeconomic variables[38], for period from 1990 to 2006, for Egypt, Jordan, Lebanon, Morocco, Tunisia, and Turkey. The aim of this study was to examine how successful these countries were in smoothly applying inflation targeting. In the case of Egypt the impulse response function for a shock, a 1% increase, in the interest rate shows a reverse impact on GDP lasts for four quarters then dies out. This can be explained, in part, by the effect of the crowding out and its impact on investment and the sensitivity of investment to monetary shocks. In addition, the interest rate shock affects price negatively but this effect turns out to become significant after six quarters. This study is good

[37] Overnight corridor system is the overnight interbank interest rate which the CBE used as a monetary tool from June 2005. Additionally, this corridor floor is the overnight deposit interest rate, whereas its ceiling is the overnight lending interest rate (Al-Mashat and Billmeier, 2007).

[38] These variables are real GDP, consumer price index, exchange rate, and Treasury bills interest rate. All of these variables are quarterly seasonally adjusted and all of them, except Treasury bills interest rate, are in natural logarithm form.

as a comparative study but it used quarterly data that, in case of Egypt, do not exist for the whole period, for some variables like GDP.

The interest rate pass-through for lending and deposit rates in Egypt was estimated by Boughrara (2008b). He found that the pass-through coefficients in the long run are small, which were equal to 31% for the lending rate and only approximately the third of this figure, 11%, for the deposit rate. The weak pass-through in Egypt can be explained by the stickiness of retail (lending and deposit) rates which, in turn, were related to adjustment costs. Additionally, the low degree of competitiveness among banks and low credibility of the monetary authority are both responsible for the weak pass-through in Egypt.

5.3.2. Evidence from Other Countries

Morsink and Bayoumi (1999) in their study on the Japanese economy, found that interest rate shocks have significant effects on real private demand, since an unexpected increase in short-term interest rates resulted in a fall in real private demand after 8 to 10 quarters. Moreover, the interest rate innovation affects the price level positively in Japan. After adding the interest rate on new bank loans, Morsink and Bayoumi (1999) found that any unexpected change in the overnight call rate reflecting immediately and strongly the lending interest rate. As a consequence, the relationship between lending interest rate, in one side, and both broad money and private demand, on other side, is negative and statistically significant. Thus, they conclude that the interest rate channel in Japan takes a special place in MTM if the policy interest rate is the lending interest rate and the bank balance-sheet effect exists.

In the case of Thailand, the impact of the interest rate channel alone was equal to the combination of impacts of bank lending channel, exchange rate channel and asset price channel since the interest rate channel was responsible for about 50% of the GDP response

(Disyatat and Vongsinsirikul, 2003). The VAR analysis of Singapore found that the interest rate channel plays a significant role in propagating the exchange rate shock but this was stills not strong (Chow, 2004).

Monetary policy in Jordan accounts for about 18% of changes in output whereas the real lending rate only contributes to 1% of changes in output by two years, after the monetary shock. As a consequence, some have concluded that the interest rate (i.e. lending rate) channel did not exist in Jordan between 1996 and 2005 (Poddar *et al.*, 2006). In addition, there is some evidence for the transmission of repo rate shocks to CPI in Armenia, and the interest rate channel is weak (Dabla-Norris and Floerkemeier, 2006). Also, only 4% or less of the fluctuations in output, prices and money can be accounted for by the real lending rate shocks in Vietnam. Accordingly, the evidence indicates that interest rate channel has a small significant effect in the monetary transmission mechanism in Vietnam (Hung and Pfau, 2009).

Tieman (2004) found that the significance of monetary policy rate as an explanatory variable of short- and long-term market rates is diverse in central Europe transition economies. In case of the Czech Republic, Hungary, Romania and the Slovak Republic, the coefficients were less than one, but the lowest is of Hungary and Slovenia. Additionally, these were resulted from the commercial banks' power and the absence of the substitutions of bank loans (Tieman, 2004).

Crespo-Cuaresma *et al.* (2004) suggest that the complete interest rate pass-through in Poland exists while there is some evidence of incomplete interest rates pass-through in both Hungary and the Czech Republic during ten years ended up in 2003. Furthermore, the enterprise loan rate (12 months) pass-through coefficient in Poland is the highest among these three countries (Crespo-Cuaresma *et al.*, 2004). They argue that in Hungary the least

coefficient of pass-through was 0.491 and the highest value was 1.021, while in the Czech Republic the least and the highest were 0.747 and 0.895, respectively.

Sander and Kleimeier (2004) assert that the long run high growth rate has a positive relationship with the interest rate pass-through in the euro-zone. Also, short-term corporate lending rate pass-through reacts faster than deposit rate pass-through (Sander and Kleimeier, 2004).

The MTM's interest rate channel was tested econometrically in some Middle East and North Africa, MENA, countries by using a VAR approach and the impulse response function (Neaime, 2008).[39] The interest rate channel's impacts on GDP, prices and exchange rate differed from country to country. In Jordan a 1% interest rate shock has a significant negative effect on GDP up to 2 quarters, while its impacts on prices and exchange rate are insignificant. The same shock in Lebanon does not have any significant impact on GDP and prices; whereas it is resulted in an exchange rate appreciation lasting up to 9 quarters. The Moroccan case shows that the interest rate shock's effect last for 16 quarters on prices and GDP and this effect is negative. However, the effect of the interest rate shock on GDP, in Morocco's case could be due to the sensitivity of investment to monetary policy changes. Furthermore, the interest rate shock resulted in an appreciation of the exchange rate which lasted for 9 quarters in Morocco. Additionally, Tunisia's case shows a significant effect of the shock on the three variables; where both GDP and prices decreased for 2 years and 4 years respectively, and a 7 quarter currency appreciation. Finally, for Turkey a similar impact to Tunisia was found, but the effects die out faster, where the effects last for 7, 5 and 3 quarters for prices, GDP and exchange rate, respectively.

[39] This study contains 6 countries: Egypt, Jordan, Lebanon, Morocco, Tunisia, and Turkey.

5.4. Econometric Methodology

Although economic theory is responsible for identifying the relationships among variables according to the time-series modelling structural approach, it is not always enough rich to identify the dynamic specification among the variables of interest. In addition, the endogenous variables can appear in each sides of the estimated model which, in turn, complicates the estimation and econometric inference. One of remedies proposed is using the non-structural approach. A VAR is a non-structural approach that is employed in time-series econometrics to analyse and forecast the interrelated relationships and the dynamic effects of random disturbances on a system of variables (Lütkepohl, 1993)

A Vector autoregressive model, VAR, is a system of regression equations which brings together the characteristics of the univariate time-series models and the simultaneous equations models to establish the multivariate time-series models (Brooks, 2008). A VAR became a widely used technique in econometrics after it is introduced by Sims (1980). VAR models have many advantages that attract researchers to adopt it in econometrics, especially in monetary policy and transmission mechanism field. Brooks (2008) pointed out some of these advantages, like a) the differentiation between endogenous and exogenous variables becomes unnecessary in VAR models because all variables will be treated as endogenous variables, b) the Ordinary Least Square (OLS) method can be used to estimate each equation in the VAR system; as long as the contemporaneous terms of variables will not appear on the right hand side of the estimates equations and c) the VAR system provides better forecasts than traditional structural models.[40]

Nonetheless there are still some drawbacks in this technique, which Brooks (2008) summarised in three points. Firstly, a VAR is *a-theoretical* approach which does not depend

[40] See Sims (1980) and McNees (1986).

on the theoretical information to specify the relationships among the variables in the estimated system model. As a consequence, a VAR is not preferable for theoretical analysis. Also, the interpretations of VAR's coefficients are not clear in many cases. Secondly, the number of parameters which are estimated under the VAR technique is relatively large. Therefore, in a small sample the degree of freedom will be used up and the standard errors will become larger making the confidence intervals of the model's coefficients wider. Thirdly, stationarity of the VAR variables is essential especially when statistical tests of the model's coefficient are run. For that reason, it is recommended to induce stationarity for non-stationary variables through differencing variables. On other side, one of VAR main purposes is to examine the long-run relationships among the system's variables, but differencing the variables will throw the long-run information away.

Although, the VAR models have some drawbacks according to Brooks (2008), Juselius (2009) argues that the VAR approach provides a well specified economic model in the short and long run when cointegration exists among variables. Consequently, a VAR can provide a suitable framework for steady-state relations and common trends, interaction and feedback effects. Additionally, the unrestricted VAR model is a reformulation of the covariances of the data so that it gives a suitable summary of the stylised facts of the data (Juselius, 2009). Furthermore, a VAR approach avoids the criticism of the lack of empirical relevance that the theory-based approach models face (Juselius, 2009).

Rudebusch (1998) asserts that the VAR technique can lead to a misspecified result when it measures the impact of monetary policy shocks on the real economy. He argued that the VAR approach ignored the individual equation's structural interpretation and the individual equation's parameters instability. On other side, Sims (1980) replied to the criticisms by claiming that these criticisms can be exist in the widely used macroeconomic models.

Furthermore, Maddala (1992, p.569) argues that, however, cointegrated relationships may not have any economic interpretation, but it can be used to enhance the VAR model's predictions.

The multivariate information criterions are used to determine the optimal lag length of the estimated VAR model. Furthermore, the three commonly used information criteria are Akaike Information Criterion (AIC), Schwarz Bayesian Information Criterion (SBIC) and Hannan-Quinn Information Criterion (HQIC) (Akaike, 1974; Hannan and Quinn, 1979; Schwarz, 1978). The values of these criterions are calculated depending on the variance-covariance residual matrix, $\sum \hat{u}\hat{u}'$, number of observations, T, and the total number of regressors, K', in all equations.[41] These three information criteria are given by (5.2), (5.3), and (5.4) respectively. Additionally, the smaller information criterion value is the more preferable in determining the suitable lag length in a VAR model.

$$AIC = \log|\sum \hat{u}\,\hat{u}'| + \frac{2K'}{T} \tag{5.2}$$

$$SBIC = \log|\sum \hat{u}\,\hat{u}'| + \frac{K'}{T}\log(T) \tag{5.3}$$

$$HQIC = \log|\sum \hat{u}\,\hat{u}'| + \frac{2K'}{T}\log(\log(T)) \tag{5.4}$$

However, the lag length criteria, like AIC, SBIC, and HQIC or any others, are helpful in determining the optimal lag length that are capturing the relationships among variables, but these should be used as a guide instead of an obligatory rule (Neaime, 2008).

In a VAR system with numerous variables' lags it may be useful to test if a set of variables has a significant power in affecting the dependent variables. This type of tests, using the *F-Test* framework, and is called causality tests (Brooks, 2008). The Granger causality[42]

[41] This total number of regressors is calculated by using number of equations, P, and the lags of each variables, k, where $K' = P + K \cdot P^2$.

[42] The Granger causality term is a misnomer and the causality here refers to *"a chronological ordering of movements in the series"* (Brooks, 2008, p.312). Also, this test works as a block erogeneity *Wald-Test*. See Granger (1969) for more details about the Granger causality test.

test is used in order to describe the correlation relationship between the current value of one variable and the past values of other variables. Nevertheless, it means that the changes in one variable cause the changes in another variable (Brooks, 2008). Additionally, the three possible outcomes of this test are a) the variable x Granger-causes variable y, but not vice versa, which means that lags of x will be significant in equation of y, and the x is strongly exogenous in equation of y, b) both of x and y Grange-cause each others; so that there is two-way causality of feedback between these variables, *c)*both of x and y do not have a causality relationship, thus they are independent (Brooks, 2008).

However, the block *F-tests* indicates the statistical significant impacts of the variables on the future values of each variable in a VAR model, but it is still unable to demonstrate the direction, sign, of the relationships or how long the impact needs to appear in the VAR system. Both the impulse response function and variance decomposition are being used in order to solve the previous deficiencies in the block *F-tests* (Brooks, 2008).

An impulse response function, *IRF*, represents the impact of a one-time shock to one of the innovations on current and future values of each endogenous variable in the VAR system. Also, the impulse response should die out to zero in case of a stationary VAR system, whereas the accumulated response should reach to none-zero constant value. Additionally, the impulse response works as a vector moving average in a VAR system (Brooks, 2008). Moreover, variance decomposition separates the variation in each endogenous variable into the component shocks to the VAR system. Also, the variance decomposition identifies the relative importance of each random innovation in affecting the VAR's variables.

Assuming a VAR system with p endogenous variables and lag length equals k, this system equation can be given by (5.5) as follow

$$y_t = \mu + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots + \beta_k y_{t-k} + u_t \quad (5.5)$$

where y is a vector of endogenous variables, μ and u are a vector of constants and a vector of error-terms, respectively, and all have $p \times 1$ dimensions. The matrices of coefficients βs are $p \times p$ dimensions. In addition, the previous equation can be presented as

$$y_t = \mu + \sum_{i=1}^{k} \beta_i y_{t-i} + u_t \quad (5.6)$$

The previous system, VAR, should be modified to become a VECM; in order to be suitable for using Johansen's cointegration test. Also, a VECM is a restricted VAR that is used with a cointegrated non-stationary time-series. In a VECM the endogenous variables long-run movements are determining by the cointegration relationships, while allowing for short-run adjustment dynamics. Therefore, the equation (5.6) transferred to (5.7) in order to become a VECM, as follow:

$$\Delta y_t = \mu + \left(\sum_{j=1}^{k} \Gamma_j - \mathrm{I} \right) y_{t-1} + \sum_{i=1}^{k-1} \left(- \sum_{j=i+1}^{k} \Gamma_j \right) \Delta y_{t-i} + u_t \quad (5.7)$$

The equation (5.7) can be presented in condensed form after rearranging to become the equation (5.8):

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i^* \Delta y_{t-i} + u_t, \quad (5.8)$$

$$where\ \Pi = \sum_{j=1}^{k} \Gamma_j - \mathrm{I} \text{ and } \Gamma_j^* = -\sum_{j=i+1}^{k} \Gamma_j$$

The first differences of variables are cointegrated in vector Δy_t in left-hand side (LHS), and its lags appear in right hand side (RHS) from first lag until lag $k-1$. In addition, the short run relationships will be measured between the dependent variables, which

represented by vector Δy_t, and the independent variables, which it takes the form of differences lags of dependent variables, vectors $\Delta y_{t-1}, \Delta y_{t-2}, \cdots, \Delta y_{t-(k-1)}$, by the matrices of coefficients $\Gamma_1, \Gamma_2, \cdots, \Gamma_{k-1}$. Also, the error-correction term, i.e. first lag of level, is vector y_{t-1} and the long-run coefficients matrix is Π.[43]

As long as matrix Π represents the long run relationships among the endogenous variables, ys, then Π will be tested to decide if there are any cointegrated relationships in the system. Eigenvalues, i.e. characteristic roots, are used to determine the rank of Π. Also, the number of non-zero eigenvalues is exactly the rank of matrix Π. These eigenvalues, λ_i, are arranged in a descending order; so that the largest comes first and the smallest becomes at the end, i.e. $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_g$. The form $ln(1-\lambda_i)$ is used in order to test the hypothesis that rank of Π is not different from 0; i.e. there are no cointegration relationships in the system, under Johansen's approach.

Johansen's test has two test statistics, i.e. $\lambda_{trace}(r)$ and $\lambda_{max}(r, r+1)$ which are given by

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} ln(1-\hat{\lambda}_i) \tag{5.9}$$

$$\lambda_{max}(r, r+1) = -T\, ln(1-\hat{\lambda}_{r+1}) \tag{5.10}$$

where T is the number of observations, r is the number of cointegrating vectors under the null hypothesis, and $\hat{\lambda}_i$ is the estimated value for the ith ordered eigenvalue from the long-run coefficient matrix Π (Brooks, 2008).

Furthermore, the null hypothesis of the joint test $\lambda_{trace}(r)$ is the number of cointegration vectors in the system less than or equal to r, while the alternative hypothesis is that the number of cointegrating vectors in the system is more than r, but it is not specified.

[43] In equilibrium the changes, i.e. first difference, will equal zero, also the expected value of the error term, u_t, will approach to zero. Therefore, the term Πy_{t-1} will be equal zero.

Alternatively, the $\lambda_{max}(r, r+1)$ test statistic has a sequence of null and alternative hypotheses which are as follow:

$$\begin{aligned} H_0:\ r = 0 \quad &, \quad H_1:\ 0 < r \leq p \\ H_0:\ r = 1 \quad &, \quad H_1:\ 1 < r \leq p \\ \vdots \quad \vdots \quad &, \quad \vdots \quad \vdots \\ H_0:\ r = p-1 \quad &, \quad H_1:\ r = p \end{aligned}$$

Matrix Π can not be a full rank except in a case that all endogenous variables are stationary, but its rank can be zero if the long-run relationships disappear and the first difference of endogenous variables depends only on its lags. Thus, when $1 < rank\ (\Pi) < p$ the long-run relationship exists, and matrix Π will be a product of the adjustment parameters matrix, α, and matrix β', where β is the matrix of the cointegrating vectors' coefficients. Therefore, the matrix Π can be given by equation (5.11).

$$\Pi = \alpha\, \beta' \tag{5.11}$$

One of advantages in Johansen's cointegration approach is the ability to test hypotheses on the cointegrating relationships. These tests appear as restrictions on matrix Π as restrictions on α and/or β matrices. Furthermore, the test statistics in this case takes the form (5.12).

$$LR_J = -T \sum_{i=1}^{r} [ln(1-\lambda_i) - ln(1-\lambda_i^{*})], \qquad LR_J \sim X^2(m) \tag{5.12}$$

where LR_J is Johansen-test statistic, λ_i and λ_i^{*} are the characteristic roots of unrestricted and restricted model, respectively. Also, r and m are number of non-zero characteristic roots in the unrestricted model and the number of restrictions in the model, respectively (Brooks, 2008).

5.5. Data

This chapter uses annual data from 1975 to 2010 on the Egyptian economy to estimate the interest rate channel. The sources of data are in the data appendix at the end of the thesis. The model contains four endogenous variables: log real gross domestic product, *y*, inflation rate, i.e. the annual change in the consumer price index, *inf*, nominal lending interest rate, r^l, and log real M2, *m2*.

The analysis of all of these variables and the related issues are discussed in Chapter 2, but this section illustrates the general trend of these variables. It is clear that there is a continuous increase in real GDP, while this increase is steady compared with nominal GDP, figure 5.2. The difference in the growth between the nominal and real GDP is became more distinct after 2002, when nominal GDP grew rapidly.

Figure 5.2: Movements in GDP and Real GDP

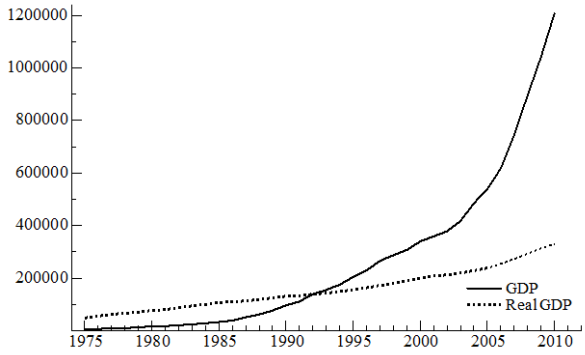
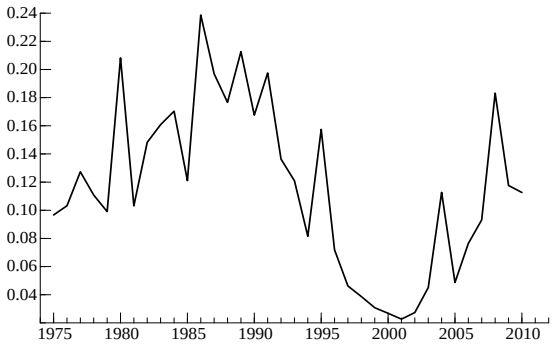


Figure 5.3: Inflation Rate



The inflation rate shows high levels which exceed 20% before implementing the economic reform in 1991, figure 5.3. The high inflation rate before the ERSAP returned to the high budget deficit and its finance. The ratio declined sharply after 1991 when the budget deficit to GDP ratio reached to about 1% in 1998. From 2003 it reverted to be rapidly increased. Partially due to the currency depreciation after floating the Egyptian exchange rate

in 2003. Additionally, the increase of the international food prices, beginning from 2007, raised the inflation rate in recent years.

The nominal deposit and lending interest rates were controlled by the CBE before 1990s. However, the real terms show a more fluctuated shape especially before 1996 where the first stage of economic reform was accomplished. Starting from 2003 the real interest rates declined sharply when the inflation rates beginning to amplify again. The worst decline occurred in 2008 when the inflation rate picked up dramatically by effect of raise in imported goods' prices, figure 5.4.

Figure 5.4: Nominal and Real Lending Interest Rate

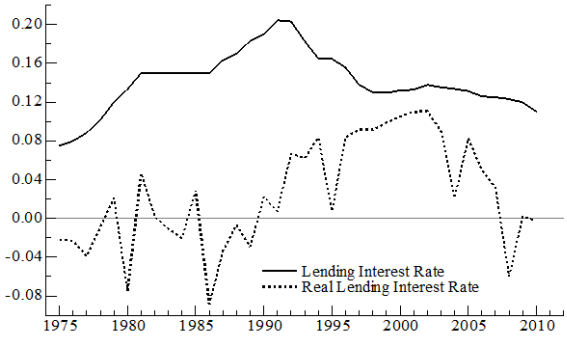
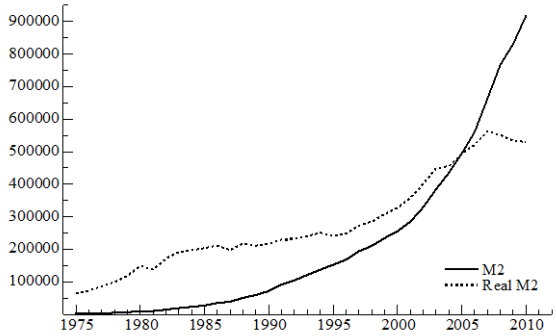


Figure 5.5: Monetary Policy Stance



The broad money, in nominal term, had a continuous upward trend; however, this increase can be divided into three stages: a) the period before 1991, when the increase was steady, b) from 1991 to 2005 when the increase was moderate, and c) after 2005 when a sharp increase was observed. The pattern of the nominal broad money takes the same trend as nominal GDP. Moreover, the change in pattern of nominal broad money can be explained by the movements in the monetary policy. Contrarily, real broad money, figure 5.5, increased steadily until 1996, the end of the ERSAP, then it started in a higher growth until early 2008, then started in declining from 2008.

5.6. Econometric Model

In this section, the multivariate time-series model, which describes the interest rate channel, will be established. The VAR approach is used to estimate the model and it ends up estimating the VECM, identifying the long-run relationship among variables in the interest rate channel.[44]

The model consists of 4 endogenous variables; they are selected to identify the interest rate channel and its relations with macroeconomic variables. Furthermore, the variables that are included depends on the suggestions and assumptions of the theory and previous empirical studies results. It is common to include variables like income measure, prices and monetary policy measure in the models of MTM's channels. The majority of studies of MTM involve these three variables beside variables that represent the monetary channel, for example interest rate, credit, and exchange rate. Different measures for income, prices and monetary policy stance are used in empirical studies of the MTM's channels, see table 5.1. Real GDP and inflation rate will be used, in this thesis, as measures of income and price.

Determining the optimal monetary stance in Egypt is difficult as a result of the frequent changes in operational targets and instruments of monetary policy from 1975 to 2010. Both excess bank reserves and nominal short-term interest rates, mainly the CBE discount rate and 3-month deposit rate, were, especially in period 1991-2004, the main operational targets. From June 2005 the CBE established a corridor system to manage the interest rates with a ceiling, the overnight lending rate from CBE, and a floor, the overnight deposit rate at CBE, and the operational target became the overnight interest rate on interbank transactions (Moursi *et al.*, 2006). As long as the operational target interest rate is not one during all period of study, thus, it is difficult to choose one of them alone to represent the

[44] The estimation and diagnostic tests of the econometric model are beneficiated from and followed, in general, the sequence of Juselius (2009).

monetary policy.[45] Consequently, many researchers used the broad money, M2, as the monetary policy stance in Egypt, as it was the intermediate target of monetary policy for a long time, see appendix 2.1, and they find it is a good proxy of monetary stance (Al-Mashat and Billmeier, 2007; Moursi *et al.*, 2006, 2007; Noureldin, 2005). For these reasons the broad money or domestic liquidity, M2, is used as the monetary policy variable of the Egyptian economy in estimating the MTM's channels in Egypt.

Table 5.1: Macroeconomic Measurements in Empirical Studies of the MTM's Channels

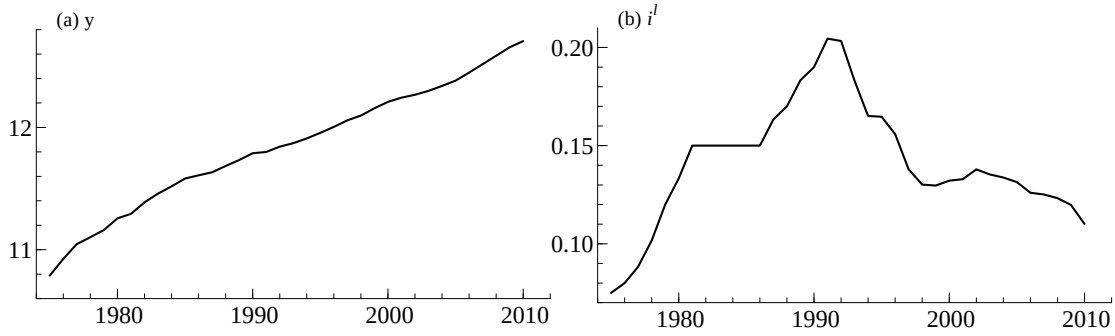
No.	Study	Measures of Macroeconomic Variables		
		Income	*Prices*	*Monetary Policy*
1.	Hung and Pfau (2009)	Real industrial output	CPI	Broad money
2.	Samkharadze (2008)	Real GDP	CPI	M1, M2 and M3
3.	Bhuiyan (2008)	GDP	CPI	M1
4.	Neaime (2008)	GDP	CPI	Money supply
5.	Al-Mashat and Billmeier (2007)	Real GDP	WPI	Reserve Money (M0) and 3-month deposit rate
6.	Hesse (2007)	Manufacturing production index	CPI	Real money(M1)
7.	Alam and Waheed (2006)	Real output	CPI	Call money rate
8.	Besimi *et al.* (2006)	Industrial production index	CPI	Base money(M0)
9.	Cheng (2006)	Real GDP	CPI	Money stock
10.	Dabla-Norris and Floerkemeier (2006)	GDP	CPI	Money supply
11.	Horvath and Maino (2006)	Output gap	Inflation	Money
12.	Noureldin (2005)	GDP	CPI	Reserve money (M0) and Broad money (M2)
13.	Arnoštová and Hurník (2005)	Real GDP	CPI	Domestic money stock
14.	Chow (2004)	Industrial production index	CPI	3-month interbank rate
15.	Al-Mashat (2003)	Industrial production index	WPI	Call money rate
16.	Wrobel and Pawlowska (2002)	GDP	CPI	Money market rates
17.	Baqir (2002)	Real GDP	CPI	Money base (M0)
18.	Girardin and Horsewood (2001)	All-industry output index	CPI	Broad money
19.	Morsink and Bayoumi (1999)	Real private demand	CPI	Real broad money
20.	Levy and Halikias (1997)	GDP	CPI	Stock of M1

Source: Prepared by the author.

[45] The CBE used discount rate, deposit rate, lending rate, Treasury bills rate, and overnight interbank rate in different time periods during the period of study.

The first variable is the real income variable, y, which represents the economic activities. The second variable is the inflation rate, inf, that is reflecting the monetary stability. The lending interest rate, r^l, reflecting the impact of changes in interest rate on income, i.e. interest rate channel. The last endogenous variable is the real domestic liquidity, $m2$, which is the proxy of monetary policy in the economy. Figure 5.6 shows the developments of income and the interest rate; also both inflation and monetary stance variables are in figure 3.6.

Figure 5.6: Interest Rate Channel VAR Model's Variables



The first step of estimation is testing the time-series properties of the variables of the model. Three different unit roots tests are employed, the *ADF-test*, *the PP-test*, and the *KPSS-test*. Table 5.2 asserts that all variables are non-stationary in levels in all tests at 5% and 1% levels of significant.[46] As long as the variables are *I*(1) and the cointegration relationship exists among these variables, as it will be shown later, then the VAR model will be estimated in levels as it is suggested by Maddala (2001), Phillips (1991) and Sims (1980).

[46] Except y which is stationary at 5% in the PP-test.

Table 5.2: Unit Root Tests of the Interest Rate Channel's Variables

Variables	ADF-test						PP-test						KPSS-test					
	Level			*Difference*			*Level*			*Difference*			*Level*			*Difference*		
y	-1.781	2	*t*	-4.591*	0	*c*	-3.907**	3	*t*	-4.639*	3	*c*	0.17	3	*t*	0.393**	3	*c*
inf	-1.645	4	*c*	-10.129*	0	-	-2.564	2	*c*	-10.902*	3	-	0.469	2	*c*	0.110**	2	*c*
i^l	-1.811	3	c	-2.262**	2	-	-2.056	3	c	-2.601**	2	-	0.720	0	c	0.423**	4	c
$m2$	-3.226	4	*t*	-4.837*	0	*c*	-2.864	2	*t*	-3.886*	2	*c*	0.423	3	*t*	0.306**	4	*c*

Note: (*) and (**) mean that the variable is stationary at 1% and 5%, respectively. The critical value of KPSS-test, at 5%, in case of the series has trend is 0.146 and in case of the series has constant only is 0.463. Critical values of ADF-test and PP-test are following MacKinnon (2010), see table 3.4, while those for KPSS-test are following Kwiatkowski *et al.* (1992). The numbers beside the critical values represent the number of lags, while *t, c,* and – after the critical values represent the variant of the series trend and constant, constant, and no constant or trend, respectively.

To estimate the interest rate channel a VAR (2) model, i.e. with two lags, including log real GDP, y, inflation rate, inf, the lending interest rate, i^l, and log real broad money, $m2$, respectively, was estimated including constant and trend. The number of lags was determined according to the suggestions of *AIC* and *HQIC*. The Wald F-tests of lags exclusion assert the significance of each lags at 1% level of significant.[47] The individual equations show high R^2 and R^2_{adj}, which reached more than 95% in all equations except inflation equation which was 65% and 52%, respectively. In addition, σ's were 0.46 and 0.49 in case of income and monetary policy, respectively, while it was 0.06 and 0.03 for inflation and the interest rate, respectively.

The VAR model passed all diagnostic tests. The unit root test proves that no root lies outside the unit root circle, $F_{ar(1-2)} = 0.878[0.65]$. The null hypothesis of no autocorrelation do not rejected, $F_{ar} = 14.386[0.57]$, and the null hypothesis of no heteroskedasticity do not rejected also, $F_{het} = 1.476[0.07]$. The residual normality test shows that all variables do not suffer from skewness or excess kurtosis and the vector is also following the normality,

[47] The *F-test* statistics were 2.80 with *p-value* 0.002 in case of the first lag and 8.80 with *p-value* 0.000 in case of the second lag.

$\chi^2_{nor}\,[8] = 10.624[0.22]$.[48] In addition, The model does not suffer from misspecification, $F_{reset} = 1.079[0.40]$.

The Granger causality tests of the unrestricted VAR model, table 5.3, show that all variables in the income equation cause the real GDP jointly at 10%, however only $m2$ has a significant effect on income at 5% level of significant. In the inflation equation, only $m2$ causes the inflation at 5%. Furthermore, all variables do not cause the lending interest rate separately or jointly, even at 10% level of significant. Moreover, all variables cause $m2$ jointly at 1%, and inflation and the interest rate cause it separately at 1% and 5%, respectively.

Table 5.3: Granger Causality of the Unrestricted VAR Model

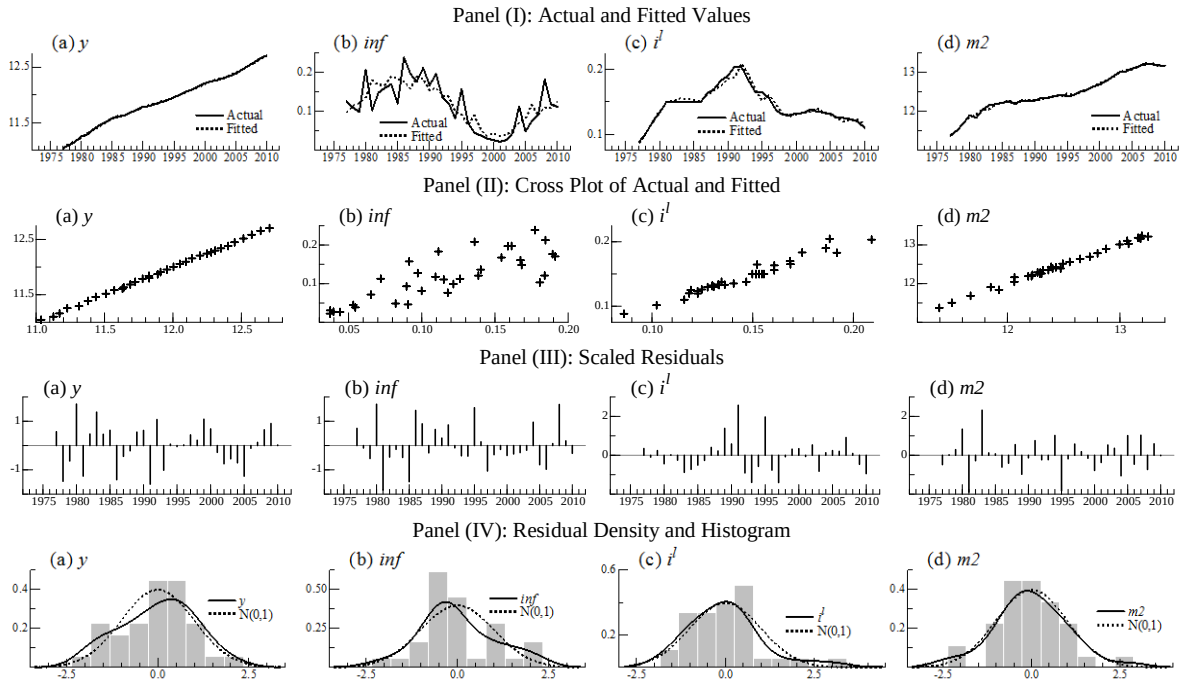
Excluded Variables	y			Excluded Variables	inf		
	χ^2	df	$p-value$		χ^2	df	$p-value$
inf	1.075	2	0.584	y	0.464	2	0.792
i^l	0.517	2	0.772	i^l	0.236	2	0.888
$m2$	6.447	2	0.039**	$m2$	6.965	2	0.031**
$Jointly$	11.247	6	0.081***	$Jointly$	9.092	6	0.1684
Excluded Variables	i^l			Excluded Variables	$m2$		
	χ^2	df	$p-value$		χ^2	df	$p-value$
y	4.181	2	0.123	y	2.071	2	0.354
inf	2.891	2	0.235	inf	20.241	2	0.000*
$m2$	2.623	2	0.269	i^l	7.809	2	0.020**
$Jointly$	9.394	6	0.152	$Jointly$	36.924	6	0.000*

*, **, and *** are denoting rejection of the exclusion at the 1%, 5% and 10% significance levels.

[48] Verbeek (2007, p.185) argues *"non-normality of* ε_i [i.e. OLS residual] *does not invalidate consistency of the OLS estimator nor its asymptotic normality"*. The normality test consists of skewness and kurtosis, but a large sample is required to achieve asymptotic normally distribution in both of them. However, Shenton and Bowman (1977) suggest a transformation of skewness and kurtosis in order to induce normality. Moreover, Juselius (2009) argues that the variance of skewness is less than the variance of kurtosis; so that the normality test is more sensitive to skewness than kurtosis. Furthermore, the problem of non-normality of errors appears in some cases of estimating econometric models, but this problem can be neglected if the errors do not suffer from skewness and the non-normality returns to excess kurtosis or the rejection of normality hypothesis was marginal (Ford and Mohammad, 2010; Johansen and Juselius, 1990; Mousa, 2010; Muhammad, 2010; Oladipo, 2005; Wibowo, 2005).

The graphic analysis of the unrestricted VAR model of the interest rate channel indicates that the model performs statistically well, figure 5.7. The actual and fitted values and the cross plot of actual and fitted values, panels I and II of figure 5.7, reveal that all individual equations show goodness of fit. These results are supported by the scaled residuals, panel III, where the residuals are relatively low and there are no outliers in all individual equations. Additionally, panel IV asserts that the residuals are normally distributed for all individual equations as the skewness and excess kurtosis problems are not evident in the estimated interest rate channel's unrestricted VAR model.

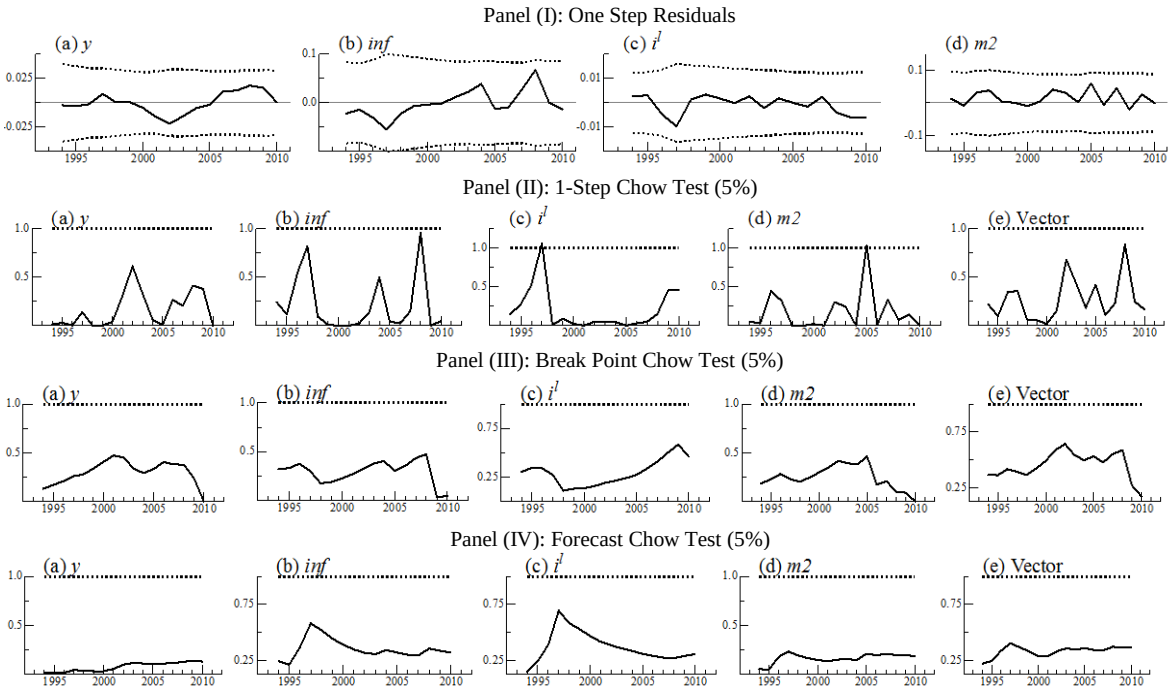
Figure 5.7: Graphic Analysis for the Unrestricted VAR Model



Recursive estimation was carried out to examine whether the relationship remained constant over the sample period.[49] The Chow tests of the model stability had been drawn in figure 5.8. The 1-step residuals figures indicated that the relationships do not have breakdown. Also, the other stability chow-tests confirm the stability of the model at 5%.

[49] Favero (2001) argues that in many empirical studies of VAR models outliers and non-normality exist and the parameters stability is a debated issue.

Figure 5.8: Recursive Analysis for the Unrestricted VAR Model

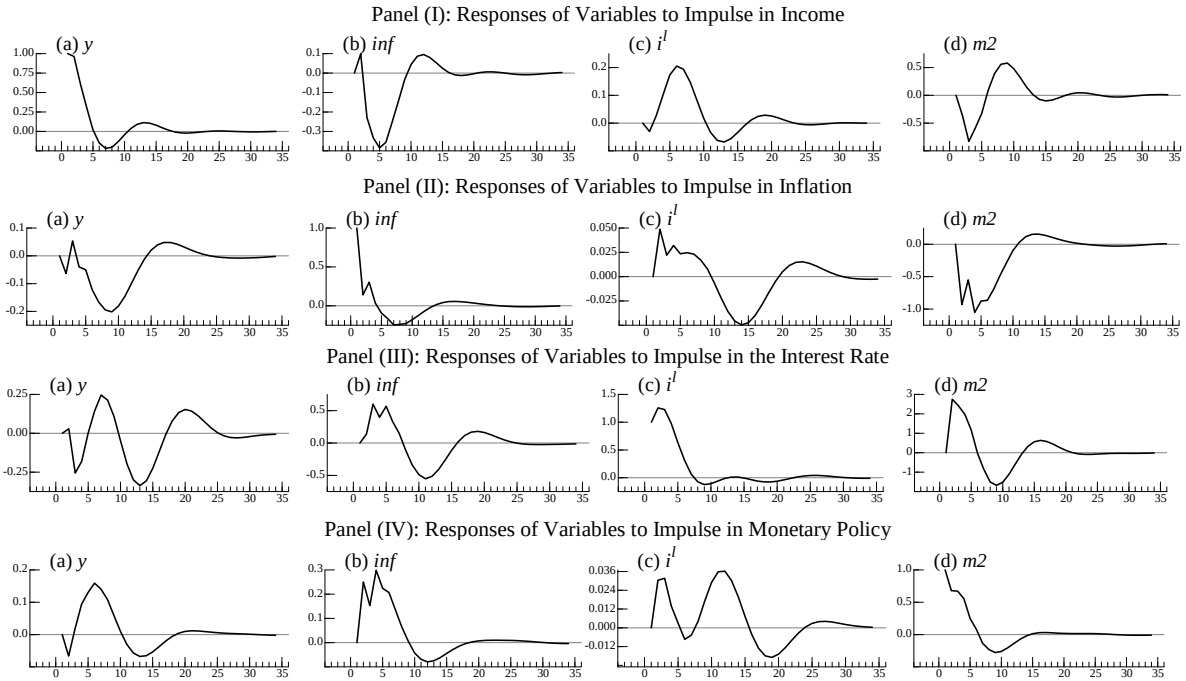


Favero (2001) asserts that the monetary transmission mechanism is a short-run phenomenon and for this reason researchers in this field prefer to use the impulse response function (IRF) of an unrestricted VAR; in order to evaluate the short and medium time term effects. Consequently, the impulse response function and variance decomposition will be applied for the unrestricted VAR model.

The impulse response functions, based on the Cholesky decomposition, are used here to explain the inter-relationships among the interest rate channel variables, figure 5.9. The impulse response graph, panel I, shows that a positive shock in income equals one standard deviation (SD) is resulted in a continuous decrease in inflation rate by about 30% of *SD* during the first 5 years. This response returns to the negative impact of increase in real GDP on the inflation level. Furthermore, the interest rate increased by 20% of *SD*, after 7 years, as a response of the shock in income. Also, $m2$ declined in first 3 years, then it will increase by

50% of SD after 10 years, which reflects the expansionary monetary policy as a response to the increase in real income.

Figure 5.9: Impulse Response Function (Cholesky One SD Innovation)



The one standard deviation shock in inflation rate, panel II, resulted in a decrease in income by 20% after 8 years of the shock and the interest rate increased by 5% after 3 years then reached to zero in the tenth year. In addition, $m2$ declined sharply as a response to the increase in the inflation rate. The responses of variables to a shock in interest rate, panel III, was negative in case of y and positive in case of inf and $m2$. The real income will decline as a result of an increase in the interest rate up to 3 years. This effect can be explained by the negative impact of an increase in interest rate on consumers' expenditure and private investment expenditure. Also, the positive impact of the interest rate shock on inflation rate can be explained by the rise in the cost of funds according to the increase in interest rate, and this will increase production cost, then prices will rise if the producers do not want to reduce their profit margin, i.e. cost-push inflation. Furthermore, there is another expected reason for

this increase in inflation rate comes from the labour market. An increase in the interest rate could rise inflation because employers might want to compensate their employees for higher interest cost so they raise employees' wages. Between 1985 and 2007 the average wage earnings in Egypt had an increasing trend, as it was increased from L.E. 32 per week in 1985 to L.E. 252 per week in 2007, which reflected in a higher production cost and prices increased, i.e. cost-push inflation, (ILO, 2013). A shock in $m2$, i.e. expansionary policy, will lead real income to increase by more the 15% in first 5 years. Similarly, both inflation rate and the interest rate will increase then they will decline after 5 and 3 years, respectively.

Table 5.4: Variance Decomposition of the Unrestricted VAR Model

Response Variable	Period	S.E.	Impulse Variable			
			y	inf	i^l	$m2$
y	1	0.016	100	0	0	0
	2	0.023	97.47	0.51	0.04	1.98
	5	0.028	91.21	1.48	2.19	5.12
	10	0.034	68.48	18.00	1.73	11.80
	15	0.035	63.76	20.75	1.63	13.86
inf	1	0.042	1.610	98.38	0	0
	2	0.045	1.732	88.40	0.05	9.81
	5	0.050	1.639	78.54	0.57	19.24
	10	0.056	2.705	77.88	0.902	18.50
	15	0.057	2.973	76.68	1.041	19.30
i^l	1	0.006	6.98	16.77	76.24	0
	2	0.011	6.27	27.39	64.44	1.88
	5	0.016	6.04	25.90	65.70	2.34
	10	0.018	20.57	22.05	54.90	2.46
	15	0.019	21.03	24.84	49.51	4.60
$m2$	1	0.045	5.73	0.996	2.59	90.67
	2	0.064	3.88	29.14	4.16	62.79
	5	0.093	8.35	45.63	3.38	42.62
	10	0.107	7.54	52.78	2.98	36.68
	15	0.112	7.22	53.86	2.95	35.95

Cholesky Ordering: y,inf,i^l, and $m2$.

The variance decomposition represents the relatively importance of each variables in affecting the other variables. From table 5.4 it is clear that up to period 15 there are changes in the contributions of each variable in the variance of other variables. This shows the probability of long-run relationships as the contribution of many variables lasts in the long-run, which means, in turn, the existence of cointegration between variables.

The question now is the long-run relationship among these variables exists and if yes it can be *identified* or not?. Therefore the cointegration test, based on Johansen approach, is run and the results are summarised in the table 5.5. From the cointegration test, it can be concluded that a long-run relationship among the VAR model's variables exist. Also, the *trace-test* and *max-test* refer to one possible cointegration relationship at 95% significance level. To identify the long-run relationship a vector error-correction model (VECM) will be used.

Table 5.5: Cointegration Test of the Unrestricted VAR Model

Hypothesis		**Eigenvalue**	**Trace-test**		**Max-test**	
H_0	H_1		Statistic	*p-value*	Statistic	*p-value*
$r = 0$	$r > 0$	0.637	67.55**	0.022	34.42**	0.022
$r \leq 1$	$r > 1$	0.365	33.13	0.335	15.46	0.605
$r \leq 2$	$r > 2$	0.270	17.67	0.374	10.72	0.554
$r \leq 3$	$r > 3$	0.185	6.95	0.360	6.95	0.361

(**) denotes rejection of the null hypothesis at the 5% level of significance. The critical values are following MacKinnon *et al.* (1999).

Juselius (2009) states that the larger number of variables is in the VAR model the larger expected cointegrating relations exist in the system. Subsequently, the difficulty of identifying these cointegrating relations is increased since the number of possible combinations of the relationships become too large.

Favero (2001) argues that identification is required within Johansen's cointegration analysis. Thus, cointegrating restrictions are imposing on a VAR model in levels in order to increasing the estimators' efficiency, taking in account the inconsistency cost when imposing incorrect identifying restrictions (Favero, 2001). Also, in the light of this framework, the identifying restrictions should be at the minimum level.[50]

Mousa (2010) and Wibowo (2005) give clear examples of difficulties in identifying the long-run relationship among cointegrating variables in VAR models. Mousa (2010)

[50] Favero (2001) points out that the VAR models of monetary transmission mechanism are very rarely cointegrated VAR.

estimated the monetary transmission mechanism in the case of Jordan by using a VAR model. However, all variables in his case were *I*(1) and the Johansen cointegration tests, i.e. *trace-test*, assert the existence of the long-run relationships among variables. Nevertheless, the cointegration analysis for his system gave unsatisfactory results.[51] Furthermore, Wibowo (2005) estimated the MTM in Indonesia using the VAR approach. However, he found 3 cointegrating vectors in his system at 5% and 1% levels of significant but he estimated an unrestricted VAR and did not identify these cointegrating vectors.[52]

The VECM is estimated with one cointegration vector, CV, and the long-run relationship was identified depending on the theory suggestion, if possible[53], the significance of the estimated parameters and the Granger causality test[54]. The Granger causality tests show that inflation rate is insignificant in the income equation, see table 5.3, also the coefficient of inflation rate in the cointegrated vector is insignificant, so that the coefficient of inflation in the cointegrated vector and its speed of adjustment were imposed to zero. The restrictions identified the cointegrated vector and the Likelihood Ratio test, *LR-test*, confirms that restrictions identified the long-run matrix, β, where *LR-test* statistic is 4.20 [0.12].[55] The identified VECM is represented in table 5.6 and the speed of adjustment matrix is represented

[51] Mousa (2010) used three different monetary policy variables, i.e. 3-month CDs, excess reserves and discount rate, in a 5 variables VAR model, and the *trace-tests* rejects the hypotheses of no cointegration at 5% up to 5, 4, and 3 cointegrating vectors with these policy variables, respectively. The result with 3-month CDs refers to non-existence of a relationship between variables or instability of the relationship if it is exist, Mousa (2010). Moreover, the results with other monetary variables suggest that finding a unique relationship between the system's variables is implausible and raises the identification issue (Mousa, 2010).

[52] Wibowo (2005) argues that the critical values provided by Johansen (1995b) will not be suitable since the system has dummy variables as exogenous variables. Instead of this, he tests again under Johansen and Nielsen DisCo approach. The cointegration test with dummy variables indicates no cointegrating vectors in the system at 1% and 5% significance level.

[53] The VAR model, and in general time-series models, is a-theoretical approach which, in turn, makes the theory handicapped in guiding econometricians in imposing restrictions in cointegrated VAR models.

[54] This test proposes the variables that can be excluded from each individual equations, therefore it can be a guide when restrictions like $\beta_i = 0$, where β_i is the parameter of the variable, is needed to identify the cointegrated vector.

[55] The degree of freedom for this test, χ^2, is calculated by $d.f = \sum_{i=1}^{r}(m_i - r)$ where m is the number of restrictions in each equation and r is the rank of matrix Π, i.e. number of cointegrated vectors, see Johansen (1995b).

in table 5.7. The normalisation was imposed on GDP, while the coefficient of inf in the cointegrated vector, β, and its speed of adjustment in the loading matrix, α, imposed to zero.

Table 5.6: Identified Cointegration Vector (Long-Run Coefficients)

$\widehat{\boldsymbol{\beta}}'$	y_{t-1}	inf_{t-1}	$i^l{}_{t-1}$	$m2_{t-1}$	$Trend$	$Intercept$
	1	0	2.182	-0.178	-0.033	-9.344
			(0.603)	(0.084)	(0.004)	

Standard errors values are in ( ).

The long-run relationship, i.e. equation (5.13), represents the relation between the income, in one side, and the other macroeconomic variables, i.e. the nominal lending interest rate and real broad money, on other side. This relationship (equation 5.13) is expected to represent the interaction between money demand (liquidity preference) and money supply. In terms of a core macro model, it would be a representation of the equilibrium LM, Liquidity preference-Money supply, curve which describes the relationship between aggregate income, interest rate and the money supply in equilibrium. An increase in the stock of money, $m2$, will raise aggregate nominal income which in turn will have a positive impact on output, y. In addition, excess supply of money will lower its price (opportunity cost) and therefore lower interest rates. This will have a further positive impact on income. As macro theory tells us, a rightward shift of the LM curve (increase in money supply), will cause output to rise and interest rate to fall.

$$\underset{(SE)}{y_t} = 9.344 - \underset{(0.603)}{2.182}\, i^l{}_t + \underset{(0.084)}{0.178}\, m2_t + \underset{(0.004)}{0.033}\, Trend \qquad (5.13)$$

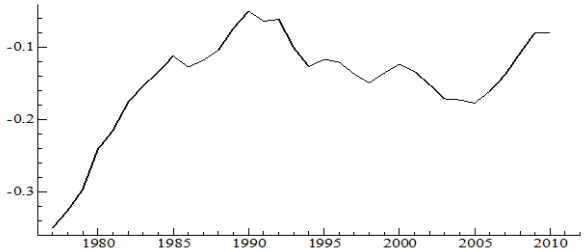
Table 5.7: Loading Matrix (The Speed of Adjustment)

	$\hat{\alpha}$
y_{t-1}	-0.162 (0.068)
inf_{t-1}	0 ---
$i^{l}{}_{t-1}$	-0.017 (0.027)
$m2_{t-1}$	-0.695 (0.198)

Standard errors values are in ( ).

According to (5.13), the interest rate has a negative impact on the real income, however real broad money has a positive impact on it. Also, the effects of i^l and $m2$ are statistically significant. This asserts the existence of the interest rate channel in the Egyptian economy during the last four decades, and it explains the role of interest rate in affecting the real income level in the economy. In addition, the speed of adjustment of CV is plausible, because it is significant, less than one in absolute value and negative, α_{11}= -0.162 with standard error value equals 0.068. This means that the disequilibrium in real income will be corrected within approximately 6 years by the effect of the interest rate and real broad money. Additionally, figure 5.10 depicts the long-run relationship in the estimates system, i.e. the cointegrated vector. Moreover, the presence of a trend in the cointegrated vector in early years is expected as the income variable is increasing from year to year, i.e. has a trend, and also the Johansen cointegration test has run with a trend, see table 5.5 and table 5.6.

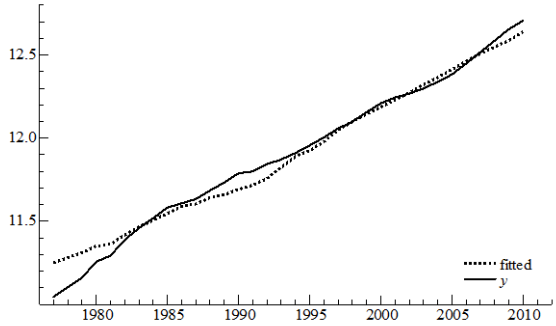
Figure 5.10: The Cointegrated Vector of the Interest Rate Channel



5.7. Summary of Results

This chapter provides a well robust estimated cointegrated VAR model for the interest rate channel in Egyptian economy. Also, the actual and fitted values of real GDP, according to the estimated cointegrated VAR model, are depicted in figure 5.11. The estimated model passed all diagnostic tests and its results are in a line with the economic theory.

Figure 5.11: Actual and Fitted Values of the Income Vector



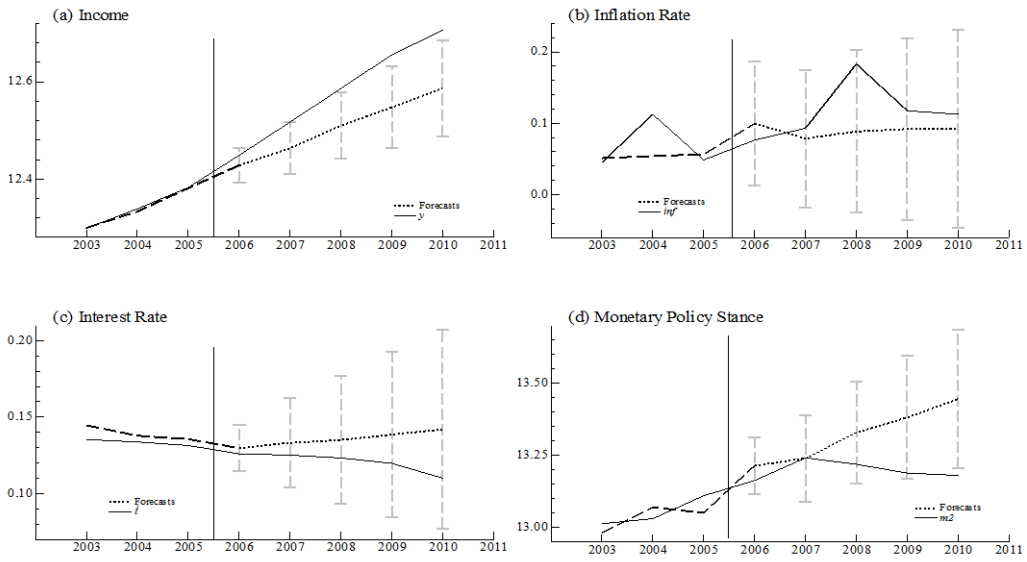
Additionally, the in-sample forecasts of VECM's variables are presented in figure 5.12, with two standard deviations as the error bands. This figure asserts that the estimated model is able to forecast the values of variables within the error bands. However, the forecasted real income values are within the error bands up to 3 years, but the forecasted $m2$ values are within these bands up to 4 years. Additionally, the forecasted values of the interest rate and inflation are better comparing to other variables, as all their values within the error bands. Additionally, the forecasting power of the estimated VECM is high which means that it can be used for forecasting purpose and the results will be satisfactory.

The interest rate channel in Egypt exists during the period of study, 1975-2010. The effect of the interest rate on real GDP is negative and significant in the long-run relationship, and this effect is greater than four times the effect of real broad money, after transforming the

interest rate coefficient to log scale. In addition, the system will return to equilibrium within 6 years, as the speed of adjustment equals 16%.

The interest rate channel in the Egyptian economy can be more active in the future, because the CBE controlled the interest rates in Egyptian economy during the majority of study period, especially before 2001 (see Al-Mashat and Billmeier, 2007), which decreased the role of the interest rate channel in macroeconomy. However, the role of this channel is expected to increase after the liberalisation of the interest rates and applying the corridor system of the interest rates in recent years.

Figure 5.12: In-Sample Forecasts of the Model's Variables



The role of interest rate channel in affecting real income is expected to return to the effect of the interest rate on the consumers' expenditure more than its effect on the private investment expenditure, because the investment in Egypt is not highly sensitive to changes in the interest rate, i.e. the lending interest rate, comparing to other things like taxation system, government regulations, and political system. These results are in a line with those of Chapter 3, i.e. modelling the consumers' expenditure in Egypt, and Chapter 4, i.e. estimating the investment expenditure under uncertainty in Egypt.

The previous conclusion leads us to study other monetary policy's channels, like the bank lending, the exchange rate and the asset price channels. But, the asset price channel cannot be estimated according to the very short time-series data that are available for this channel, because the Egyptian stock market data only available for recent years, in optimistic case from 1997.

5.8. Conclusion

Although there are studies of the interest rate channel in developed countries, they are scarce in developing countries. Some research does exist for the interest rate in Egypt. This chapter tried to fill a part of that gap.

The main question of this chapter was, Did the interest rate channel exist in Egypt during the period 1975-2010?, and if it is exists, Is the long-run relationship of this channel identifiable or not?. These questions were answered by using the suitable econometric approach, VAR and VECM. The VAR model analysis provides evidence for existence of the interest rate channel. Additionally, the Johansen's Cointegration test indicates that the long-run relationship exists. To identify the long-run relationship, the unrestricted VAR model is modified to become a VECM. Then, the required restrictions imposed and the cointegrated vector identified. The estimated model of the interest rate channel does not suffer from any misspecifications and the diagnostic tests support this. Additionally, the recursive analysis confirms that stability of the estimated model. This model asserts the existence of the interest rate channel in Egypt between 1975 and 2010, as the interest rate has a negative impact on the real GDP in the long-run relationship. Also, the real GDP will return to its equilibrium level within 6 years after the disequilibrium.

CHAPTER 6 : INVESTIGATING THE BANK LENDING CHANNEL IN EGYPT

6.1. Introduction

This chapter investigates the bank lending channel for the Egyptian economy during an important period of time, after the 1973 War up to the recent yeas, when the Central Bank of Egypt adopted inflation targeting policy. This chapter focuses on the bank lending channel rather than other channels of the credit channel due to its importance and the availability of data.

The bank lending channel provides another side of the MTM beside that described in the previous chapter, the interest rate channel. The econometric analysis uses time series data, and the Johansen cointegration approach was applied to estimate the relationships among variables not only in the short run but also in the long run. A vector error-correction model (VECM) is estimated and the diagnostic tests and recursive procedures are applied.

The questions that this chapter tries to answer are, *Does the bank lending channel exist in Egypt*? and if so, *Is the long-run relationship of this channel identifiable*?. To achieve this goal, this chapter is divided into sub sections. The next two sections discuss the literature on the credit channel and the results from previous empirical results. The following two sections present the data and the econometric model. The next section presents the results, with the final section concluding the analysis.

6.2. Credit Channel in the Literature

Bernanke and Gertler (1995) pointed out that the interest rate channel is inadequate alone to explain the whole effects of monetary policy.[56] Additionally, they pointed out that the external finance premium, which is the difference in financing cost between external and internal funds, is the core of the credit channel.[57] They also continued in illustrating the agency problem in financial market that results from asymmetric information and the high cost of contract enforcements. As a consequence, economists were induced to find a suitable explanation for this problem. The suggested solution was the credit channel, which, in turn, divides into the bank lending channel and the balance sheet channel (Mishkin, 1995). Although, these two are the main sub-channels of the credit channel, others exist, for example the cash flow channel, unexpected price level channel, and household liquidity effect channel (Mishkin, 2003).

6.2.1. The Bank Lending Channel

Bernanke and Blinder (1988) argue that the bank lending channel causes the IS curve in Keynesian analysis by the credit-commodity (*CC*) curve, with the *IS-LM* model transferred to *CC-LM* model.[58] Beside the previous modifications, two essential conditions should exist in order to verify that the bank lending channel exists. Firstly, some of the borrowers, especially small firms, cannot receive finance from other sources except banks. Secondly, a

[56] The *neoclassical cost-of-capital* explanation of the MTM process is not complete and difficult to demonstrate quantitatively (Bernanke and Gertler, 1995). According to the frictionless market conditions, the *neoclassical cost-of-capital* is the sum of the required return to lender and the depreciation ratio both multiplied by the price of a new capital good. On the contrary, other factors such as inventory and fixed investment have significant impacts (Blinder and Maccini, 1991; Chirinko, 1993). In addition, monetary policy is having a distinct effect on housing and production equipments, which they are sensitive to the long-term interest rate fluctuations, and this demolishes the assumption that monetary policy has a strong influence on the short-term interest rate and vice versa on the long-term interest rate (Bernanke and Gertler, 1995).

[57] Gertler and Gilchrist (1993) support this idea in their research.

[58] The framework of Bernanke and Blinder (1988) imply that interest rate elasticity of credit for demand and supply is equal, and the income elasticises of credit demand and money demand are equal also.

part of reservable deposits of banks is affected by monetary policy shocks and for this reason the banks' loans will be affected, in turn, as there is no ability for banks to accommodate these circumstance through using non-reservable sources of finance (Topi, 2003).

The mechanism this channel works through can be described briefly by assuming that the monetary authority imposes a tight monetary policy. Accordingly, the balance of bank deposits will reduce and then the bank loans will decline. Finally, output will go down due to the decreased investment.

The financial innovations caused increased competition in financial markets. As a result, the importance of banks in the credit market was diminished and then the bank lending channel became less important in recent years (Edwards and Mishkin, 1995). Also, Hülsewig *et al.* (2002) argue that, although the bank lending channel differs from the interest rate channel, but they can be complementary, as the tight monetary policy, which leads to increase in short-term interest rates, can impose its effects through the interest rate channel and the bank lending channel concurrently.

The bank lending channel needs three prerequisite conditions to exist. Kashyap and Stein (1994) and Hülsewig *et al.* (2002) summarise these conditions in: 1) intermediary loans, usually from banks, and open-market bonds should not be perfect substitutes for some firms, 2) central banks should be able to affect these intermediary loans' supply, and 3) the monetary policy shocks should not be neutral, as a result of imperfect price adjustments.

6.2.2. The Balance Sheet Channel[59]

The ability of large banks and firms to enter into financial market and capital market as borrowers will bring us to the broad lending channel. Kashyap *et al.* (1993) argue that

[59] There are many names for this channel beside the balance sheet channel. The famous two other names are the *financial accelerator* and the *borrower net worth channel*.

under the broad lending channel, the imperfect substitution is between internal and external funds instead of between bank credit and other financing resources.

The key factor in the balance sheet channel is the firm's net worth (total assets minus total liabilities). According to this channel the fall of net worth, which raises adverse selection, leads to a decline in investment loans. Moreover, the moral hazard problem, which means that firms' owners have a high desire to invest heavily in risky assets as their share in their firms' net worth is low, appears when the decrease in net worth results in a sharp decline in investment loans (Mishkin, 1995).

The balance sheet channel can be illustrated in different ways. One being how contractionary monetary policy affects the final output and expenditure in an economy. Given this, a drop in the monetary base causes a decline in equity prices, which means less net worth and then it pushes the adverse selection and moral hazard up. Consequently, the bank's lending will decrease which resulting in lower investment and output. Another scenario can happen when the contractionary monetary policy caused a distinct increase in the interest rates. In this case, the firm's balance sheet will face a deterioration effect, reflecting in a firm's cash flow, i.e. cash flow channel. Subsequently, this increases adverse selection and moral hazard.

However, the balance sheet channel works through net worth and cash flow of firms, Bernanke and Gertler (1995) suggest that the balance sheet channel can apply through consumers' expenditure. The decline in credit from banks to consumers, which is caused by monetary contraction reduces their ability to purchase houses and durable goods. These factors impact on the consumers' desire to spend, which is called the *household liquidity-effects channel*, and is important as the lenders' desire to lend (Mishkin, 1995, 2003). This channel depends on the likelihood of financial distress incidence. If the consumers expect that

they will face financial distress they will decrease their holding of financial assets, which will increase the likelihood of financial distress itself.

Another channel can be added to the balance sheet channel. This channel is the *unexpected price level channel*, which functions through the effect of monetary policy on the general level of prices in the economy. To understand this channel we should differentiate between the effect of an unexpected rise in general prices on both sides of a firm's balance sheet. However, the value of a firm's liabilities (debt burden) will decline in real term as a result of an unexpected increase in inflation level, but this will not decline the value of the firm's assets (Mishkin, 2003). Consequently, a contractionary monetary policy that results in an unexpected decrease in general prices level will increase the adverse selection and moral hazard effect. Consequently, the incentive of banks to lend will decrease and then the income will decline after the contraction in the investment.

6.2.3. The Bank Capital Channel

The traditional credit channel assumes that central banks affect the loan supply by using reserve requirements. Bindseil (2004) pointed out that a traditional instrument like reserve requirement might not be active if the central bank targets short-term interest rate or inflation. In addition, it is difficult to think that the monetary contraction will decrease the bank's balance sheet volume. Van-den-Heuvel (2007) formalised a channel of MTM called the bank capital channel. Égert and MacDonald (2006) assume that the bank capital channel needs some preliminary assumptions such as: a) it is costly for banks to raise additional capital; b) the interest rate risk of credit is higher than the interest rate risk of deposits with the same maturity; and c) capital regulations affect the credit supply.

If monetary policy results in raising the interest rates the cost of finance (deposits) will increase, but the other components of the bank's balance sheet do not change due to maturity mismatch. As a result of these is a shrinking in capital size, affecting minimum capital requirements, so there will be a decline in the loans supply as raising additional capital is costly (Égert and MacDonald, 2006).

The expected probability of borrowers' default should be taken into account when a bank's manger chooses the suitable lending interest rate for each borrower. The previous rate is calculated in a simple way by adding the credit spread to the risk free rate. According to the previous context, the bank capital will be the cover of unexpected losses (Chmielewski, 2006).

If the bank mangers decided to maintain the riskiness of banking operations after a monetary policy shock, which redistributes the loan losses, there are have two options: raise additional capital or change the assets structure (Chmielewski, 2006). The first option, raise additional capital, may not work in the short term (Bolton and Freixas, 2000, 2006; Myers and Majluf, 1984). The second option is changing the asset structure, which, in turn, may be not easy according to the high share of illiquid loans to the total amount (Chmielewski, 2006).

Markovic (2006) found that the bank capital channel affects the MTM significantly, and it works together with the balance sheet channel. In addition, it becomes more important in some cases, for example the writing-off of bank's non-performing loans or changing the regulatory framework of capital requirements.

6.2.4. The Credit Channel and Trade Credit

Firms usually try to find an alternative source of finance of bank credit, especially in times of tightening monetary policy. One source of external finance to firms is trade credit,

which means simply that '*firms postpone payment of their due bills to their suppliers*' (Petersen and Rajan, 1994). The amount of trade credit relies on the transaction value, transaction motive and the relationship between a supplier and its customers, i.e. firms. Also, suppliers try to increase their sales by using trade credit through letting firms to buy without thinking about the cash, i.e. finance motive (Nilsen, 2002).

Trade credit became cheaper than bank credit in time of a tightening monetary policy (Égert and MacDonald, 2006). Recently, a great deal of external finance of firms comes from trade credit (Ono, 2001). One reason is that the high ability of suppliers to monitor their customers and to force them to repay their loans through cut-off future supplies or repossess goods (Petersen and Rajan, 1994). The effect of trade credit on the credit channel has been studied by many researchers (Choi and Kim, 2003; De-Blasio, 2003; Nilsen, 2002; Valderrama, 2003). Furthermore, there are many trade credit theories that can explain the effect of the trade credit on the MTM's channels. These theories are summarized as follow:[60]

1. The *transaction cost theory* argues that a supplier and its firms can optimize inventory and cash flow in a long-term relationship by a good scheduling of the deliveries and payments of supplies (Ferris, 1981). Another good reason pointed out by Emery (1987) that suppliers can adjust their trade credit terms instead of changing the prices due to the variable demand of their customers.

2. Smith (1987) offers another theory of the trade credit, the *quality guarantee theory*, as when the quality of product cannot be verified instantly, the firm will take extra time to check it, before paying the price.

[60] The explanation of these theories can be found in many references. For *transactions cost theory* see Nilsen (2002), for *cash-management theory* see Ferris (1981), Ng *et al.* (1999) and Nilsen (2002), for *quality guarantee theory* read Deloof and Jegers (1996), for *price discrimination theory* return to Brennan *et al.* (1988), Petersen and Rajan (1997, 1994) and Wilner (2000). And finally, for *financing advantage theory* read Ng *et al.* (1999) and Nilsen (2002).

3. Petersen and Rajan (1994) and Mateut (2005) assert that suppliers can reduce the effective price to low quality firms by using trade credit and this is the core of the *price discrimination theory*. Suppliers, which have a significant price margin (i.e. the difference between the price and the cost of the product), can increase their sales volumes if they cut price, which transfers into price discrimination if the antitrust law exists in the market. Moreover, the suppliers not only use price discrimination with the risky firms which have no alternative to trade credit, but also with firms that suppliers want to develop a long-term relationship with.

4. The *financing advantage theory* of trade credit, which was built up by Schwartz (1974), assumes that trade partners, according to a long period of transactions know other partners' financial and business strength well compared to banks. They will be accurate in their judgement of their partners' financial capability (Brennan *et al.*, 1988). Mian and Smith (1994) attribute this to the high ability of suppliers to liquidate goods when their customers default on their trade credit. However, banks can do the same action, but they did not have the experience of suppliers in this field.

6.2.5. Factors Affect the Credit Channel

The credit channel is affected by many factors for example internal capital markets, banking systems, and banking concentration. Some of these determinants can be discussed as follow:

1. *Government Intervention*: this type of intervention, even if it is declining over time, can exist through direct public ownership of banks or through public guarantee (Ehrmann *et al.*, 2001).

2. *Banking Concentration*: a high degree of banking concentration gives large banks more accessibility to find alternative external sources of finance. Hence large banks can prevent their credit supply from the impact of monetary shocks (Adams and Amel, 2005). Égert and MacDonald (2006) highlighted the connection between the credit channel and banking concentration. They think that there is a reverse relationship between vulnerability of the credit channel and the degree of concentration. Additionally, they indicated that banks, in this type of markets, are not sensitive to interest rate changes, i.e. interest rate pass-through.

3. *Internal Capital Markets*: multi-bank companies can effortlessly set up an internal capital market in order to provide their affiliated banks with internal finance to insulate the supply of loans from monetary policy shocks. Furthermore, the real size of an affiliated bank's assets, liabilities and liquidity depends on the size of the internal capital market between the multi-bank companies (Ashcraft, 2001).

4. *Foreign Currency Denominated Loans*: Égert and MacDonald (2006) assert that the higher share of foreign currency denominated loans, where interest rates are calculated by adding the exchange rate premium to the foreign interest rate, the lower the (direct) impact of domestic monetary shocks on domestic lending and borrowing processes.

There are a number of other determinants of the credit channel. The first one is the *ability to predict the financial constraints in advance*, which reduces the lending channel effectiveness through altering capacity utilization (e.g. Wang, 2001). The second factor is the *soft budget constraints* which may imply easy access to additional loans from governmental banks (e.g. Kornal *et al.*, 2003). Another factor is the *distribution of small firms among sectors*, which implies a heterogeneous impact of the credit channel across sectors (e.g. Tornell and Westermann, 2002). Finally, the *dependency of small firms on bank loans* as if this index is small then it is normal to expect that the influence of the bank lending channel on economy will be small (Égert and MacDonald, 2006).

6.3. Credit Channel's Empirical Studies

This section surveys the results of empirical studies of the credit channel and is divided into two sub-sections. The first displays the evidence of the credit channel in the Egyptian economy, while the other summarises the results of some studies of other countries.

6.3.1. Evidence in Egypt

The Egyptian bank lending channel from 1980 to 2002 was investigated by Noureldin (2005) using a structural vector autoregressive (SVAR) model, that consisted of six variables.[61] He found that the growth in total liquidity did not play a significant role in both the credit and the exchange rate channels. Moreover, The importance of the credit channel in the Egyptian economy can be illustrated as the monetary authority (i.e. the CBE) managed the credit growth and intervened directly in the credit market during the mid-1990s to stabilise and reduce the inflation rate (Noureldin, 2005).

[61] Reserve money, broad money, real effective exchange rate, credit to private sector, real GDP and CPI are the six variables that were used in this study.

However, the quantity of obtainable credit to the private sector, in the case of Egypt, is more important than interest rates, as the nominal interest rate did not have a significant effect on credit growth. This approach suggests a soft budget constraint[62] of borrowers from banks (Hassan, 2003).

Abdel-Kader (2006) agreed that in the Egyptian credit market the decisive element in a lending decision is a non-interest rate criterion. According to the growth of non-performing loans in the Egyptian banking sector, banks become risk-averse, so that they invest more in Treasury bills and government bonds (which include more liquid investment with less risk) and less in the private sector investment (i.e. banking credit provided to private sector). Likewise, the results of the survey show that business sector activities were financed through retained earnings (70%), bank credit (24%) and the reminder (6%) comes from the stock market (4%) and bond market (2%). He asserts that internal finance is cheaper and easier when compared with external finance in the sample firms.[63]

During the 1980s and 1990s, the real lending rates were volatile in Egypt. From the beginning of 1997 these rates became more stable ranging between 9% and 11% (Noureldin, 2005). Nevertheless, the credit to the private sector declined from 26% in 1997 to 5% in 2002 (Noureldin, 2005). The reasons of this decline are the slowdown of economic activity. In addition, the increasing in NPLs, in the second half of the 1990s, led to an increase in the lending interest rate margin (Noureldin, 2005).

Boughrara (2008b) argues that using a VAR approach with the Egyptian data confirms that the lending channel is very weak with the interest rate not affecting banking lending. The possible cause of this is a high ratio of non-performing loans and an underdeveloped financial

[62] This means that borrowers prefer to be financed by short-term debt than to be financed by increasing the equity (i.e. capital).

[63] The survey contains 351 firms distributed as follow: 38% from industry sector, 28% from trade sector, 18% from service sector and 16% from agricultural sector. Also, the size of firms in survey divided into 53% for large firms and the reminder for small and medium firms.

market. In addition, Ziaei (2009) asserts that decreasing interest rates could increase bank credit to the private sector in Egypt and other MENA countries, so that the bank lending channel can be an effective channel of the MTM. Furthermore, the fall of the interest rate in line with the rise of foreign asset returns, encourages banks to increase holding of foreign assets in the bank's balance sheet in MENA countries like Egypt, Lebanon and Oman (Ziaei, 2009).

Al-Mashat and Billmeier (2007) argue that after a monetary easing shock and an appreciation of the nominal effective exchange rate, domestic credit expands. Also, the bank lending channel supports the transmission of monetary policy on output, and the lending to the business sector is more important than to the households sector.

6.3.2. Evidence from Other Countries

The effect of the credit channel differs between developing countries and developed countries. The bank lending volume decreased in Indian economy after applying an unexpected contractionary monetary policy, but this decline was a small per cent and slowly happened. As a consequence, the bank lending channel in India is weak, which can be explained by the low pass-through coefficient from monetary policy rates to lending rates (Al-Mashat, 2003).

Boughrara (2008a) suggests that the lending channel operates in parallel with the interest rate channel in both Morocco and Tunisia but the importance of the lending channel is higher in the latter (Boughrara, 2008a).

Nevertheless, the credit channel operates through small banks as the case of Poland (Wrobel and Pawlowska, 2002). The State Bank of Vietnam is using credit to inject liquidity to the economy, and the credit channel plays the main role in the monetary transmission

mechanism in Vietnam. Additionally, credit shocks accounted for 23% of fluctuations in Vietnam's economy during the ten years ended up in 2005 (Hung and Pfau, 2009).

In Thailand, the transmission of monetary shocks through bank lending is uncertain, and the transmission from the policy rate to the bank lending rate is weak. Also, the impact of bank lending shocks on output is weak because only 9% of changes in output at two years was accounted for bank lending shocks, reflecting the non-active bank lending channel in Thailand from 1993 to 2002 (Baqir, 2002).

The empirical results in France suggest that the credit channel is significant, because the dependence on the banking credit is essential for enterprises during 1993 to 1995 (Levy and Halikias, 1997). In contrast, the credit channel in Jordan is weak as only 7% of changes in output is accounted for by credit after two years of a monetary shock, and in the same time foreign reserves accounts for 14% of changes in output (i.e. equals a double of credit impact) (Poddar *et al.*, 2006).

Morsink and Bayoumi (1999) found that the overnight call rate innovation in Japan resulted in a rise in investment in the business sector by more than 0.2% over potential GDP after 30 months. Furthermore, this ratio becomes 0.1% for households' spending, which, in turn, refers to the importance of the bank lending channel in the Japanese economy during the period 1980-1998. In addition, they argue that bank loan shocks have a significant impact on private demand (Morsink and Bayoumi, 1999).

The empirical studies suggest that the trade credit is an important source of external finance, and it is clear in developed countries. Kohler *et al.* (2000) pointed that during the period 1983-1995, in the United Kingdom, trade credit was 70% of total short-term debts and 55% of total short-term credit in firm's balance sheet. Rajan and Zingales (1995) found that trade credit in Italy, France and Germany was about 25% of firm's total asset in 1991 and this

ratio was 22% and 17.8% in UK and USA respectively. In 1993 the previous ratio was 15.78% in USA (Berger and Udell, 1998).

6.4. Data

The annual data from 1975 to 2010 of the Egyptian economy are used to estimate the bank lending channel. The selection of sample period was determined by the availability of data and economy conditions. The sources of data are in the data appendix at the end of the thesis. The model contains four endogenous variables: log of real gross domestic product, y, inflation rate, inf, log of real bank credit to the private sector, $cred^P$, and log of real broad money, $m2$.

The time series patterns of income, inflation and monetary policy were discussed in the previous chapter, so the development of the bank lending in the Egyptian economy will only be discussed briefly, however more detailed discussion is in section 2.5 of Chapter 2.

Banking credit to the private sector over the period of study are summarised in table 6.1. Before 1980, the bank loans to the private sector were small in nominal and real terms. The period 1981-1990 saw a significant increase compared with the period before 1980, when the private sector share at the economic market increased after the 1973 War and the open-door policy.

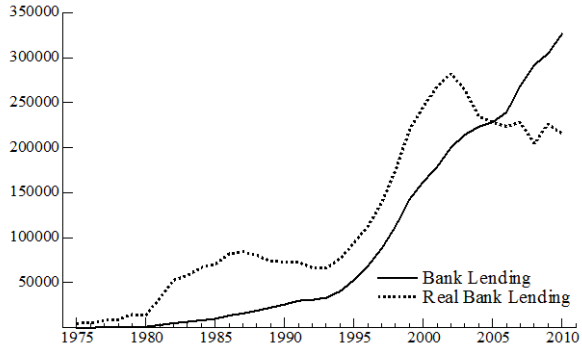
During the period from 1991 to 1996, where the economic reforms were undertaken, there was an increase in the bank loans to the private sector. The share of credit to the private sector increased which was partly due to the economic reform and the decline in the public budget deficit, figure 6.1. The reduction in the government budget deficit financed by the banking sector provided the required finance for the private sector. Additionally, the period after 1995 saw a sharp rise in the bank loans to the private sector, since the growth of the private sector and implementing the privatisation programme.

Table 6.1: Average Values of Bank Lending to the Private Sector

Period	Nominal Bank Lending to the Private Sector	Real Bank Lending to the Private Sector
	Millions of L.E.	
1975-1980	680	13810
1981-1985	6587	133832
1986-1990	19310	392333
1991-1995	37572	763372
1996-2000	114694	2330305
2001-2005	208885	4244042
2006-2010	276034	5608341

Source: IMF (2012b) and CBE (2012)

Figure 6.1: Developments of Bank Lending to the Private Sector



The sharp increase in real bank lending to the private sector reached to its peak in early 2001, then it started in decline. This decline returns to the NPLs problem which became dangerous in 2001. Additionally, the decline in the real bank lending to the private sector was resulted partly to the world financial crisis in 2008. [64]

6.5. Econometric Model

The same methodology which was applied in Chapter 5 for the interest rate channel in Egypt is applied in this chapter.[65] In this section a VAR model will be estimated in order to

[64] See sub-section 4.6.2 for more details about the effect of NPLs and the world financial crisis of 2008 on the economy.
[65] Return to chapter 5 section 5.4, econometric methodology, for more details.

describe the bank lending channel in Egypt from 1975 to 2010. The estimation of the bank lending channel as a proxy of the whole credit channel depends on the availability of data. Bank loans were the main source of credit in the Egyptian economy, similar to the majority of developing countries that do not have an active stock exchange market.

The model consists of 4 endogenous variables, capturing the main features of the bank lending channel. The selection of these variables was following the mainstream of research in the MTM's channels. Consequently, the model contains the income variable, y, inflation rate, inf, bank lending to the private sector, $cred^P$, and the monetary policy variable, $m2$. Figure 5.6 shows the income variable and figure 4.5 depicts the credit variable, however figure 3.6 show inflation and monetary policy variables. It is clear that some series have a deterministic trend, especially income, so a trend will be added to the unrestricted-VAR model.

Unit root tests are undertaken to determine the order of integration of the series, see table 6.2. The results confirm that all variables are non-stationary in levels as all of them have unit roots. All variables are *I(1)* in the *ADF-test* and the *PP-test* at 1% level of significance. However, they are *I(1)* in the *KPSS-test* at 5%.

Table 6.2: Unit Root Tests of the Bank Lending Channel's Variables

Variables	ADF-test						PP-test						KPSS-test					
	Level			*Difference*			*Level*			*Difference*			*Level*			*Difference*		
y	-1.781	2	*t*	-4.591*	0	*c*	-3.907**	3	*t*	-4.639*	3	*c*	0.170	3	*t*	0.393**	3	*c*
inf	-1.645	4	*c*	-10.129*	0	-	-2.564	2	*c*	-10.902*	3	-	0.469	2	*c*	0.110**	2	*c*
$cred^P$	-2.525	2	*t*	-4.319*	0	*c*	-1.662	2	*t*	-4.503*	3	*c*	0.156	3	*t*	0.338**	4	*c*
$m2$	-3.226	4	*t*	-4.837*	0	*c*	-2.864	2	*t*	-3.886*	2	*c*	0.423	3	*t*	0.306**	4	*c*

Note: (*) and (**) mean that the variable is stationary at 1% and 5%, respectively. The critical value of KPSS-test, at 5%, in case of the series has trend is 0.146 and in case of the series has constant only is 0.463. Critical values of ADF-test and PP-test are following MacKinnon (2010), see table 3.4, while those for KPSS-test are following Kwiatkowski *et al.* (1992). The numbers beside the critical values represent the number of lags, while *t, c,* and – after the critical values represent the variant of the series trend and constant, constant, and no constant or trend, respectively.

The unrestricted-VAR model of the bank lending channel will be estimated in levels.[66] The VAR model will be estimated with two lags as the three information criteria, i.e. *AIC*, *SBIC* and *HQIC*, suggest two lags as the optimal number of lag. The Wald F-tests of lags exclusion assert the significance of the first lag at 1% and the second lag at 5% level of significant.[67]

The individual equations have high R^2 and R^2_{adj}, which reached more than 95% in all equations except inflation equation which was 70% and 58%, respectively. In addition, σ's were 0.01 and 0.16 in case of income and bank lending variables, respectively, however it was 0.04 and 0.05 for inflation and the monetary stance, respectively. Additionally, the diagnostic tests of the unrestricted-VAR model indicate that the model passed all of these tests. The unit root test proves that no root lies outside the unit root circle, $F_{ar(1-2)} = 1.749[0.06]$. The null hypothesis of no autocorrelation do not rejected, $F_{ar} = 13.009[0.67]$, and the null hypothesis of no heteroskedasticity do not rejected also, $F_{het} = 0.838[0.73]$. Also, the residual normality test shows that all variables do not suffer from skewness or excess kurtosis and the vector is also following the normality, $\chi^2_{nor}\,[8] = 6.201[0.62]$, and the model does not suffer from misspecification, $F_{reset} = 1.302[0.23]$.

Table 6.3 summarises the results of the Granger causality tests of the unrestricted VAR model. All variables jointly in the income equation cause the real GDP at 1%, although only the bank lending causes the real GDP separately at 1% level of significance, which reflects the importance of the bank lending channel in the Egyptian economy. Similarly, all variables cause inflation jointly at 5% level of significant, whereas only broad money causes inflation at 1% level of significance. Moreover, there is no variables cause the bank lending

[66] See Maddala (2001), Phillips (1991) and Sims (1980).
[67] The *F-test* statistics were 6.78 with *p-value* 0.000 in case of the first lag and 2.02 with *p-value* 0.034 in case of the second lag.

even at 10% level of significance. Finally, all variables jointly cause the real broad money at 1% , and only the real income causes it separately at 5% level of significant.

Table 6.3: Granger Causality of the Unrestricted VAR Model

Excluded Variables	y			Excluded Variables	inf		
	χ^2	df	$p-value$		χ^2	df	$p-value$
inf	2.584	2	0.274	y	1.275	2	0.528
$cred^P$	12.481	2	0.001*	$cred^P$	2.496	2	0.287
$m2$	2.1664	2	0.338	$m2$	11.443	2	0.003*
$Jointly$	26.508	6	0.000*	$Jointly$	13.032	6	0.042**
Excluded Variables	$cred^P$			Excluded Variables	$m2$		
	χ^2	df	$p-value$		χ^2	df	$p-value$
y	3.953	2	0.138	y	8.135	2	0.017**
inf	4.141	2	0.126	inf	4.117	2	0.127
$m2$	3.001	2	0.222	$cred^P$	4.532	2	0.103
$Jointly$	8.364	6	0.212	$Jointly$	30.497	6	0.000*

*, **, and *** are denoting rejection of the exclusion at the 1%, 5% and 10% significance levels.

Graphic analysis of the unrestricted-VAR model of the bank lending channel asserts that the model performs statistically well, figure 6.2. The actual and fitted values and the cross plot of actual and fitted values, panels I and II, confirm that all individual equations have a high goodness of fit. Although, the fitted values in the cases of income, credit, and monetary policy stance are closer to the actual values in comparing with inflation. This is reflected in the cross plot, panel II, where the income, credit, and monetary policy stance figures show, approximately, 45° lines. These results are supported by the scaled residuals; panel III, where the residuals are low, i.e. within ±2σ, and there are no outliers in all individual equations. Additionally, the panel IV asserts that the residuals are normally distributed for all individual equations. Additionally, the normality of errors asserts that the skewness and excess kurtosis problems are not coming out in the estimated bank lending channel's unrestricted-VAR model.

Figure 6.2: Graphic Analysis for the Unrestricted VAR Model

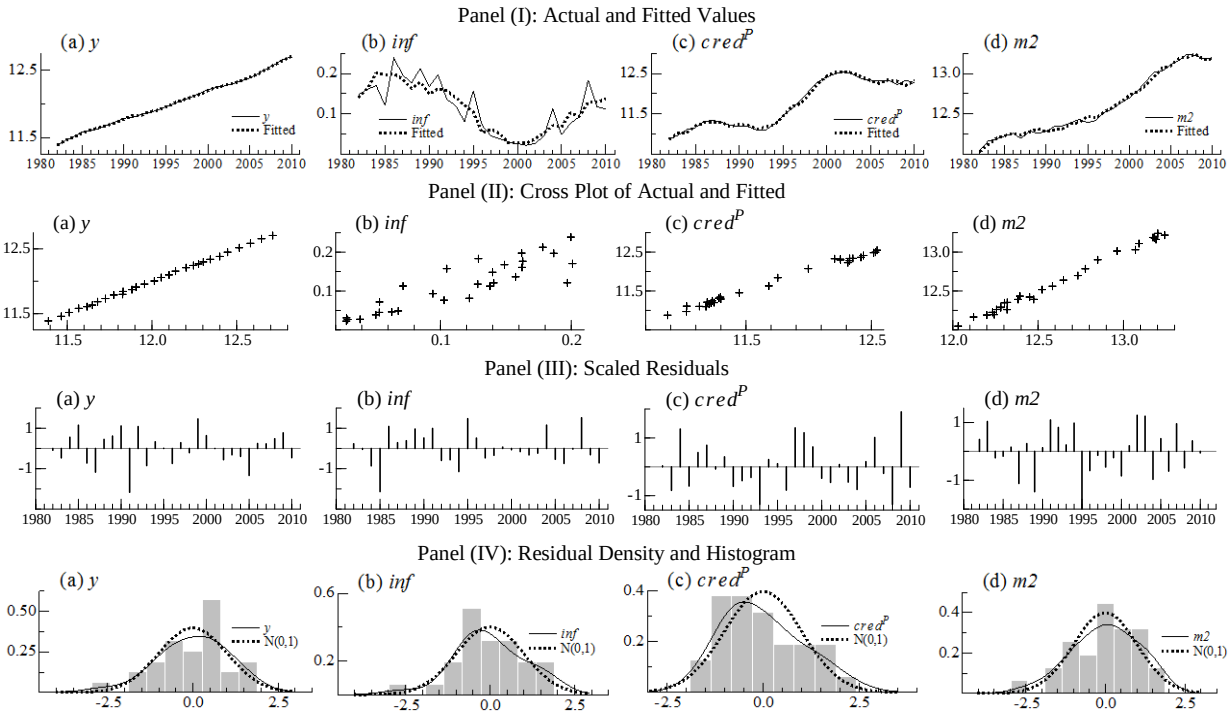
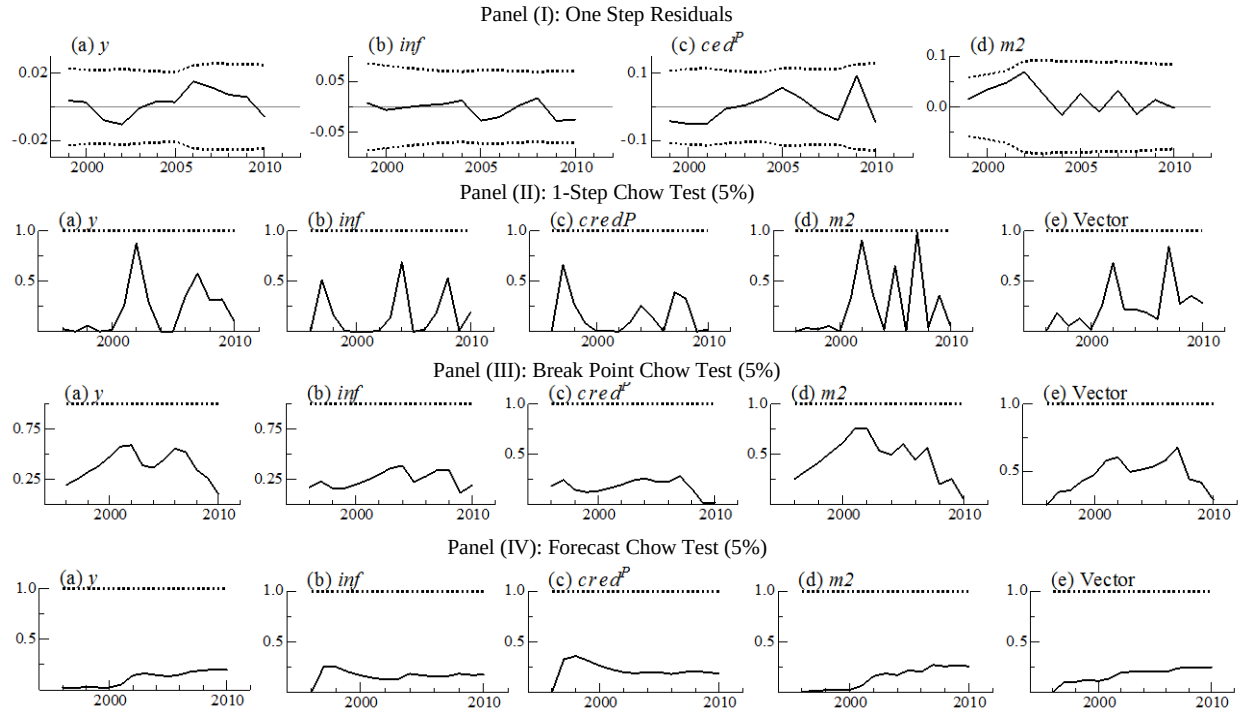


Figure 6.3: Recursive Analysis for the Unrestricted VAR Model



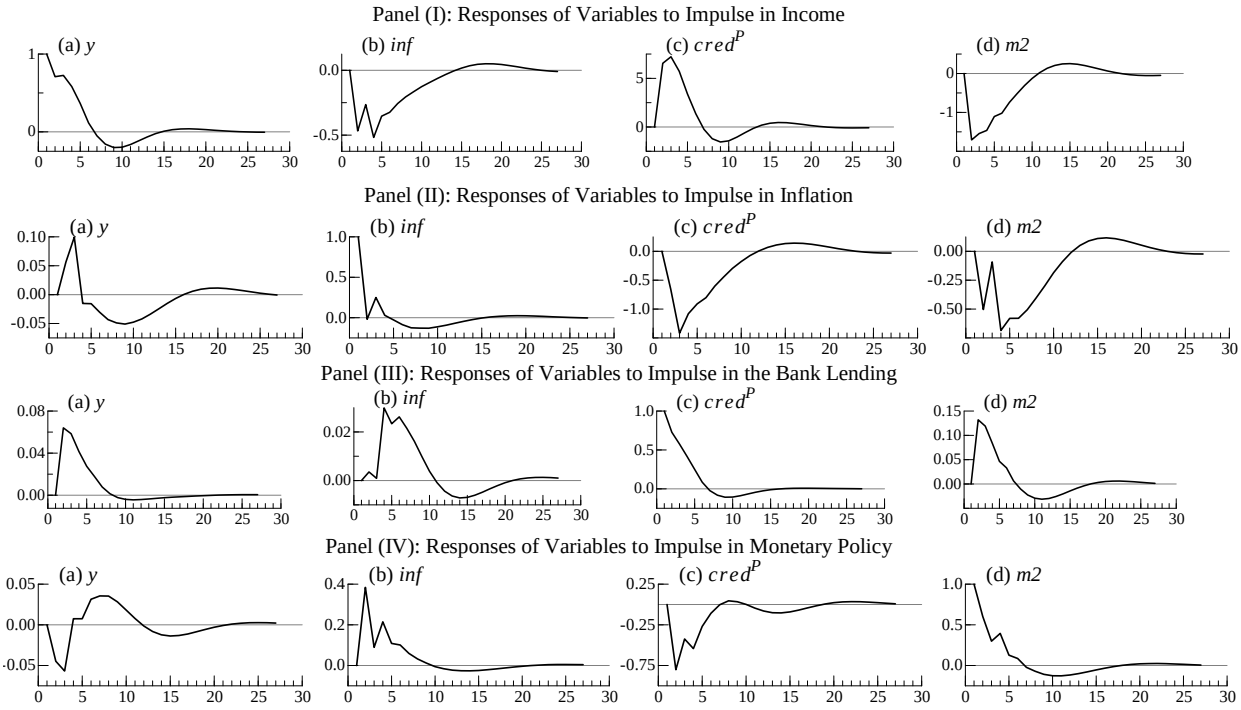
Recursive analysis gives an obvious evidence for the stability of the bank lending channel model at all individual equations and the vector, figure 6.3. The one-step residuals ±2σ, panel I, illustrates that all individual equations remained within a 5% confidence band. Also, the stability tests, i.e. *1-Step Chow-test*, *Break Point Chow-test* and *Forecast Chow-test*, show clear evidence of the stability of all individual equations and the vector, where there are no outliers at the 5% level of significance. These results of the estimated unrestricted-VAR model of the bank lending channel in Egyptian economy assert that the equations have remained constant over time.

The interrelationships among the bank lending channel's variables are discussed by using the impulse response function and variance decomposition. The impulse response fuction, based on Cholesky decomposition, is illustrated in figure 6.4. A shock in real income, panel I, equals one standard deviation will decrease the inflation rate by the half in the first five years, which describes the negative impact of increasing the real income on the inflation rate. Furthermore, an income shock will have a positive impact on the real bank lending to the private sector equals 7 times the income shock in the first three years, then the real bank lending will decline until it became zero after 7 years. Additionally, the real broad money will decline in the first two years then it starts to increase until it returns to zero after 10 years.

A shock in the inflation rate, panel II, will have a negative impact on real income, real credit, and real money. Although, the real income will return to zero after less than 5 years, but both credit and broad money will take about 10 years to return back to zero. Furthermore, a shock in real bank lending to the private sector, panel III, has a positive effect on the real income equals about 6% within the first two years. Moreover, this shock will affect positively other variables, i.e. inflation rate and broad money; however the impact of this shock on broad money is greater than its impact on inflation. Finally, a shock in broad money, panel IV, has a

positive impact on real income after 5 years. The effect of this shock on inflation rate is positive and is declining up to 10 years, while it is negative on the real bank lending to the private sector.

Figure 6.4: Impulse Response Function (Cholesky One SD Innovation)



In order to determine the relatively importance of every variable in influencing the other variables variance decomposition is used. Table 6.4 illustrates the contribution of each variable in the variance of other variables. The contribution of each variable in the variance of other variables is lasting for 15 years or more, which refers to the probability of the existence of the long-run, i.e. cointegration, relationship between the variables.

In the case of income, bank lending to the private sector is responsible for about 20% of the changes in income after 5 years, however this effect rises to 23% after 15 years, which reflects the importance of the bank lending in determining the level of income. Also, the impacts of broad money and inflation exist for up to 15 years, however the impact of the

broad money is the double of inflation impact. Moreover, the impact of income and credit on the inflation rate is, approximately, equal after 15 years, but the impact of the broad money is greater. Additionally, in the case of bank lending, both income and broad money have a small impact in the long run. In addition, the broad money is affected by income, inflation and cred in the long run as all of them share by more than 20% even after 15 years.

Table 6.4: Variance Decomposition of the Unrestricted VAR Model

Response Variable	Period	S.E.	Impulse Variable			
			y	inf	$cred^P$	$m2$
y	1	0.013	100	0	0	0
	2	0.018	80.07	1.60	18.33	0
	5	0.022	68.98	1.44	20.74	8.84
	10	0.030	63.23	4.80	18.78	13.19
	15	0.036	48.84	9.51	23.47	18.18
inf	1	0.041	1.20	98.80	0	0
	2	0.046	1.02	79.81	7.33	11.84
	5	0.051	3.07	66.86	11.00	19.08
	10	0.060	17.07	54.34	10.81	17.78
	15	0.068	16.18	47.04	16.42	20.35
$cred^P$	1	0.163	14.98	32.15	52.87	0
	2	0.231	7.50	35.35	53.18	3.97
	5	0.346	3.54	45.07	45.47	5.92
	10	0.379	3.56	43.71	43.89	8.84
	15	0.386	5.25	43.13	42.66	8.96
$m2$	1	0.047	1.54	0.24	37.37	60.85
	2	0.061	6.73	18.64	22.36	52.27
	5	0.091	32.26	28.55	10.48	28.71
	10	0.133	24.78	32.55	18.04	24.63
	15	0.156	30.44	25.50	20.30	23.77

Cholesky Ordering: y,inf,$cred^P$, and $m2$.

The Johansen's cointegration test is run in order to determine if the long-run relationship between variables exist, and if yes, it can be identified?. Table 6.5 presents the results of the Johansen's cointegration test and it asserts that there is one possible cointegration relationship among the VAR model's variables according to the *trace-test* and *max-test* at 1% level of significance. Therefore, a VECM will be used to identify this relationship.

Table 6.5: Cointegration Test of the Unrestricted VAR Model

Hypothesis		Eigenvalue	Trace-test		Max-test	
H_0	H_1		Statistic	*p-value*	Statistic	*p-value*
$r = 0$	$r > 0$	0.879	98.35	0.000*	57.06	0.000*
$r \leq 1$	$r > 1$	0.607	41.29	0.071	25.22	0.057
$r \leq 2$	$r > 2$	0.291	16.07	0.495	9.28	0.699
$r \leq 3$	$r > 3$	0.222	6.79	0.378	6.79	0.379

(*) denotes rejection of the null hypothesis at the 1% level of significance. The critical values are following MacKinnon *et al.* (1999).

A VECM is estimated with one cointegration vector in order to identify the long-run relationship, i.e. the bank lending channel. Identification of this vector depends on the theory, significance of parameters and Granger causality tests. According to the Granger causality tests, the monetary policy does not cause the real income, see table 6.3. Consequently, the cointegrated vector normalised to y, and the long-run coefficient of $m2$ imposed to zero. Furthermore, all speed of adjustment coefficients except this for y were imposed to zero because their coefficients were insignificant, which means there are no feedbacks from these variables. These restrictions identified the cointegrated vector where *LR-test* statistic is 5.165 [0.27]. The cointegrated vector is represented in table 6.6 and the speed of adjustment matrix is represented in table 6.7. Also, the speed of adjustment for the cointegrated vector is -0.389, which is plausible and at a reasonable level in a developing country like Egypt. This means that the disequilibrium in this system will be corrected after two years and half by the changes in inflation and the bank lending. Figure 6.5 illustrates the cointegrated vector of the bank lending channel.

Table 6.6: Identified Cointegration Vector (Long-Run Coefficients)

$\widehat{\boldsymbol{\beta}}'$	y_{t-1}	inf_{t-1}	$cred^{P}_{t-1}$	$m2_{t-1}$	$Trend$	$Intercept$
	1	-1.207 (0.243])	-0.035 (0.016)	0	-0.050 (0.002)	-10.397

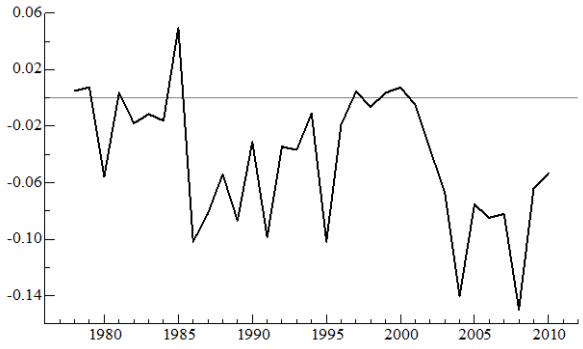
Standard errors values are in ( ).

Table 6.7: Loading Matrix (The Speed of Adjustment)

	$\hat{\alpha}$
y_{t-1}	-0.389 (0.081)
inf_{t-1}	0
$Cred_{t-1}$	0
$m2_{t-1}$	0

Standard errors values are in ( ).

Figure 6.5: The Cointegrated Vector of the Bank Lending Channel



Equation (6.1) is the long-run relationship between the variables. This equation describes the equilibrium in the goods and services market under the IS-LM model. According to this model the equilibrium in goods and services market is summarised in IS curve, Investment-Savings, which describes the interaction between income, the interest rate, savings and investment. Mainly, the savings volume is a direct function in income, where an increase in income will raise the savings level. However, investment is a reverse function in the interest rate, as an increase in the interest rate will decline the level of investment, because the marginal efficiency of capital of the new investment should be equal to or more than the new higher interest rate to encourage investors to invest in these new projects. In equilibrium investment is equal to savings, and this will derive the IS curve, which, in turn, gives the

combinations of the income and the interest rate which are compatible with investment-savings equilibrium. The forces of demand, i.e. investment, and supply, i.e. savings, will determine the equilibrium in this market, therefore the bank lending, i.e. credit, will be determined at its equilibrium level. This level of credit will describe the interaction between investment and savings. So that an increase in bank lending will combine with a higher level of income, because if this increase in credit means an increase in investment, this will be a new injection to income, which will increase savings as it is a positive function in income.

Equation (6.1) satisfies the previous analysis as the relationship between, $cred^P$, which describes the investment-savings equilibrium, and y is positive and significant. In addition, this result asserts the existence of the bank lending channel in Egypt during the study period. However, the positive effect of inflation on the real income can return to the expectation channel which is out of the limits of this thesis.

$$\underset{(SE)}{y_t} = 10.397 + \underset{(0.243)}{1.207}\ inf + \underset{(0.016)}{0.035}\ cred^P + \underset{(0.002)}{0.050}\ Trend \qquad (6.1)$$

This identified cointegrated-VAR, VECM, raises the long-run weak exogeneity issue as the variables' coefficients of speed of adjustment are imposed to zero except this for the real income. The weak exogeneity are discussed in a large number of academic research, like Engle *et al.* (1983), Ericsson (1992), Ericsson *et al.* (1998), Hendry (1995), Johansen (1992), Juselius (2009), and Urbain (1992).The exclusion test for these coefficients, i.e. *LR-test* statistic is 5.165 [0.27], confirms the exogeneity of inf, $cred^P$, and $m2$ in the estimated system, which means that those variables do not correct to the cointegrating vector as their level are exogenous and are determined outside the system.

The cointegrated-VAR system can be reduced and represented by a single equation as long as all variables are exogenous in the real income equation. The cointegrated vector, i.e. equation (6.1) is represented by $\beta' X_{t-1}$, where β' is the long-run coefficients matrix and X_{t-1} is a vector of variables. The term ECM_{t-1} is used as equivalent to $\beta' X_{t-1}$, where equation (6.2) represents the bank lending channel as an error-correction mechanism equation. According to (6.2), the long-run relationship, i.e. the bank lending channel, among variables exists, as ECM_{t-1} is statistically significant and its speed of adjustment is -0.192, which means the disequilibrium will be corrected within 5 years. Finally, this model does not have any statistical problem and it is well specified.

$$\begin{matrix} \Delta y_t = 0.035 + 0.337\Delta y_{t-1} - 0.087\ \Delta inf_{t-1} + 0.072\Delta cred^{P}_{t-1} - 0.192\ ECM_{t-1} \\ \quad [4.84] \quad [2.42] \qquad [-1.48] \qquad [4.84] \qquad [-3.17] \end{matrix} \tag{6.2}$$

$R^2 = 0.530 \quad R^2_{adj} = 0.460 \quad RSS = 0.005 \quad \sigma = 0.019 \quad F = 7.622[0.00]$
$F_{ar}\,[2,25] = 0.188[0.83] \quad F_{arch}\,[1,30] = 0.139[0.71] \quad F_{het}\,[8,23] = 0.473[0.86]$
$\chi^2_{nor}\,[2] = 1.881[0.39] \quad F_{reset}\,[2,25] = 0.549[0.58]$

6.6. Summary of Results

This capter provides a well robust estimated VECM model for the bank lending channel in Egypt from 1975 to 2010. This model does not suffer from any statistical problems, as the errors are not correlated or heteroskedastic. Also, the errors follow the normal distribution and the model is well specified. In addition, the model passed all stability tests. Furthermore, the actual and fitted values of real GDP, according to the estimated cointegrated VAR model, are depicted in figure 6.6.

Figure 6.6: Actual and Fitted Values of the Income Vector

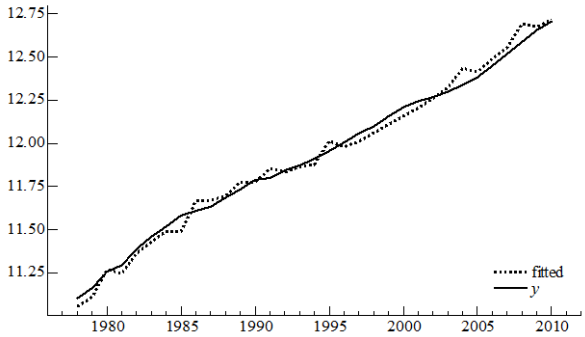
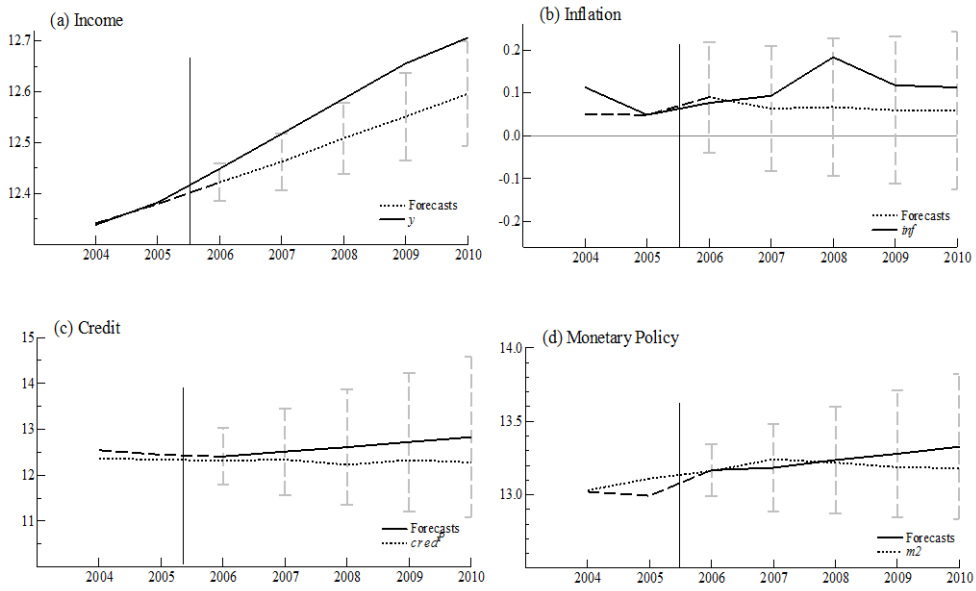


Figure 6.7 illustrates the in-sample forecasts of the cointegrated VAR variables with two standard deviations as the error bands. This figure confirms the ability of the estimated model to provide good forecasts for the variables, as all variables actual values within the error bands up to 5 years except the real income, which is in those bands up to three years. Moreover, the forecasts of the bank lending and the monetary policy variables are better than those for real income and inflation, because the forecasting errors are small in former variables. Consequently, using this model for forecasting purpose will provide reasonable results.

The estimated model shows the role of the bank lending in the Egyptian Economy during the last four decades. The positive effect of the bank lending to the private sector on the real income is significant. The long-run relationship between the bank lending channel's variables will be corrected if the disequilibrium occurred within two years and half as the speed of adjustment is equal to 39%. Moreover, according to the results of Chapter 3 and Chapter 4, it is expected that the role of the bank lending channel in affecting the real income comes from the effect of the bank lending on the consumers' expenditure and the private investment expenditure.

Figure 6.7: In-Sample Forecasts of the Model's Variables



There are some reasons that affected the bank lending channel negatively, which, in turn, reflected in the limited effect of this channel in Egypt. One of these reasons is the heavy intervention of the government in the credit decision especially before applying the ERSAP, that began in 1991, see Noureldin (2005). Also, the crowding out effect of financing the government budget deficit is expected to affect the bank lending channel performance (Abdel-Kader, 2006; Abdelkader, 2004; Al-Mashat and Billmeier, 2007; Noureldin, 2005). The previous situation can occur as a result of the high share of the public ownership of banks (Égert and MacDonald, 2006; Ehrmann *et al.*, 2001) as in the case of Egypt.

Other factors like the NPLs crisis in the late 1990s and early 2000s could affect the importance of the bank lending channel. This NPLs crisis was resulted in decreasing the credit to the private sector and investing more in government bonds by banks (Abdel-Kader, 2006; Boughrara, 2008b; Noureldin, 2005). The concentration in the Egyptian banking credit market may also affect the channel[68], which could explain why the bank lending channel in Egypt is

[68] For detail about this problem see Adams and Amel (2005) and Égert and MacDonald (2006).

limited. Unfortunately, these reasons required such data that are not provided by the governmental sources in Egypt.

6.7. Conclusion

The credit channel, including the bank lending channel, has been the focus of recent research in the developing countries like Egypt. In contrast, the number and the quality of these studies in the case of Egypt raised a challenge due to the problem of a developing country and the lack of data. Thus, it is important to try to fill a part of this gap. This chapter accompanies the previous one in order to put together the main channels of the MTM in Egypt. Furthermore, it provides reasonable and plausible results that can be used by policy makers in the government, like the CBE, when the economic policy is undertaken at the macroeconomic level.

This chapter answered the key questions, *Does the bank lending channel exist in Egypt between 1975 and 2010 or not?*, and if it does exist, *Is the long-run relationship of this channel identifiable or not?*. These two questions are answered by the estimated VECM. The results confirm the existence of the bank lending channel, although it has a limited effect. Additionally, this proposed model performs well theoretically, in general, and econometrically. The diagnostic tests and recursive analysis support the stability of the estimated system. Moreover, the forecasting power of the model is relatively high.

However, this chapter and the previous one, the interest rate channel, capture a big portion of the MTM framework in Egypt, but there is another channel should be added to complete the building of this framework. This channel that is needed to be estimated for the Egyptian economy is the exchange rate channel. This will be the last block of the building of this thesis, since the next chapter will be devoted totally for this purpose.

CHAPTER 7 : ESTIMATING THE EXCHANGE RATE CHANNEL WITH THE REGIME SHIFT IN EGYPT

7.1. Introduction

One of the main cornerstones in the transmission mechanism of monetary policy is the exchange rate channel. The exchange rate channel has attracted many economists to investigate it and how it works. However, the role of this channel differs in developing countries from its role in developed countries, but it is important in many countries in these two different groups. This importance depends, in part, on the degree of openness for a country in terms of trade and capital mobilisation. The exchange rate pass-through, which represents how the changes in the exchange rate is reflected in the level of prices, plays a chief role in developing countries, which depend on imports to cover its needs from necessary goods like foods and inputs of industry.

A large number of studies have investigated this channel in developed countries, but the number looking at developing countries is still small. Additionally, in the case of Egypt these studies are rare and cover a short time span. This chapter will complete the final link of the transmission mechanism by the exchange rate channel, in Egypt. This chapter covers a very rich time period of economic changes and reforms in the Egyptian economy.

The investigation of the exchange rate channel will try to test how the exchange rate affects the macroeconomic conditions in the Egyptian economy in the period of study. Not only will the short-run analysis be discussed here but also the analysis of the long-run will take place. Consequently, the VAR approach is used as the first step, and then it developed to

end up with a restricted (cointegrated) VAR model based on cointegration analysis following Johansen's approach. The cointegrated-VAR will be used to check the short- and long-run effect of the exchange rate channel in the Egyptian economy. Recursive analysis is used to check the stability of the coefficients in the estimated model. Additionally, the cointegration relationship was determined and identified.

The main questions that this chapter tries to answer are, *Does the exchange rate channel exist in Egypt during the period of study*? if so, *Is the long-run relationship of this channel identifiable*?. To achieve this goal, this chapter is divided into sections. The next two sections discuss the literature on the exchange rate channel and previous empirical studies, respectively. The following sections present the econometric methodology, the data and the econometric model. This is followed by the summary of results and the final section presents the conclusion.

7.2. Exchange Rate Channel in the Literatures

Beside the interest rate channel and the credit channel, there are other channels like the exchange rate and the asset price channels. The role of exchange rate channel starts from its link with monetary shocks, mainly through decisions of the central bank. These monetary shocks on the exchange rates can be divided, according the final effects, into changes in the prices levels, increases in trade volume and fluctuations in the investment. The first sub-channel describes the impact of short-term interest rates on the exchange rate. The second sub-channel, i.e. the exchange rate pass-through, illustrates the transmission from exchange rate to imports and domestic prices which, in turn, will be reflected in alteration in the main variables like trade volume and investment (Égert and MacDonald, 2006).

The real exchange rate is normally affected by price level fluctuations in the floating exchange rate regime compared with the fixed exchange rate regime (Mussa, 1986). Relative prices may not respond to real shocks when price stickiness exists even under a flexible exchange rate regime. The required adjustment in relative prices can be achieved, even if price stickiness exists, if the prices are sticky in the producers' currency. However, this will not occur if the prices are sticky in the consumers' currency (Engel, 2002).

Mishkin (1995) summarized the exchange rate channel in two steps. The first step is the connection between the interest rate and exchange rate and the second one being the relation between the exchange rate and output. The mechanism which the exchange rate channel can work starts from an increase of interest rate as a result of a monetary shock, then, normally, the domestic deposits denominated in domestic currency become more preferable than deposits denominated in foreign currencies. Hence, there is an appreciation in the domestic currency exists, so the cost of exports goes up and the net export decline. Finally, as long as net export is a part of output, then a decline in output will be expected.

Égert and MacDonald (2006) pointed out that the monetary authority not only can affect the exchange rate indirectly through short-term interest rate changes, but also the authority can affect the exchange rate directly through the direct intervention in the foreign exchange market. In addition, the transmission process from the exchange rate to consumer prices can take two directions. Firstly, directly from the exchange rate to consumer prices through imports prices or indirectly when imports prices affect producer prices (in the case of imported intermediate goods), then reflected on consumer prices (Égert and MacDonald, 2006).

7.2.1. The Exchange Rate Pass-Through

The exchange rate pass-through expresses the effects of exchange rate changes on imports and exports prices, consumption prices, investment and trade volume (Darvas, 2001). The VAR approach was used in many studies to estimate the exchange rate pass-through. McCarthy (1999) used this approach with 6 equations, and he begins with oil price inflation, P_t^{Oil}, (7.1), goes through output gap, $\tilde{y}_t$, (7.2), exchange rate movements, e_t, (7.3), imports prices inflation, P_t^{import}, (7.4), then producer prices inflation, P_t^{PPI}, (7.5), and ends up with consumer prices inflation, P_t^{CPI}, (7.6), where ε_t is the error term in each equation. This model can be summarized as follow:

$$\Delta p_t^{oil} = E_{t-1}\left(\Delta p_t^{oil}\right) + \varepsilon_t^s \tag{7.1}$$

$$\tilde{y}_t = E_{t-1}\left(\tilde{y}_t\right) + \beta_{11}\varepsilon_t^s + \varepsilon_t^d \tag{7.2}$$

$$\Delta e_t = E_{t-1}\left(\Delta e_t\right) + \beta_{21}\varepsilon_t^s + \beta_{22}\varepsilon_t^d + \varepsilon_t^e \tag{7.3}$$

$$\Delta p_t^{import} = E_{t-1}\left(\Delta p_t^{import}\right) + \beta_{31}\varepsilon_t^s + \beta_{32}\varepsilon_t^d + \beta_{33}\varepsilon_t^e + \varepsilon_t^{import} \tag{7.4}$$

$$\Delta p_t^{PPI} = E_{t-1}\left(\Delta p_t^{PPI}\right) + \beta_{41}\varepsilon_t^s + \beta_{42}\varepsilon_t^d + \beta_{43}\varepsilon_t^e + \beta_{44}\varepsilon_t^{import} + \varepsilon_t^{PPI} \tag{7.5}$$

$$\Delta p_t^{CPI} = E_{t-1}\left(\Delta p_t^{CPI}\right) + \beta_{51}\varepsilon_t^s + \beta_{52}\varepsilon_t^d + \beta_{53}\varepsilon_t^e + \beta_{54}\varepsilon_t^{import} + \beta_{55}\varepsilon_t^{CPI} \tag{7.6}$$

The exchange rate pass-through coefficient value depends, beside other influences, on the pricing policy of the importing firms. According to this, when the importing firms adopt a producer currency pricing policy, *PCP*, then changes in the exchange rate will be transmitted onto prices and the exchange rate pass-through coefficient will be complete, i.e. equal one (Égert and MacDonald, 2006). But, if the other policy is adopted, i.e. local currency pricing[69],

[69] Also it can be called consumer currency pricing, *CCP*.

LCP, alterations in exchange rate will not be reflected completely in domestic prices and the exchange rate pass-through can be, approximately, equal zero (Égert and MacDonald, 2006). Also, the behaviour of importing firms will differ depending on the pricing policy. Under *PCP*, firms almost prefer to alter labour and output level in order to face the changes in local prices, but if the firms adopt *LCP*, then they will be able to modify their profit level, i.e. mark up, in response to the alteration in the exchange rate (Égert and MacDonald, 2006).

Changes in productivity or relative wages are essential to avoid the dramatic fluctuations in tradable goods between two countries, when the appreciation of exchange rate happened in one of these countries (Goldberg and Knetter, 1997). The labour market adjustments, which are driven by exchange rate fluctuations, play a real significant role on domestic prices with a delay of at least three years or more. In addition, this can be explained as short-run quantities (employment or unemployment) react to these fluctuations but in the long run wages begin to react (Jakab and Kovács, 2003).

Mihailov (2009) claims that under monetary uncertainty and nominal rigidities the wide range use of the local currency pricing in the bilateral trade decreases the pass-through from exchange rates to imports and consumer prices. Conversely, the pass-through will be stronger when the producer currency pricing approach is in use (Mihailov, 2005).

Exchange rate volatility can decrease the pass-through when importers adjust their profit margins as a remedy for risks they expected from prices changing (McCarthy, 1999). Furthermore, the same impact on pass-through will happen in the case of more volatile aggregate demand in imperfectly competitive markets after exchange rate fluctuations (McCarthy, 1999).

Burstein *et al.* (2004b) suggest not slow adjustments in imports or exports prices but rather slow adjustments in non-tradable goods and services prices are the major cause of large

declines in the real exchange rate. Also, exchange rate pass-through for non-tradable goods prices is lower than for tradable goods prices (Burstein *et al.*, 2004a). Campa and Goldberg (2002) argue that monetary policy will deal with real shocks more effective if the import prices pass-through is low[70] but if pass-through is endogenous then the effectiveness of the policy will be less than in the previous case.

7.2.2. Exchange Rate and Trade

If any movement in the exchange rate, far away from equilibrium level, occurs, then this will result in the deterioration of the trade balance of the balance of payments. If for example there is a depreciation (appreciation) of the exchange rate that leads to a rise (decline) in exports and a decline (rise) in imports which finally reflected in a surplus (deficit) in the trade balance. For the previous analysis to be correct, the *Marshal Lerner* condition needs to exist. The *Marshal Lerner* condition[71] depends on full import prices pass-through (in local currency) and zero export prices pass-through (in foreign currency). If any of these two conditions of pass-through do not exist then the *Marshal Lerner* condition will not work (Égert and MacDonald, 2006).

The impact of exchange rate volatility on international trade flows was summarised by McKenzie (1999). The major factors of his research were as follow:

- *Risk aversion and risk neutrality*: a decline of the trade volume can happen as a consequence of the risk aversion of commodity traders' decisions when unexpected changes in exchange rates occur. Additionally, a reduction of the trade volume can occur when competitive firms, that are risk neutrality, face

[70] This means, in turn, lower expenditure switching effects of the monetary authority policy, which comes from nominal exchange rate fluctuations (Campa and Goldberg, 2002).
[71] *Marshal Lerner* condition is the case when the sum of the prices elasticity of exports and imports demanded is greater than unity.

the case of uncertainty about output prices and demand which are caused by exchange rate volatility or risk, which leads to a decline in investment after that fall in production and trade volume.

- *The nature of the trader*: multinational firms that work in foreign markets have monopoly power. Thus, when the production falls in the foreign country, e.g. the exchange rate uncertainty increased when exchange risk cannot be diversable, the multinational firms can make no changes in their plans about investment and labour demand in a foreign country if the foreign currency forward markets in this country are active and accessible.

- *Capital markets*: in competitive markets, any increase in exchange rate volatility diminishes imports and exports when forward markets do not exist.

7.2.3. Exchange Rate and Investment

Carranza *et al.* (2009) investigate the pass-through from the exchange rate into inflation, taking into account the balance-sheet effect. They argue that the existence of the balance-sheet effect in an economy is decreasing the inflation pass-through which happens as a consequence of exchange rate depreciation. Moreover, the negative balance-sheet effect on pass-through is more significant in highly dollarized economies. Furthermore, the large scale depreciation may be in line with a high negative balance-sheet effect which, in turn, results in a reduction in a firm's net worth so that the firm's investment will decline (Carranza *et al.*, 2009).

Burstein *et al.* (2004b) assume that pass-through to investment is likely to be higher than pass-through to prices of consumer goods as imported investment goods are considered

of higher importance than imported consumption goods. Both import component and exports share of production of each sector in an economy play significant roles in specifying the impact of the exchange rate in sectoral investment (Campa and Goldberg, 1998). For instance, the investment is affected by the changes in total production costs which are resulted from the exchange rate fluctuations. Campa and Goldberg (1998) pointed out that a depreciation of the domestic currency will rise the imported input costs and decreasing the marginal profitability of capital, so that the investment will decrease. Furthermore, if the exports share of sectrol production is high, then the investment will increase as long as the exchange rate appreciated (Campa and Goldberg, 1998).

7.3. Exchange Rate Channel's Empirical Studies

This section surveys the empirical studies of the exchange rate channel in Egypt and other countries. This section is divided into two sub-sections: the first discusses the evidence of the exchange rate channel in the Egyptian economy, while the other section summarises the results of some studies for other countries, mainly developing countries.

7.3.1. Evidence in Egypt

Rabanal (2005) used a VAR model[72] to test the dynamic relationship between the nominal exchange rate and prices (i.e. consumer price index, *CPI*, producer price index, *PPI*, and wholesale price index, *WPI*) in the Egyptian economy during the period of changing the exchange rate regime. He distinguished between the level and the speed of exchange rate pass-through. The pass-through level at horizon *J* is defined as "*the ratio of cumulative responses of the price level and the exchange rate j periods after the exchange rate shock*".

[72] This study used five variables and these variables are: oil price, output, nominal exchange rate, wholesale price index or producer price index if available and consumer price index.

Furthermore, Rabanal (2005, p.5) defined the speed of the exchange rate pass-through as "*the time it takes for the exchange rate shock to build up in the system, and is calculated as the ratio of the pass-through coefficient at horizon j over the long-run pass through coefficient*".

There were two major findings of Rabanal (2005). Firstly, the pass-through from the exchange rate to the WPI was between 30% and 60% and significant. Conversely, the pass-through from the exchange rate to CPI was low, between 6% and 27%, and insignificant (Rabanal, 2005). Secondly, the exchange rate pass-through in the case of Egypt was low and slow especially with the CPI. It took approximately 12 to 24 months to see an effect, which was also insignificant, but with WPI we just need between 6 to 12 months to note a significant effect on WPI. Rabanal (2005) pointed out that insignificant and weak relationship between exchange rate shocks and the CPI dues to the large share of administrated prices goods in the CPI. In addition, there is a possible reason for biases in this model as a result of changing the exchange rate regime.

The exchange rate shock decreases prices (during first 3 quarters) and resulted in a fall in the interest rate in Egypt (Neaime, 2008). The monetary authority (i.e. the CBE) tried to decrease the pressure of high interest rates on GDP and the currency. Also, the transmission of the interest rate shock extents through the exchange rate channel. Finally, the importance of the exchange rate channel in Egypt is noticeable (Neaime, 2008).

After applying the VAR model for the period extents from 1997 to 2007 in Egypt, Boughrara (2008a, b) finds that the exchange rate channel operates in Egypt and the exchange rate has a significant effect on WPI and stock prices.

The results of Al-Mashat and Billmeier (2007) study suggest that the exchange rate channel in Egypt is an important channel and is very significant, especially because it plays the major role in MTM. Additionally, as a result of deposit rate shock, e.g. a monetary easing,

the active exchange rate channel can double or triple the magnitude of price response when there is a significant impact of currency depreciation on imports prices (Al-Mashat and Billmeier, 2007). Furthermore, if the currency depreciation switched expenditure toward domestic goods, this will lead to a fall in output because there is a big share of imported inputs comes from abroad (Al-Mashat and Billmeier, 2007). The empirical evidence for the previous approach is the fall of investment and intermediate imports in the late of 1990s after the CBE applied a monetary easing (Al-Mashat and Billmeier, 2007).

7.3.2. Evidence from Other Countries

The unexpected contractionary monetary policy resulted in an appreciation of the Indian currency value by 0.5% leading to an output decline by about 0.4% (Al-Mashat, 2003). Once a positive aggregate supply shock takes place the real value of the currency appreciated by 1% (Al-Mashat, 2003). Accordingly, the exchange rate channel exists and takes a special position inside the MTM in Indian economy.

The exchange rate channel in Armenia is strong and has a significant impact on the price level as in the majority of countries which have a high degree of dollarization (Dabla-Norris and Floerkemeier, 2006). Additionally, the exchange rate channel in Vietnam has an important role in the monetary transmission mechanism as exchange rate shocks have accounted for approximately 26% of fluctuations in output in the time which money supply accounted for only 21% of changes in output level (Hung and Pfau, 2009). Moreover, the exchange rate channel has a significant and strong effect on the transmission of monetary contraction to macroeconomic variables in the Czech Republic (Arnoštová and Hurník, 2005).

Baqir (2002) asserts that the exchange rate channel effect in Thailand is not clear and within two years and half less than 10% of changes in real output accounts for real exchange

rate fluctuations. Also, Hesse (2007) argues that during the period from 1993 to 1994 (i.e. pre Asian crisis) the channel from monetary shocks to the exchange rate does not exist in Thailand. In addition, the exchange rate channel does not work in Jordan and the fluctuations in the real effective exchange rate have tiny effects on GDP (Poddar *et al.*, 2006) .

Besimi *et al.* (2006) refer to a high exchange rate pass-through, approximately 40%, between the Macedonian denar and euro. Furthermore, the negative effect of currency substitution on the price level and this effect is about 42% (Besimi *et al.*, 2006). Also, the exchange rate to prices pass-through is strong in Belarus but interest rate policy to market rate pass-through is weak (Horvath and Maino, 2006). In addition, the exchange rate pass-through to inflation is positive and statistically significant but still low in Georgia, and the impact of lending rate on prices is significant (Samkharadze, 2008).

7.4. Econometric Methodology

The methodology in this chapter is same as that employed in Chapter 5. However, some econometric issues will be discussed in this section, which are related to the estimated model. There are three main issues will be addressed here. Firstly, outliers and its types, and its relationship with structural breaks, i.e. regime shifts. Also, how dummy variables can be used as a remedy of a structural break in estimating an econometric model. Secondly, the effect of a structural break on unit root tests results. Finally, the impact of including a dummy variable in an estimated model on the result of Johansen cointegration test.

7.4.1. Outliers, Structural Breaks, and Dummy Variables

Fox (1972) asserted that the existence of outliers will not affect only a particular observation, but it will affect subsequent observations. He distinguishes between two different

types of outliers. Type I is the Additive Outlier (*AO*) which results from a gross error of observation or recording error affecting a single observation. Type II is the Innovational Outlier (*IO*) results from a single extreme innovation (Fox, 1972).

However, an outlier is defined as an observation with a large residual, but automatic exclusion of this observation not always the recommended procedure. The exclusion can be a suitable solution if this outlier occurred by, for example, errors of observation process or recording. Whereas, in case that the outlier represents an unusual situation that requires more investigation, i.e. it provides special information that other observation cannot capture it, and then the exclusion is not the wise selection.

The presence of outliers in an autoregressive model will have different effects depending on the type of this outlier. However, innovational outliers, which are produced by a shock to the innovation term of a data generating process (DGP), are propagated through the autoregressive structure of the estimated model can have effect on this model, but additive outliers, which are superimposed on the level of data, are independent from autoregressive parameters (Nielsen, 2004, p.294).

Assuming constant, i.e. stable, parameters in estimated models in practice may not exist for many macroeconomic variables. The long-time series may contain structural breaks, according to extreme conditions like wars or changes in the government policy. Hendry and Nielsen (2007) argue the structural break will shift means and variances of time series, which, in turn, is reflected in non-stationarity and unit roots problems. The structural break, which comes from intensive intervention or reform, can violate the normality assumption (Juselius, 2009).

Hendry (1995) asserts that dummy variables, like impulse or step dummies, can be used in econometric models in cases of parameter non-constancy. Hendry (1995) refers to the

policy regime shift which diminishes the efficiency of a constant parameterisation to describe accurately the data behaviour, under a regime shift. Thus, dummies[73] are included to the econometric models in order to provide a stable system. Some events like financial crisis or oil crisis are not known in advance, so that its dummies may reflect endogenous response. Additionally, policy changes are endogenously response to the economy conditions.

The intervention variables, which are dummies or indicator variables, are included in an estimated model in order to deal with outlying observations and structural breaks (Koopman *et al.*, 2009). Impulse dummies are used to capture the effect of outliers, whereas step dummies are suitable for the structural break which is resulted from a change in policy (Koopman *et al.*, 2009). Additionally, the structural break in the slope can be treated by a staircase intervention, which is a trend variable that takes values 1,2,3,... starting in the next period after the break (Koopman *et al.*, 2009, p.68).

7.4.2. Unit Root Tests and Structural Breaks

Enders (1995) points out that the existence of structural change[74] in a time series variable may lead to non-rejection of the null hypothesis of the unit root test, i.e. the series has a unit root. This because, the unit root tests will be biased in such circumstances (Enders, 1995).

[73] Dummy variables are artificial variables which often called indicator variables; as they indicate the presence of some states (Doornik and Hendry, 2009b). Nevertheless, there are many different types of dummies; three of them are common, i.e. constant, trend and seasonal indicator variable. Also, the constant do not vary and indicates the constant state, but the seasonal indicator variable refers to a seasonal effect (Doornik and Hendry, 2009b). Juselius (2009) discussed another three types of dummies that are common in empirical studies. These dummies are: D_S the mean-shift dummy $(\dots,0,0,0,1,1,1,\dots)$, D_P the permanent intervention dummy $(\dots,0,0,1,0,0,\dots)$, and D_T the transitory shock dummy $(\dots,0,0,1,-1,0,0,\dots)$. All the previous dummies are in levels, but in case of differences their form will transfer into: ΔD_S becomes a permanent intervention dummy $(\dots,0,0,1,0,0,\dots)$, ΔD_P becomes a transitory blip dummy $(\dots,0,0,1,-1,0,0,\dots)$, and ΔD_T becomes a double transitory blip dummy $(\dots,0,0,1,-2,1,0,0,\dots)$. Additionally, however, the sum of these dummies in differences will give the level values of these dummies, but the sum of levels will give the following: $\sum D_S$ will be a trend $(\dots,0,0,0,1,2,3,\dots)$, $\sum D_P$ will be a mean-shift dummy $(\dots,0,0,0,1,1,1,\dots)$, $\sum D_T$ will become a permanent intervention dummy $(\dots,0,0,0,1,0,0,\dots)$, and $\sum D_{DT}$, i.e. the double transitory blip dummy, will transfer to a transitory dummy $(\dots,0,0,1,-1,0,0,\dots)$.

[74] There are many synonyms of this expression like: structural break and policy regime shift.

Nelson and Plosser (1982) examined long historical macroeconomic time series variables of USA in order to determine if the variables are stationary around a deterministic trend or if they are non-stationary.[75] The hypothesis of unit root in these time series variables[76] was not rejected. Nelson and Plosser (1982) concluded that almost macroeconomic time series suffer from non-stationarity, i.e. have unit roots.

Perron (1989) tested the macroeconomic time series variables of Nelson and Plosser (1982), under the null hypothesis of a unit root against the alternative hypothesis of a series is trend-stationarity. Perron (1989) allows for both null and alternative hypotheses to have a dummy variable, which represents a one-time change in level or in the slope of the trend function. He found that under the standard tests of unit roots, like the *DF-test* and *ADF-test*, we cannot reject the null hypothesis of a unit root if a series is trend-stationary with a structural break. However, repeating the unit root test with dummy variable for the 1929 Great Recession, the tests of 11 out of 14 variables of Nelson and Plosser (1982) were found to be stationarity. Perron (1989) tests the post-war quarterly real GNP with dummy variable of 1973 oil price shock, and he rejects the null hypothesis of unit root. Contrast to Nelson and Plosser (1982), Perron concludes that most macroeconomic variables do not possess a unit root, but are stationary around a deterministic trend.

The exogenously determined time of the structural break, which it is used in Perron (1989), was criticized by Christiano (1992). Endogenously determining the break date was proposed by Banerjee *et al.* (1992), Perron and Vogelsang (1992), Zivot and Andrews (1992), and Perron (1989).

[75] Many studies used Nelson and Plosser (1982) data, like Stulz and Wasserfallen (1985), Wasserfallen (1986), Perron (1989), Zivot and Andrews (1992), Lumsdaine and Papell (1997) and Lee and Strazicich (2003).

[76] Nelson and Plosser (1982) used an unobserved components model to decompose fluctuations in output into growth component and cyclical component. They found that real disturbance have a high share in the fluctuations in the observed output. However, the monetary disturbances, i.e. pure transitory fluctuations, may fail in interpreting a large fraction of output fluctuations.

Banerjee *et al.* (1992) used a recursive test to determine the structural break date. They used a non-sequential test with sub-samples in order to determine the number of breaks, which could affect the power of tests as this test does not use the full information. However, Zivot and Andrews (1992) used a sequential test to determine all possible endogenous structural breaks under the full sample. The difference between critical values of Perron (1989) and Zivot and Andrews (1992) were due to the procedure of determining the break times, i.e. exogenously or endogenously.

Perron and Vogelsang (1992) present two different test statistics for unit roots. The first test is the Additive Outlier (*AO*), which is suitable for a sudden change in mean, and the second one is the Innovational Outlier (*IO*), which is suitable for a gradual change. Perron and Vogelsang (1992) used the minimal value of the *t*-statistic on the sum of the autoregressive coefficient over all possible breakpoints. Additionally, Perron and Vogelsang (1992) applied these two tests for non-trending series, while Perron (1997) used them for trending series. Perron (1997) referred to the trade-off between the power of the test and the information incorporated with respecting to determine the time of the structural change.

Ben-David *et al.* (2003) examined a unit root test which allows for two endogenously determined structural breaks for 16 developed countries during 120 years. Additionally, they reject the unit root hypothesis, with two structural breaks, for 12 out of 16 countries. They conclude that unit root tests allow for one structural break are tending to non-reject the null hypothesis of unit root more than those allow for multiple structural break.

Lumsdaine and Papell (1997) argue that the unit root test is sensitive to the number of assumed structural breaks. They extend the model of Zivot and Andrews (1992), allowing for two structural changes, under the alternative hypothesis of the unit root test, which allows for breaks in level and trend (Glynn *et al.*, 2007). Lumsdaine and Papell (1997) found that results

of unit root tests, allowing for one endogenously determined structural break, can be reversed when the tests assume two structural breaks. As an applied example, Lumsdaine and Papell (1997) tested Nelson and Plosser (1982) data with their approach, and they found that the data seem to have two structural breaks.[77]

Clemente *et al.* (1998) extended Perron and Vogelsang (1992) test with two structural breaks instead of one. They emphasized the significance of selecting the correct number of breaks when exhibiting the characteristics of the time-series variables' properties.

Glynn *et al.* (2007) argue that unit root tests allowing for endogenously determined one or multiple breaks, like Zivot and Andrews (1992), Banerjee *et al.* (1992), Perron (1997), Lumsdaine and Papell (1997) and Ohara (1999), do not allow for structural break(s) under the null hypothesis of a unit root, in contrast to Perron (1989). Thus, these tests can suffer from a bias (Glynn *et al.*, 2007).

Nunes *et al.* (1997) assert that allowing for a break under the null and sequential testing is practically appropriate for testing the unit root when a structural break exists in a time series. Non-stationary time series with break(s) might be treated as trend-stationary under endogenous structural unit root tests, so one should be careful interpreting of these tests (Glynn *et al.*, 2007).

Lee and Strazicich (2003) propose a minimum Lagrange Multiplier (*LM*) unit root test allows two-breaks endogenously determined in level and trend. Contrary to Lumsdaine and Papell (1997), their test does not diverge in the presence of break(s) in the null hypothesis. Consequently, treat difference-stationary series with break(s) as trend-stationary series with break(s) will not occur (Lee and Strazicich, 2003).

[77] These two structural breaks are centred around three events: the Great Depression, World War I, and World War II.

7.4.3. Cointegration Test and Dummies

The number of cointegrating relationships is the core part of the cointegration analysis. The determination of the cointegration rank requires the Likelihood ratio (*LR*) test, which does not follow the asymptotic distribution of χ^2, but it follows the Generalised Dickey-Fuller distribution (Johansen and Nielsen, 1993). The later distribution depends on the nuisance parameters that are included in the estimated system.[78] Doornik *et al.* (1998) emphasize that the determination of cointegration rank is a subtle task, because it depends on many considerations. One of these considerations is the presence of a structural break which, in turn, will need the introduction of a dummy variable in the estimated model.

Juselius (2009) asserts that the asymptotic distribution of the Johansen's cointegration rank test depends on the inclusion of a constant and/or a trend or not, and if they are restricted or unrestricted. In addition, Juselius (2009) points out that other deterministic components in an estimated VAR model that can affect the asymptotic distribution. One of these deterministic components is a dummy variable that may be used as a remedy of some problems that occur from outliers or a structural break.

VAR models may contain deterministic terms and these deterministic terms will appear in the cointegrated VAR model as in equation (7.7):

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \, \Delta y_{t-i} + \Phi D_t + \varepsilon_t \tag{7.7}$$

Where y_t is a vector of endogenous variables, D_t is a matrix of deterministic variables, and ε_t is a matrix of white noise disturbance terms. Also, Φ is a matrix of deterministic components' coefficients, Γ_i is a short-term coefficients matrix, and Π is a product matrix of two matrices α

[78] Johansen and Nielsen (1993) provide computer program DisCo which is simulating the asymptotic distribution of *LR-test* for cointegrated VARs with $I(1)$ variables by a reduced rank regression of variables corrected for the drift. Also, the DisCo program is suitable for models with constant and linear trend and intervention dummies.

and β, where the first is the matrix of the speed of adjustment (load matrix) coefficients and the second is the long-run coefficients matrix (cointegration coefficients matrix). Thus, equation (7.7) can be rewritten as in equation (7.8).

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \, \Delta y_{t-i} + \Phi D_t + \varepsilon_t \tag{7.8}$$

Johansen (1995b) argues that the deterministic term D_t usually contains dummies, which can be seasonal or intervention dummies. He points out those seasonal dummies are including to an estimated system to allow for a seasonally varying mean. Additionally, Johansen (1995b) asserts that it is more convenient to orthogonalise the seasonal dummies on the constant term, i.e. the sum of these dummies equals zero over a year.

Hendry (1995) asserts that the treatment of dummy variables in a cointegrated system is important for the long-run behaviour of the system's variables. These dummies usually include to an estimated system to curb the effect of outliers or policy (regime) changes, i.e. structural break[79].

Nielsen (2004) points out that the asymptotic distribution of cointegration analysis will not be affected by a fixed number of outliers; however, in case of finite samples the effect will be distortionary. Furthermore, innovational outliers have a minor impact for small inference in cointegration rank test (Doornik *et al.*, 1998), while additive outliers may bias inference, which resulted in rejecting the non-stationary hypothesis and accepting higher rank of cointegration (Nielsen, 2004). Also, Maddala and Kim (2004) point out that in the presence

[79] Hubrich (2001) argues that the time of a structural break is known in many empirical applications. Consequently, these known structural breaks should be well treated econometrically.

of a structural break, we tend to not reject, i.e. under-rejection, the null hypothesis of no cointegration.[80]

Nielsen (2004) refers to the difficulty of handling additive outliers in a cointegrated VAR model, because it is not in line with the structure of reduced-rank regression, whereas innovational outliers can be added to a cointegrated VAR model as unrestricted dummy variables.[81] Juselius (2009) suggests that if an additive outlier is observed it should be removed before applying cointegration analysis to be sure that it will not affect the asymptotic distribution. Juselius (2009) argues that unrestricted dummies which do not cumulate to trends[82], in the level of the data, like transitory and permanent dummies are not expected to affect the asymptotic distribution; however, they can influence the finite-sample distribution (Doornik *et al.*, 1998; Johansen *et al.*, 2000; Juselius, 2009). In contrast, dummies that accumulate to trends, in level, like mean-shift (step) dummies will affect asymptotic distribution however they are unrestricted or they are restricted to lie in the cointegration relations (Juselius, 2009; Nielsen, 2004).[83]

Doornik *et al.* (1998) asserts that the effect of a dummy that takes the value of one for a few observations and zero otherwise, will be asymptotically negligible in the cointegration rank test. Nevertheless, if the estimated coefficient of the dummy is large[84] in terms of its error relative to the available sample approximated, the standard asymptotic distribution which is ignoring the dummy effect will be misleading (Doornik *et al.*, 1998).

[80] See for more details Gregory *et al.* (1996).
[81] See Nielsen (2003) and Hungnes (2006) for more details about the effect of structure breaks on the cointegration analysis.
[82] Really, this is a broken linear trend.
[83] Juselius (2009, p.139) argues that case II and IV of Johansen's tables will change as a function of the number of mean-shift dummies, and the positions of non-zero values of these dummies in the sample period. Additionally, in both cases the distribution will move to the right for each deterministic term included in the cointegration relationships (Juselius, 2009).
[84] This is calculated by $\psi = \sqrt{T} \times \delta\sigma_{\nu}$, where T is the sample size, δ is an appropriate-scaled dummy, and σ_{ν} is the standard deviation. Then, by comparing the value of ψ with the standard error we can judge if the effect of the dummy is large or not (Doornik *et al.*, 1998, p.537).

Including an impulse dummy may not affect the asymptotic distribution of the cointegration test statistic, because it is excluding only one observation (Hubrich, 2001). Contrary, the break in the slope of a linear trend will change the asymptotic distribution, and then the cointegration rank will be affected (Hubrich, 2001). Johansen *et al.* (2000) assert that the asymptotic distribution approximation for the cointegration rank test requires treating breaks in linear trends carefully. Furthermore, this asymptotic distribution depends on the number of non-stationary relations, the trend specification and the location of break points in the series (Johansen *et al.*, 2000). In addition, in the case of step dummies, which are restricted to the cointegrated space, the asymptotic distribution will depend on the timing of the structural break (Hubrich, 2001; Johansen and Nielsen, 1993).

7.5. Data

Annual data from 1975 to 2010 on the Egyptian economy are used to estimate the exchange rate channel. The model contains four endogenous variables: log of real gross domestic product, y, inflation rate, inf, log of real effective exchange rate, $reer$[85], and log of real broad money, $m2$. The sources of data are in the data appendix at the end of the thesis.

Developments in the real GDP, inflation rate and real broad money were presented in Chapter 5. This section will discuss shortly the developments in the exchange rate; however a more detailed discussion is in section 2.7 of chapter 2.

Between 1953 and 1975, there was one exchange rate of the Egyptian pound (*L.E.*), however between 1976 and 1980, two exchange rates were used in the economy, the official rate and the rate with premium (MOP, 2000). In 1981 the foreign exchange market divided between the *central bank pool* which handled the government and the public business sector

[85] See appendix 7.1.

transactions, and the *commercial bank pool* which was responsible for the private and households sectors (MOP, 2000). In 1991 the Egyptian government unified the exchange rate, with only one exchange rate traded in the Egyptian economy (Abou-El-Eyoun, 2003). In 1999 the government started a series of devaluations of the exchange rate to prevent the sharp decrease in the international reserves (Al-Mashat and Billmeier, 2007, p.15). By January 2003 a floating exchange rate regime was adopted and in December 2004, a new interbank foreign exchange rate market was introduced by the CBE (Al-Mashat and Billmeier, 2007).

Figure 2.17, in Chapter 2, illustrates the fluctuations of the exchange rate from 1975 to 2010. This figure shows the devaluations of the Egyptian pounds, its dates, and its magnitudes. In addition, table 7.1 provides the average nominal and real exchange rates and the average nominal effective and real effective exchange rates during the sample period.

Table 7.1: Average Values of the Exchange Rate Measures in Egypt

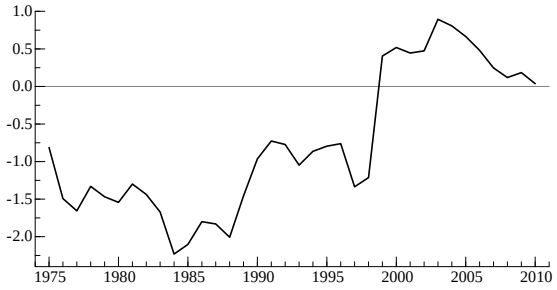
Period	Nominal Exchange Rate (EX)	Real Exchange Rate (REX)	Nominal Effective Exchange Rate (NEER)	Real Effective Exchange Rate (REER)
1976-1980	0.5148	3.3117	0.0394	0.2247
1981-1985	0.7000	3.5287	0.0370	0.1854
1986-1990	1.0400	2.5433	0.0864	0.2147
1991-1995	3.3647	4.9977	0.2860	0.4338
1996-2000	3.4518	3.9518	0.7201	0.8413
2001-2005	5.4014	5.7739	1.8196	1.9592
2006-2010	5.5467	4.6647	1.5436	1.3058

Source: IMF (2012a;b)

7.6. Econometric Model

The unrestricted-VAR model of the exchange rate channel contains 4 endogenous variables: log of real gross domestic product, y, inflation rate, inf, log of real effective exchange rate, $reer$, and log of real broad money, $m2$. Figure 7.1 illustrates the variables of the estimated unrestricted-VAR model.

Figure 7.1: The Exchange Rate Variable in the VAR Model



Unit root tests are undertaken to determine the order of integration of the series, and the results confirm that all variables, except $reer$, are non-stationary in levels as all of them have unit roots, table 5.2. All variables are *I*(1) in the ADF-test and the PP-test at 1% level of significance. However, they are *I(1)* in the *KPSS-test* at 5%.

The real effective exchange rate is expected to have a structure break as a result of the series of devaluations of the Egyptian pound started in April 1999 by the CBE (Al-Mashat and Billmeier, 2007, p.15). Also, figure 2.17, in section 2.7 of Chapter 2, refers to a clear structure break in the real effective exchange rate. Accordingly, the unit root test of Zivot-Andrews will be used to test the exchange rate variable. This test is used because the data shows a clear single structural change in 1999. The Zivot-Andrews unit root test, table 7.2, results assert that $reer$ is non-stationary in level even at 5% level of significance with the structure break in 1999. The exchange rate variable, $reer$, is stationary in the first difference at 1%, so this variable is $I(1)$ with a structural break in 1999, the date of starting the continuous devaluation of the Egyptian pound. In addition, the Perron unit root test with structure break is used and its results are similar to those of the Zivot-Andrews test, see table 7.2.

Table 7.2: Unit Root Tests with Structure Break of $reer$

Zivot-Andrews test						Perron Test					
Level			*Difference*			*Level*			*Difference*		
-4.46	1	*c*	-6.34*	1	*c*	-4.65	0	*c*	-7.42*	0	*c*
-4.41	1	*c&t*	-7.42*	1	*c&t*	-5.16	0	*c&t*	-6.82*	0	*c&t*

Note: * denotes that the variable is stationary at 1% level of significant. The numbers beside the critical values represent the number of lags, while *c* and *c&t* after the critical values represent that the series has a structure break in constant only or it has a structure break in constant and trend, respectively. The critical values of the Zivot-Andrews test at 1% are following Zivot and Andrews (1992), and they are -5.34 and -5.57 for the case of *c* and $c\&t$, respectively. Also, The critical values of the Perron test at 1% are following Perron (1997), and they are -5.92 and -6.32 for case of *c* and $c\&t$, respectively

A VAR model with two lags, including y, inf, $reer$ and $m2$, respectively, is estimated with a constant, trend because some of series like y has a deterministic trend, and a dummy variable. This dummy variable, $D99$, captures the effect of the exchange rate regime shift that started in 1999, and it is a step-shift dummy takes value of 1 for year 1999 and onwards and zero otherwise. Two lags are used in this model according to *AIC*. Furthermore, the individual equations show high R^2 and R^2_{adj}, which reached more than 92% in all equations except the inflation equation which was 68% and 52%, respectively. In addition, σ's were 0.016, 0.042, 0.259, and 0.046 in the equations of income, inflation, exchange rate, and monetary policy, respectively.

The VAR model passed all diagnostic tests. The unit root test proves that no root lies outside the unit root circle, $F_{ar(1-2)} = 1.625[0.10]$. The null hypothesis of no autocorrelation do not rejected, $F_{ar} = 14.913[0.53]$, the residuals are homosekadstic, $F_{het} = 0.738[0.87]$, and they follow the normal distribution, as the residual normality test shows that all variables do not suffer from skewness or excess kurtosis and the vector is also following the normality, $\chi^2_{nor}[8] = 2.719[0.95]$. In addition, The model is well specified, $F_{reset} = 1.385[0.16]$.

Table 7.3: Granger Causality of the Unrestricted VAR Model

Excluded Variables	y			Excluded Variables	inf		
	χ^2	df	$p-value$		χ^2	df	$p-value$
inf	1.1581	2	0.560	y	2.869	2	0.238
$reer$	1.427	2	0.489	$reer$	2.376	2	0.304
$m2$	5.802	2	0.055**	$m2$	7.353	2	0.025**
Jointly	13.389	6	0.037**	$Jointly$	9.712	6	0.137
Excluded Variables	$reer$			Excluded Variables	$m2$		
	χ^2	df	$p-value$		χ^2	df	$p-value$
y	1.482	2	0.476	y	0.605	2	0.738
inf	1.433	2	0.488	inf	10.452	2	0.005*
$m2$	1.929	2	0.381	$reer$	2.931	2	0.230
$Jointly$	4.681	6	0.585	$Jointly$	20.318	6	0.002*

*, **, and *** are denoting rejection of the exclusion at the 1%, 5% and 10% significance levels.

The Granger causality test's results, table 7.3, indicate that all variables in the income equation are jointly cause y at 5% level of significant, however only $m2$ causes y at 5% level of significance. Although, only $m2$ causes inf in the inflation equation. In addition, there are no variables causes $reer$ separately or jointly even at 10%. Finally, all variables cause $m2$ jointly at 1% level of significance, but only inf causes $m2$ separately at 1%

Graphical analysis of the exchange rate channel model, the unrestricted-VAR model, illustrates that this model performs econometrically well, figure 7.2. The actual and fitted values and the cross plot of the actual and fitted values, panels I and II, reveal that all individual equations show a high level of goodness of fit. However, variations in inf variable are higher than that in other variables. These results are supported by the scaled residuals; panel III, where the residuals are relatively low, i.e. within ±2σ, and there are no outliers in all individual equations. Additionally, the panel IV of figure 7.2 asserts that the residuals are normally distributed for all individual equations.

Figure 7.2: Graphic Analysis for the Unrestricted VAR Model

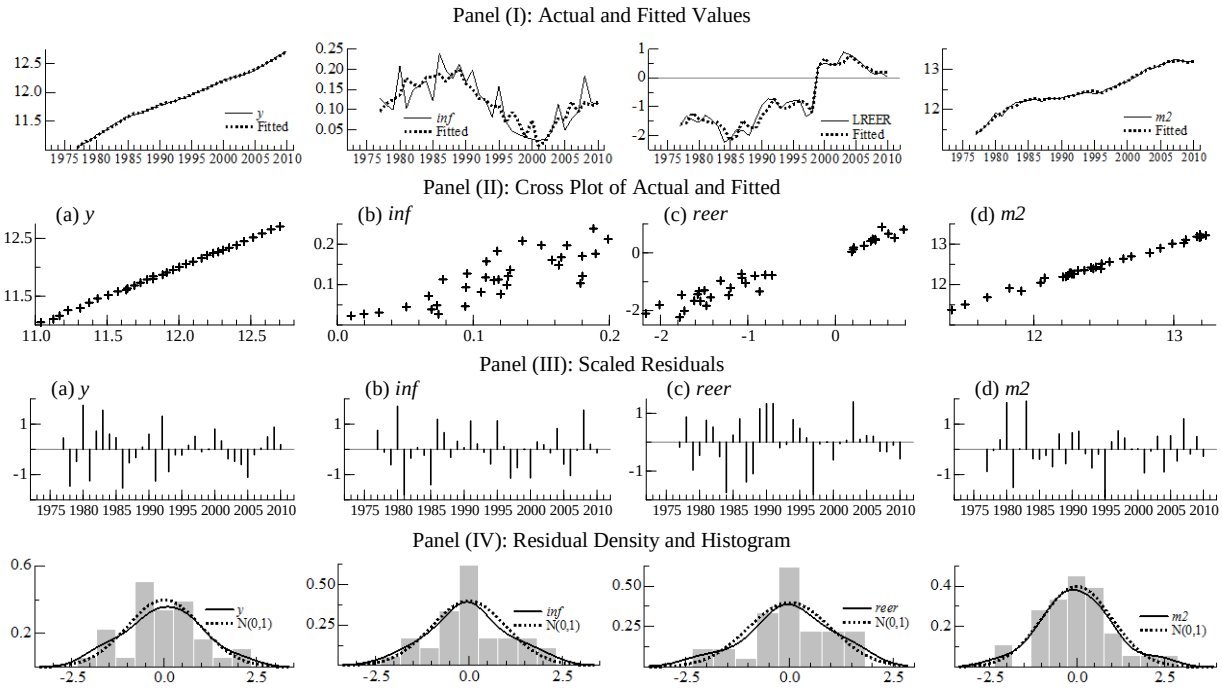
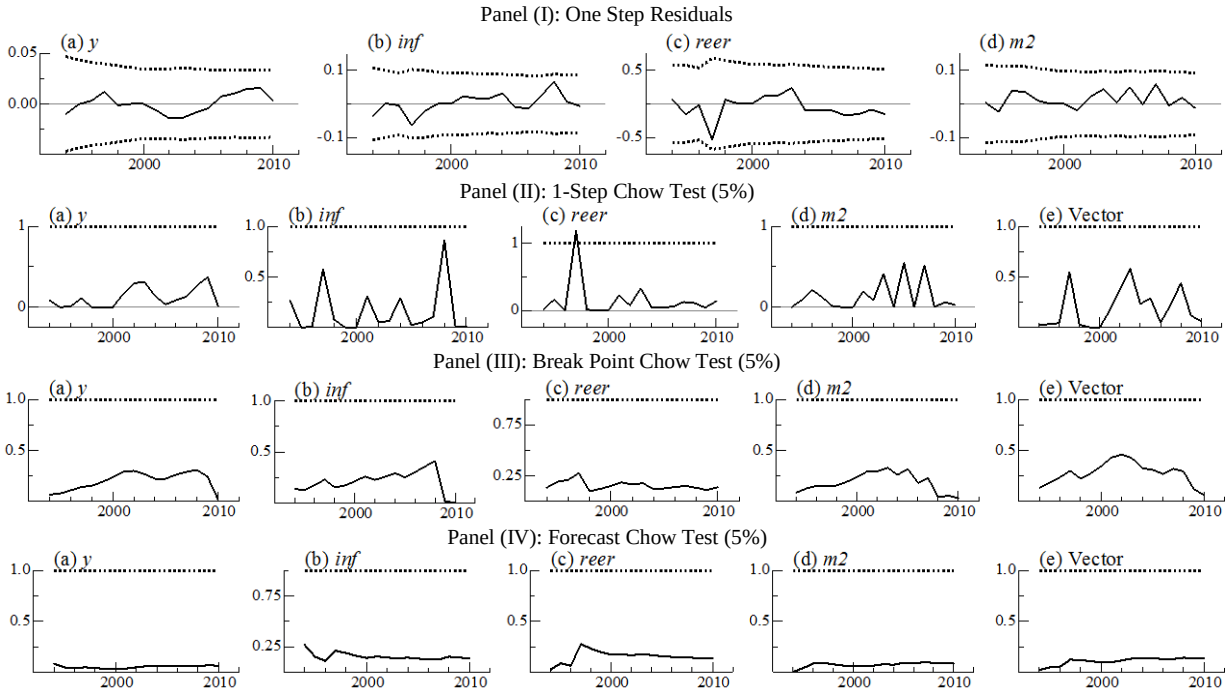


Figure 7.3: Recursive Analysis for the Unrestricted VAR Model

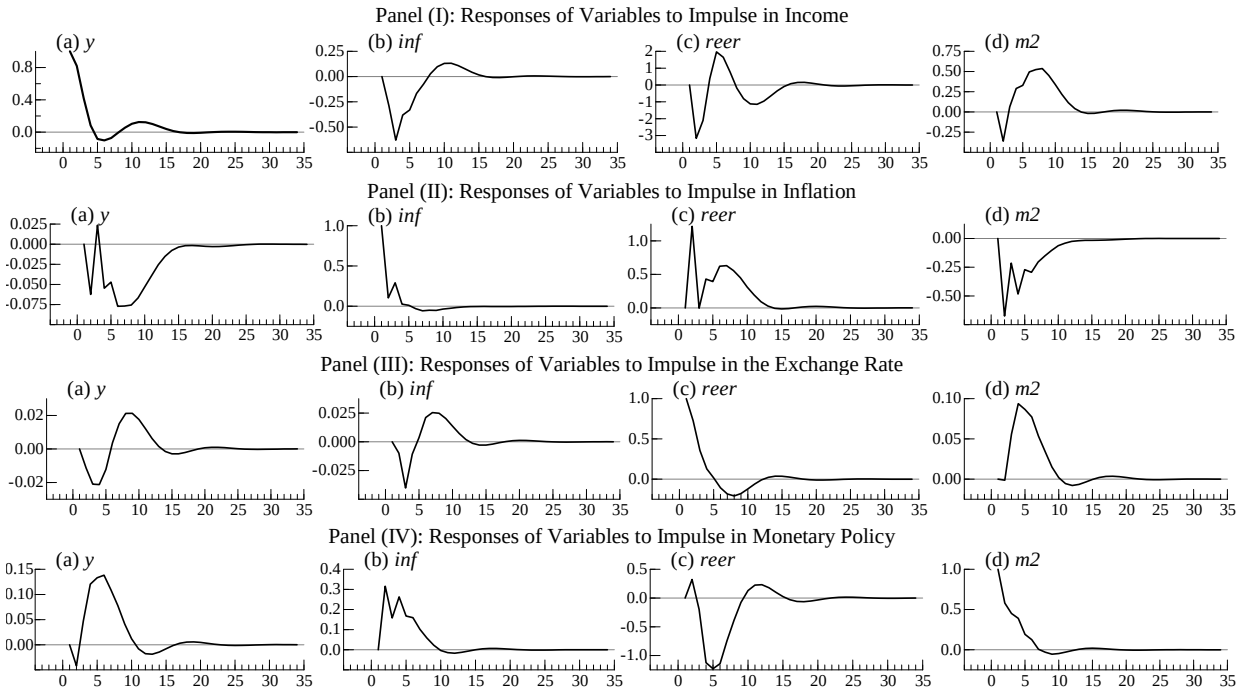


Recursive analysis gives evidence for the stability of the estimated model for individual equations and the vector, figure 7.3. The *one-step* residuals ±2σ, panel I, shows that all individual equations remained within the confidence band of 95%. Additionally, the stability tests, i.e. Chow tests, assert that all individual equations and the vector are stable. There are no outliers at the 5% level of significance, except one value in *1-Step Chow test* for $reer$ variable. The results of these tests confirm the stability of the estimated model.

The *IRF* is used here to illustrate the interrelationships among endogenous variables of the exchange rate channel. The Cholesky decomposition is used and the result is figure 7.4. A positive shock in income, panel I, results in a decrease in the inflation rate by about 60% in the first three years, a very high decline, i.e. appreciation, in $reer$ after two years, and more than 30% decline in $m2$. The effect of y on $reer$ can be clear if we assume that the increase in y is coming from an increase in the exports, which, in turn, will appreciate the exchange rate. A shock in the inflation rate will decline y by 5% to 7.5% in the first 10 years, and it will decrease $m2$ sharply and will keep it negative until more than 10 years. However, this shock will increase, i.e. depreciate, $reer$ for about 15 years.

A positive shock in the exchange rate, i.e. depreciation of *L.E.*, will decline the real income by more than 2% within the first 5 years. This negative impact can be explained in the case of Egypt by the inelastic demand on imports, which contains a high share of foodstuff, and exports. Also, the depreciation of the currency will decline the investment as the prices of imported production materials and machines became more costly for investments, which will end by a decline in the real income. The inflation rate will decline then returns to increase after 3 years, while $m2$ will increase by about 10% after 5 years as a result of a shock in $reer$.

Figure 7.4: Impulse Response Function (Cholesky One SD Innovation)



The expansionary monetary policy, i.e. a positive shock in $m2$, will have a positive impact on y as it will increase by 15% after 5 years. This shock has a positive impact on both inf and $reer$, however this impact is greater in the case of $reer$.

The contribution of each variable in other variables' variances is summarised in table 7.4. According to this table, the decomposition lasted up to 15 years, which refers to the probability of the existence of the long-run, i.e. cointegration, relationship between the variables. The contribution of inf in the real income is small, about 6%, in the long-run, while the impact of $m2$ is more than the double. The share of $reer$ in the long-run variation of y is higher than other variables, i.e. inf and $m2$, and it lasts for 15 years, which, in turn, can be explained, even partially, by the existence of the exchange rate channel in Egypt.

Table 7.4: Variance Decomposition of the Unrestricted VAR Model

Response Variable	Period	S.E.	Impulse Variable			
			y	inf	$reer$	$m2$
y	1	0.016	100	0	0	0
	2	0.022	95.82	1.99	1.51	0.67
	5	0.027	78.89	3.17	9.02	8.92
	10	0.030	63.60	5.49	16.06	14.85
	15	0.031	62.70	5.68	16.90	14.73
inf	1	0.042	0.72	99.28	0	0
	2	0.045	0.85	89.73	0.31	9.11
	5	0.050	1.32	77.87	4.31	16.50
	10	0.052	1.61	71.74	8.78	17.87
	15	0.052	1.79	71.47	8.89	17.84
$reer$	1	0.259	13.81	1.98	84.21	0.00
	2	0.340	18.85	6.41	74.58	0.16
	5	0.368	20.43	6.11	69.55	3.92
	10	0.386	19.22	6.41	68.33	6.04
	15	0.388	19.32	6.40	68.10	6.18
$m2$	1	0.046	14.18	0.05	0.01	85.76
	2	0.059	8.67	22.03	0.01	69.29
	5	0.076	5.49	20.23	19.02	55.26
	10	0.081	5.86	20.32	25.27	48.56
	15	0.081	6.13	20.31	25.24	48.31

Cholesky Ordering: y,inf,$reer$, and $m2$.

In the case of inflation only $m2$ has an average impact, being 18% after 15 years, while other variables impacts are small. Furthermore, the impact of the real income on the exchange rate is about one and half the sum of inf and $m2$ together after 15 years. Finally, both inf and $reer$ have a high impact, more than 20%, on the broad money in the long run, while the impact of real income is small comparing with other variables.

Variance decomposition results indicate the probability of the existence of the long-run relationship between the exchange rate channel's variables, so that Johansen cointegration test is required to determine if there is long-run relationship or not. Johansen's cointegration test is run for the exchange rate channel model twice. The first neglecting the effect of the dummies, and the second accounting for the effect of dummies. The results assert that in case of neglecting the effect of dummies the cointegration rank was higher than its true rank, because the rank 2 at 1% level of significance was found in the first case, however the true rank is only 1 in the second case, see table 7.5. This result is in a line with those of Maddala

and Kim (2004). Consequently, the vector error-correction model of the exchange rate channel in the Egyptian economy will be estimated with rank equal to 1.

Table 7.5: Cointegration Test of the Unrestricted AR Model

Hypothesis		Eigenvalue	Trace-test		Max-test	
H_0	H_1		Statistic	p-value	Statistic	p-value
$r = 0$	$r > 0$	0.656	77.46	0.002*	36.25	0.012**
$r \leq 1$	$r > 1$	0.479	41.22	0.072	22.15	0.145
$r \leq 2$	$r > 2$	0.292	19.06	0.283	11.74	0.452
$r \leq 3$	$r > 3$	0.194	7.32	0.321	7.32	0.322

(*) and (**) denotes rejection of the null hypothesis at the 1% and 5% level of significance, respectively. The critical values are following MacKinnon *et al.* (1999). Also, eigenvalues, trace-test statistics, and max-test statistics are calculated by OxMetrics 6.2 Software, for the unrestricted-VAR model with a step dummy. [86]

The specification of the deterministic terms, that are included in Johansen's cointegration test, is highly important (Turner, 2009). Also, when the test contains unrestricted intercepts and/or trends, the importance becomes higher. Turner (2009) used Monte Carlo simulations for the Johansen cointegration test in order to test the appropriateness of the reported critical values for some econometric software.[87] He found that the most appropriate critical values of Johansen's cointegration test are those provided by MacKinnon *et al.* (1999), because they bring together the Johansen approach, which is described in Johansen (1995a), and the effect of Pesaran *et al.* (2000) work. Therefore, the critical values of the Johansen's cointegration test are calculated from MacKinnon *et al.* (1999) and used in determining the cointegration rank for the estimated model.

The mistaken exclusion of a deterministic trend will probably replace it by a stochastic trend (Doornik *et al.*, 1998). The cost of including a restricted trend in the cointegration space is small when the time series have no trends. Nevertheless, adding an unrestricted trend has a

[86] Pesaran *et al.* (2000) critical values with a dummy variable of the *trace-test* at 5% for $H_0 = r$ where $r = 0, 1, 2, and\ 3$ are 72.10, 49.36, 30.77 and 15.44, respectively, and for the *max-test* critical values are 34.70, 28.72, 22.16, and 15.44, respectively, which gives the same results of Table 7.5.
[87] These packages are Microfit version 4.0, Eviews version 5.1, PcGive version 11.1, and Stata version 9.

high cost and is problematic because it could lead to excess rejection for cointegration ranks above that in the modelled variables (Doornik *et al.*, 1998, pp.561-562). Additionally, it is preferable to restrict the constant term to lie in cointegration space when the modelling variables have no possibility of inherent drift, like interest rates (Doornik and Hendry, 2009b).

The VECM was estimated with deterministic terms. These deterministic terms are restricted constant and trend. Additionally, the step-shift dummy, $D99$, is restricted to lie in the cointegrating space; otherwise it gets integrated to be a broken trend if unrestricted, and the difference of the step-shift dummy, $\Delta D99$, is included unrestrictedly for a consistent formulation.

A VECM is estimated with one cointegration vector in order to identify the long-run relationship, i.e. the exchange rate channel. The cointegrated vector normalised to y and the long-run coefficient of $m2$ imposed to zero. Furthermore, all speed of adjustment coefficients except this for y were imposed to zero because their coefficients were insignificant, which means there are no feedbacks from these variables. These restrictions identified the cointegrated vector as *LR-test* statistic is 9.955 [0.08]. The identified VECM is represented in table 7.6 and the speed of adjustment matrix is represented in table 7.7. Also, the speed of adjustment for the cointegrated vector is -0.341, which is plausible and at a reasonable level. This means that the disequilibrium in this system will be corrected after three years by the changes in inflation and the real effective exchange rate. Figure 6.5 illustrates the cointegrated vector of the exchange rate channel.

Table 7.6: Identified Cointegration Vector (Long-Run Coefficients)

$\widehat{\boldsymbol{\beta}}'$	y_{t-1}	inf_{t-1}	$reer$	$m2_{t-1}$	$Trend$	$Intercept$	$D99$
	1	-0.392	0.081	0	-0.050	-10.854	-0.091
	---	(0.226)	(0.021)	---	(0.002)	(0.039)	(0.038)

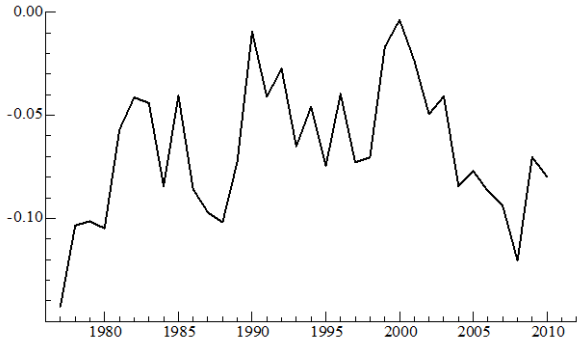
Standard errors values are in ( ).

Table 7.7: Loading Matrix (The Speed of Adjustment)

	$\hat{\alpha}$
y_{t-1}	-0.341 (0.052)
inf_{t-1}	0 ---
$reer$	0 ---
$m2_{t-1}$	0 ---

Standard errors values are in ( ).

Figure 7.5: The Cointegrated Vector of the Exchange Rate Channel



The cointegrated vector of the exchange rate channel is represented in equation (7.9). This equation can represent the balance of payments, BP, schedule in the IS-LM-BP model, i.e. Mundell-Fleming model. The BP is the interaction between income, the interest rate and the exchange rate which they may be adjusted to ensure that sum of capital account and current account of the balance of payments is zero. This equation together with equation (5.13) and equation (6.1) derive the framework of macroeconomic equilibrium in open economy, IS-LM-BP model. The BP curve will be determined according to the prevailing exchange rate level. The equilibrium will depend on some factors, like the elasticities of imports and exports, the sensitivity of LM curve and BP curve to changes of interest rates, the exchange rate regime (fixed or floating), the role of the monetary authority in managing international reserves and sterilisation policy.

Simply speaking, changes in exchange rate can affect income level through its impact on net exports. An increase in exchange rate, i.e. depreciation, is expected to decline imports and increase exports. However, this is related to the elasticities of imports and exports. Furthermore, the depreciation in exchange rate will affect investment badly because the price of imported investment goods will become higher, which may decrease the demand on these goods by nationals. Therefore, it is expected that an increase in exchange rate has a reverse impact on income level, through its impact on investment. Equation (7.9) asserts the previous analysis because the negative sign of the exchange rate coefficient.

Additionally, this equation provides an evidence of the role of the exchange rate channel in the transmission mechanism of monetary policy in Egypt during the last four decades. As similar as the bank lending channel, inflation has a positive impact on the real income in the long run, which may return to the expectation channel.

$$\underset{(SE)}{y_t} = \underset{(0.039)}{10.854} + \underset{(0.226)}{0.392}\, inf - \underset{(0.021)}{0.081}\, reer + \underset{(0.002)}{0.050}\, Trend + \underset{(0.038)}{0.091}\, D99 \qquad (7.9)$$

The restrictions on α matrix, i.e. the speed of adjustment, raise the long-run weak exogeneity issue as the speed of the adjustment coefficients of these variables were restricted to zero except the speed of adjustment coefficient of real income. The exclusion test for these coefficients, i.e. *LR-test* statistic is 9.955 [0.08], confirms the exogeneity of $inf, reer$, and $m2$ in the estimated system. The cointegrated vector, i.e. equation (7.9) is represented by ECM_{t-1}, which represents the long-run relationship, i.e. the exchange rate channel. Then, an error-correction model is estimated, i.e. equation (7.10), and it asserts the existence of the exchange rate channel in the long-run. Also, this model does not have any statistical problem and it is well specified, and it has a reasonable speed of adjustment, i.e. 30%.

$$\begin{aligned}\Delta y_t = &-0.024 + 0.407\,\Delta y_{t-1} - 0.011\,\Delta inf_{t-1} + 0.003\,\Delta reer_{t-1} \\ &[-1.36] \quad [3.11] \qquad [-2.06] \qquad [0.46] \\ &- 0.297\,ECM_{t-1} + 0.030\,Trend \\ &[-2.92] \qquad [2.95]\end{aligned} \tag{7.10}$$

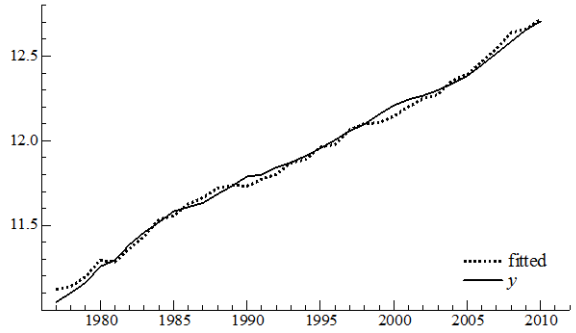
$R^2 = 0.512 \quad R^2_{adj} = 0.401 \quad RSS = 0.003 \quad \sigma = 0.016 \quad F = 4.621[0.00]$
$F_{ar}\,[2,20] = 0.679[0.52] \quad F_{arch}\,[1,26] = 1.730[0.20] \quad F_{het}\,[10,17] = 1.603[0.19]$
$\chi^2_{nor}\,[2] \quad = 1.946[0.38] \quad F_{reset}\,[2,20] = 0.930[0.41]$

7.7. Summary of Results

The estimated VECM model for the exchange rate channel, in Egypt from 1975 to 2010, is robust. This model does not suffer from any statistical problems, as the errors are not correlated or heteroskedastic. Also, the errors follow the normal distribution and the model is well specified and it is stable over time.

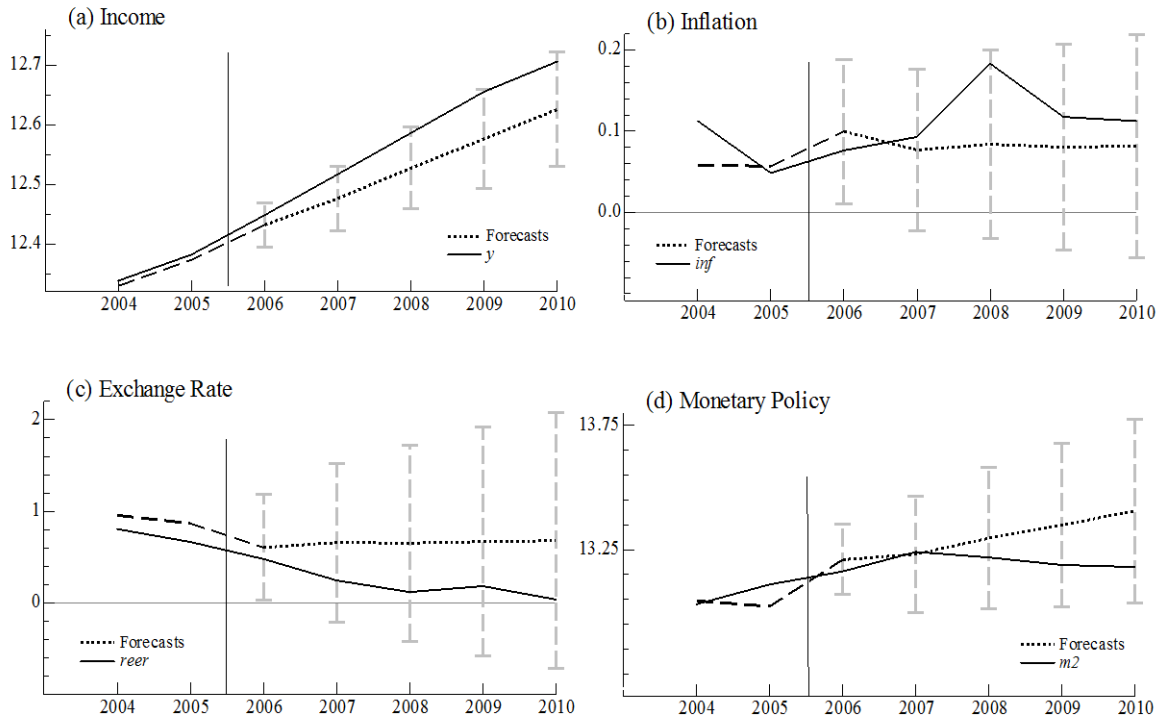
The actual and fitted values of the real income vector are depicted in figure 7.6. These actual and fitted values of cointegrating vector are shown as in deviations from the mean (Doornik and Hendry, 2009b, p.241). Also, the long-run fitted and actual are the sum of the non-normalised coefficients which are plotted against the normalised variables (Doornik and Hendry, 2009b). The fitted values do not differ significantly from real values, except for period of changing the exchange rate regime. The previous figure asserts that the estimated VECM of the exchange rate channel is capturing the real economy changes values.

Figure 7.6: Actual and Fitted Values of the Income Vector



The in-sample forecasts of the cointegrated VAR's variables are presented in figure 7.7, with error bands of two standard deviations. This figure asserts that the estimated model provides good forecasting performance for all endogenous variables. The forecasted values of y are relatively close to actual values with compared to $reer$, which has relatively a wider range of error bands. Additionally, the cointegrating vector describes the behaviour of data efficiently. The forecasting power of the estimated system is high, since forecasted values perform well in the long run, at least up to 5 years. Consequently, we believe the estimated model is a satisfactory description of the exchange rate channel in the Egyptian economy.

Figure 7.7: In-Sample Forecasts of the Model's Variables



The cointegrated VAR model asserts that the exchange rate channel was effective during the study period in Egypt, as expected from previous studies[88]. The exchange rate

[88] See Neaime (2008), Boughrara (2008a), and Al-Mashat and Billmeier (2007).

affects the real GDP through the investment expenditure, as Chapters 3 and 4 pointed out that the exchange rate has a significant role on the private investment expenditure but this role is insignificant in the case of the consumers' expenditure. However, there are some elements that can influence the effectiveness of the exchange rate channel in Egypt, for example the relatively long period that the exchange rate was pegged to US dollar, the intensive intervention of the CBE in the exchange rate market in some periods, especially before 2003. Additionally, the elasticity of exports and imports[89] in the Egyptian economy are important to understand the real role of the exchange rate channel.

7.8. Conclusion

The exchange rate channel played an active role in Egypt during 1975-2010, given the evidence from the econometric model in this chapter and by the results of previous studies. This chapter provides a reasonable survey of the exchange rate channel theoretically and empirically. Some econometric problems were encountered with Egyptian data in particular outliers, structural break, the unit root tests with structure breaks, the cointegration test with dummies, and the effect of the deterministic components on the cointegration rank. Thus, the final cointegrating-VAR provides realistic and plausible results that can be very informative for policy makers at the macro level, especially those in the CBE.

This chapter has answered the key question of , *Does the exchange rate channel exist in Egypt with the regime shift?*. The results confirm the existence of an exchange rate channel in Egypt during the period 1975-2010 using a vector error-correction model (VECM) which performs well theoretically and econometrically. The estimated cointegrated vector identified the long-run relationship between the endogenous variables. Also, the diagnostic tests and

[89] Generally, the imports of Egypt are not elastic as a big share is made up of food and essential goods, plus the imported inputs for industry and fertilities for agriculture.

recursive analysis support the stability of the estimated model and the model appears good at forecasting.

This chapter, beside the previous two, the interest rate channel and the bank lending channel, together draw the main block of the transmission mechanism of monetary policy framework in Egypt, which is helpful in removing the shortage of studies in this field, which is very important in recent years for the policymakers in Egypt, especially for those interested in macroeconomic and monetary policy.

Appendix (7.1): The Nominal and Real Effective Exchange Rates in Egypt

The term of exchange rate has different definitions according to the economists' views. Simply, the exchange rate is the price of one currency in terms of another (Mishkin, 2004). However, the real exchange rate was defined differently. But, these different views can be summarised in three views as that mentioned in Edwards (1989, p.3): a) the real exchange rate is *the nominal exchange rate corrected by the ratio of the foreign to the domestic price level*, b) the real exchange rate is *the Purchasing Power Parity (PFP) exchange rate*, and c) the real exchange rate is *the domestic relative price of tradable to non-tradable goods.*

These previous exchange rate definitions refer to the bilateral rates, but in an open world economies there are numerous numbers of these rates for the individual country. Thus, indexes of exchange rates that take into account the behaviour of all relevant bilateral rates have been introduced (Edwards, 1989). Additionally, these indexes are divided into two groups: nominal effective exchange rates and real effective exchange rates, which all of them are affected by the weights of trade with other countries.

The calculated effective exchange rates, i.e. nominal and real, for Egypt is followed, in general, Edwards (1989) approach, which can be summarised in the following equations:

$$TV_i = M_i + X_i \tag{8A.1}$$

$$W_i = \frac{TV_i}{\sum_{i=1}^{n} TV_i} \tag{8A.2}$$

M_i : Imports of Egypt from country $(\boldsymbol{i})$

X_i : Exports of Egypt from country $(\boldsymbol{i})$

TV_i : Trade volume of Egypt with country $(\boldsymbol{i})$**,** and$\sum_{i=1}^{n} TV_i$ is total trade volume with all countries

W_i : Weights of country $(\boldsymbol{i})$in the overall trade volume of Egypt, and $\sum_{i=1}^{n} W_i = 1$

$$RER_{it} = ER_{it} \times \frac{CPI_{it}}{CPI_t} \quad (8A.3)$$

$$NEER_t = \sum_{i=1}^{n} ER_{it}{}^{W_{it}} \quad (8A.4)$$

$$NEER_t = \sum_{i=1}^{n} RER_{it}{}^{W_{it}} \quad (8A.5)$$

CPI_t : Consumer price index in Egypt.

CPI_{it} : Consumer price index in country ($\boldsymbol{i}$).

ER_{it} : Nominal bilateral exchange rate of the Egyptian pound to country ($\boldsymbol{i}$)exchange rate.

RER_{it} : Real bilateral exchange rate of the Egyptian pound to country ($\boldsymbol{i}$)exchange rate.

$NEER_t$: Nominal effective exchange rate for Egypt with all trading partners.

$NEER_t$: Real effective exchange rate for Egypt with all trading partners.

The calculation of nominal and real effective exchange rate for Egyptian economy is depending on the largest 8 trading partner's countries.[90] These countries are: France, India, Italy, Japan, Republic of Korea, Saudi Arabia, the United Kingdom, and the United States of America. Another, countries like: China, Germany, and USSR excluded from calculation by effect of missing values for needed data. Two sources of data are used the IMF- International Financial Statistics (IMF-IFS) and the IMF – Direction of Trade (IMF-DOT).

Table 7.8 shows the nominal and real effective exchange rates. While, an increase in these indexes indicates depreciation and a decline implies appreciation. The calculated indexes capture the real circumstances in Egyptian economy during the period of study (1975-2010). The period before 1990 shows a high level of exchange rate according to the fixed exchange rate regime, then in 1991, when the economic reform programme implied, the exchange rate depreciated, then until 1998 they, i.e. NEER and REER, were stable within a

[90] The same approach was applied for estimating the effective exchange rate for Egypt in some studies like Noureldin (2005), who studied the bank lending channel in Egypt using a VAR model. Nonetheless, he used 6 trading partners only.

specific range. In 1999, a series of depreciations of the Egyptian Pound occurred to save the foreign reserves.[91]

Table 7.8: The Egyptian Nominal and Real Effective Exchange Rates

Year	NEER	REER	Year	NEER	REER
1975	0.0678	0.4431	1993	0.2322	0.3509
1976	0.0369	0.2247	1994	0.2946	0.4214
1977	0.0325	0.1907	1995	0.3567	0.4514
1978	0.0456	0.2641	1996	0.3834	0.4667
1979	0.0416	0.2302	1997	0.2191	0.2628
1980	0.0406	0.2137	1998	0.2509	0.2971
1981	0.0512	0.2725	1999	1.2910	1.4993
1982	0.0446	0.2375	2000	1.4565	1.6802
1983	0.0373	0.1878	2001	1.3545	1.5606
1984	0.0233	0.1073	2002	1.4146	1.6063
1985	0.0289	0.1220	2003	2.1979	2.4452
1986	0.0466	0.1652	2004	2.1866	2.2395
1987	0.0525	0.1603	2005	1.9446	1.9446
1988	0.0496	0.1342	2006	1.6920	1.6161
1989	0.1007	0.2329	2007	1.4179	1.2793
1990	0.1825	0.3808	2008	1.4135	1.1261
1991	0.2665	0.4836	2009	1.6511	1.2016
1992	0.2800	0.4616	2010	1.5409	1.0382

[91] See Al-Mashat and Billmeier (2007).

CHAPTER 8 : CONCLUSION AND FURTHER RESEARCH

This brief chapter aims at bring together the main findings of thesis and the further research. This chapter will be divided into two sections. The first is conclusion and main findings, and the second is research limitation and further research.

8.1. Conclusion and Findings

The main conclusion of this thesis is that the monetary transmission channels, like the interest rate, the bank lending and the exchange rate, exist in the Egyptian economy and have a significant impact on the real income between 1975 and 2010. This main conclusion can be divided into some findings which are related to each chapter.

Chapter 3, modelling the consumers' expenditure in Egypt, pointed out that income, wealth, inflation, the interest rate, and the bank lending to households determine the consumers' expenditure behaviour in Egypt. Three models are estimated to determine the effect of the income, inflation, financial wealth, the interest rate, and bank lending on the consumers' expenditure in Egypt from 1975 to 2010. These three models follow the Engle-Granger two-step cointegration approach, which provides the short- and long-run relationships. Also, the long-run relationships between these variables exist and these models are well specified and do not suffer from any econometric problems. Additionally, these models have a reasonable speed of adjustment and provide good forecasts.

The impact of income, in these three models, is positive and statistically significant, also it dominates other variables effects. The effect of financial wealth, or the liquidity, is

high, about 50% of the income effect, positive and statistically significant. However, the impact of the nominal lending interest rate is negative and significant on the consumers' expenditure during the study period in Egypt. The interest rate effect is about 40% of the income effect. Furthermore, the effect of the bank lending is positive and statistically significant, but is relatively small comparing with other variables, about 15% of the income effect. Also, the ARDL bounds tests supported the long-run relationships among variables in these three models.

These results refer to the possibility of the existence of the interest rate and the bank lending channels, which affect the real GDP through their impact on the consumer's expenditure in the Egyptian economy.

Chapter 4, estimating the investment expenditure under uncertainty in Egypt, asserts the effects of income, the interest rate, the bank lending to the private sector, and the exchange rate on the private investment in the Egyptian economy during the last four decades. The impact of the real income on the private investment expenditure dominates other impacts. A significant positive impact of the real income with a high magnitude on the private investment was founded. However, the effect of the interest rate was negative and insignificant. The bank lending effect was positive and statistically significant, but it is about 30% of the income effect. Additionally, the exchange rate has a significant negative impact on the investment, as an increase in the exchange rate, i.e. depreciation, will result in a decrease in the private investment, partially because the imported production material and machines became more costly which decrease the incentive to invest.

The uncertainty about the future of economy, at macro level, plays a significant role on the investment decisions, and this role lasts in the long-run. This uncertainty is measured by a GARCH model, as the conditional variance of GDP is used as a proxy for uncertainty.

The ECM of private investment expenditure is well specified, does not have any statistical problems, have a reasonable speed of adjustment equals to 34%, and it provides a good in-sample forecast. Some events, like 11th September 2001 attack, NPLs crisis, and the financial crisis of 2008, have a clear impact on the estimated model. Additionally, the significant effect of the bank lending and the exchange rate on the investment expenditure refers to the probability of the existence of the bank lending and the exchange rate channels. Furthermore, the ARDL bounds test was run to check the previous results, and it supported them.

Chapter 5, investigating the interest rate channel in Egypt, asserts the existence of the interest rate channel in Egypt. The nominal lending interest rate has a significant negative effect on the real income in the short- and long-run. The estimated VECM of the interest rate channel has a small speed of adjustment, 16%, which means that any disequilibrium in this system will be corrected within 6 years, and it provides a good in-sample forecast.

The interest rate channel role in the economy is expected to be more active after the liberalisation of the interest rate and applying the corridor system of the interest rates recently. According to the results of Chapters 3 and 4, the effect of the interest rate on the real income comes from its effect on the consumers' expenditure more than its effect on the private investment expenditure.

Chapter 6, investigating the bank lending channel in Egypt, provides a VECM that describes the bank lending channel in Egypt. The bank lending channel plays a significant role in affecting the real income, through its impact on both consumer's expenditure and private investment. The effect of inflation on the long-run real GDP needs to examine another channel of the monetary transmission mechanism, i.e. the expectation channel. Furthermore,

the long-run weak exogeneity hypothesis was tested in the estimated system and we cannot reject it. Also, the cointegrated VAR provides good in-sample forecasts for the system.

Some factors affected the bank lending in the Egyptian economy, like the heavy intervention of the government in the credit decision especially before applying the ERSAP, the crowding out effect of financing the government budget deficit, the high share of the public ownership of banks, the concentration in the Egyptian banking credit market. Also, other factors like the NPLs and the global financial crisis in 2008 have an impact on the private investment expenditure.

Chapter 7, estimating the exchange rate channel with regime shift in Egypt, estimated the exchange rate channel in Egypt from 1975 to 2010. The fluctuations in real effective exchange rate affect the real GDP through its impact on the private investment. The exchange rate has a significant negative impact on the real income in the long run.

The regime shift, i.e. floating the Egyptian pound, has a clear effect on the exchange rate channel. This regime shift, or structure break, needs a special treatment in order to be able to estimate the exchange rate channel correctly. A dummy variable is used to capture the impact of this structure break on the unit root tests and the cointegration test. Both, unit root tests and cointegration test, were affected by this structure break.

The cointegrated VAR of the exchange rate channel raised the long-run weak exogeneity phenomenon, so that the statistical test was run and its results do not reject the weak exogeneity in the estimated model.

Some factors influenced the effectiveness of the exchange rate channel in Egypt, for example the long period that the exchange rate was pegged to US dollar, the intensive intervention of the CBE in the exchange rate market, and the elasticity of exports and imports.

These findings can be connected to the research questions to answer them. Table 8.1summarises these questions and their answers.

Table 8.1: Research Questions and Answers

Research Questions	Research Answers
1. Does a stable consumption function exist in Egypt? If it does, What is the impact of financial wealth, the interest rate and bank lending?	Yes, Chapter 3 provides a stable consumption function for the Egyptian economy between 1975 and 2010. Both financial wealth and bank lending to the households have a significant positive effect on the consumers' expenditure, however the interest rate has a significant negative impact on the consumers' expenditure.
2. Does uncertainty affect the private investment expenditure in Egypt? and What are the other variables that determine the investment in Egypt?	Yes, uncertainty, measured by the conditional variance of GDP, has a significant negative impact on the private investment in Egypt. The real income and bank lending to the private sector have a significant positive impact on the private investment. Although, the interest rate and the exchange rate have a negative effect on the private investment expenditure, but the interest rate effect is insignificant.
3. Does the interest rate channel exist in Egypt in the long-run?	Yes, the interest rate exists in the Egyptian economy, from 1975 to 2010, and the long-run relationship is identified in Chapter 5.
4. Does the bank lending channel play a significant role in the Egyptian economy?	Yes, Chapter 6 provides a VECM, which identifies the bank lending channel in the Egyptian economy in the last four decades, and this model confirms the significant role of the bank lending channel in affecting the real GDP in Egypt.
5. Does the exchange rate channel exist in Egypt under the regime shift?	Yes, Chapter 7 identified the exchange rate channel in Egypt with the regime shift, and the estimated VECM confirms the effect of the exchange rate on the real income between 1975 and 2010.

8.2. Research Limitation and Further Research

There are a number of limitations faces this study. The one point is the availability of data and its consistency. Some data are not available from the governmental sources, for example the CBE do not provide excess reserves data, which can be used as a monetary policy stance. Additionally, a consisting long-run data set for some variables like the unemployment ratio, which can be used in estimating the expectation channel or the Phillips curve , are not available yet. Furthermore, the data of the Stock Exchange Market in Egypt are available for the few recent years, i.e. from 1997. In addition, the high frequency data are not available for some important economic variables, for instance, the quarterly date of GDP, consumers' expenditure, and investment expenditure except for the very recent years.

There are many internal and external situations and political events that affected the economy, like the 1967-1973 War, the Bread Riots (1977), the Camp David Accords (1978), The Peace Treaty (1979), President Al-Sadat Assassination (1981), Egyptian Conscription Riot (1986), The Iraq-Kuwait War (1990), the Asian Crisis (1997), the Luxor mascara (1997), the financial crisis of 2008. Consequently, estimating robust well specified econometric models on the macro level becomes a tough process.

However, this thesis decreasing the gap of research in fields of macroeconomics and monetary policy in Egypt, but there is extra research required. The results of Chapters 6 and 7 raise the need to investigate the expectation channel in Egypt in order to be able to provide more explanation about the effect of the fluctuations in inflation on the real GDP especially in the long-run. Moreover, estimating the asset price channel is another further research that can be added to the other channels were estimated in this thesis to capture the whole picture of the monetary transmission mechanism in the Egyptian Economy.

THE DATA APPENDIX

Variable	Source	Code Line
Broad money (M2)	IMF-International Financial Statistics (IFS).	59M..ZK
Credit to the households sector	The Central Bank of Egypt (CBE)	---
Credit to the private sector	The Central Bank of Egypt (CBE)	---
Exchange rate	IMF-International Financial Statistics (IFS).	AE.ZF
Exports	IMF-Direction of Trade (DOT)	---
GDP deflator	World Bank-World Development Indicators (WDI)	NY.GDP.DEFL.ZS
Gross domestic product (GDP)	World Bank-World Development Indicators (WDI)	NY.GDP.MKTP.CN
Gross national product (GNI)	World Bank-World Development Indicators (WDI)	NY.GNP.MKTP.CN
Household final consumption expenditure	World Bank-World Development Indicators (WDI)	NE.CON.PRVT.CN
Imports	IMF-Direction of Trade (DOT)	---
Inflation rate	IMF-International Financial Statistics (IFS).	64..XZF
lending interest rate	IMF-International Financial Statistics (IFS).	60P..ZF
Total private investment expenditure	The Ministry of Planning (MOP)	---

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